Investigation on manganese (Mn^{2+}/Mn^{3+}) – vanadium (V^{2+}/V^{3+}) redox flow battery

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Abstract: A novel Mn^{2+}/Mn^{3+}– V^{2+}/V^{3+}redox flow battery has been designed. The electrochemical response of high concentration Mn^{2+}/Mn^{3+} couple in H_2SO_4 solution were investigated via cyclic voltammetry, steady polarization curve, electrochemical impedance spectroscopy, and chargedischarge experiments. The electrochemical and the kinetic parameters for anodic oxidation of Mn^{2+} and cathodic reduction of Mn^{3+} were measured. Performance of a RFB employing Mn^{2+}/Mn^{3+} couple as anolyte active species and V^{2+}/V^{3+} as catholyte ones was evaluated with constant-current charge-discharge tests. When the current density varies from 20 to 80 mA cm^{-2}, the average coulombic efficiency varies from 81.5% to 92.5% and the voltage efficiency varies from 93.5% to 85.3%. Accordingly the whole energy efficiency varies from 76.2% to 81.2%. Energy efficiency is about 20% higher than that of the all-vanadium battery and average discharge voltage is 1.66 V, which is about 14% higher than that of the all-vanadium battery. The energy density is calculated to be 40.8 Wh/kg, which is 60% higher than that of the all-vanadium battery. The preliminary exploration shows that the Mn^{2+}/Mn^{3+} couple is electrochemically promising for redox flow battery.

Keywords: Redox Flow Battery (RFB); Mn^{2+}/Mn^{3+} couple; V^{2+}/V^{3+} couple

Investigation on electrolytes in vanadium halide redox flow battery for energy storage

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Abstract: To optimize the anode electrolyte in vanadium halide redox flow battery, the viscosity, electrochemical impedance, cyclic voltammograms and steady polarization curve analysis have been studied. When the range of from 1.0 M to 1.5 M, the viscosity is small and the results of cyclic voltammograms, Electrochemical impedance spectroscopy and steady polarization curve show good reversibility of electrolyte. The sodium bromide concentration range from 1 M to 1.5 M is the suitable concentration range of sodium bromide..

Key words: vanadium halide, redox flow battery, anode

Application of Genetic Programming to Identifying Water-level and Storage-capacity Curve of the Xingxingshao Reservoir

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***Abstract*-Water-level and storage-capacity curve (WSC) fitting is the foundation and key link of reservoir flood routing programming. Also, its precision directly determines the accuracy of flood routing. In this paper, based on the measured hydrological data, the correlations of water-level and storage-capacity are identified using genetic programming (GP), and the equations of water-level and storage-capacity curve are established. Then, the research results are applied to the feasibility study to enhance the flood limit level of Xingxingshao Reservoir. And the results indicate that, compared to the measured data, the water-level and storage-capacity curve identified by GP has a more satisfied accuracy, which provides a fundamental guarantee for the accurate flood routing.**

Keywords-Genetic programming, Water-level and Storage-capacity Curve, Identification, the Xingxingshao Reservoir

Series Solution of Dynamics Stability of a Class of Deformed Bubble in Vertical Pipe

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***Abstract*—A theoretical research on dynamics stability of a class of deformed bubble is conducted to unveil characteristics of fully developed incompressible adiabatic laminar bubble flows without mass transfer. Not only make use of curves theory and surfaces theory of differential geometry, but also the variatio□ principle to get the series solution of dynamics stability of a class of deformed bubble in vertical pipes.**

Keywords-series solution; deformed bubble; dynamics stability; variation principle; similarity solution

Application of Robust Control Theory to

Main Steam Temperature of Circulating Fluidized Bed Boiler

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***Abstract*—Main steam temperature of circulating fluidized bed boiler possesses the features such as large inertia□large lag and non-linear, so it can be equivalent to a one-step inertia object with time delay which has measurable disturbance in a specific condition. This paper is based on FOPDT model, design a new kind of non-fully differential PID controller with H□ control technology, then makes the widely used PID controller more robust, while avoiding the problem of controller directly designed with control theory is hard to be realized for higher-step.**

Keywords-circulating fluidized bed boiler; main steam temperature system; one-step inertia object with time delay; nonfully differential; robust controller

The Regional Stability and the Site Stability of Phase III Qinshan Nuclear Power Plant, China

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***Abstract*—The regional stability and regional geologic structure are closely related. On the basis of the regional geological structure and earthquake geology records, the regional earthquake characteristics and stability were analyzed and assessed in this paper. The research results show that there is no trace of new structure activity at the radius of 320km around the site of Phase III Qinshan Nuclear Power Plant, the earthquake activity is weak and the basic intensity of the site earthquake is VI degree. The geologic structure of the site and seismic wave tests were studied, the relationships between seismic waves and the**

geologic structure and the site strata lithology were built based on the analysis of site geological conditions through in-situ investigations, drilling, sampling, seismic wave test of rock samples. The dynamic parameters of the site rock mass were deduced. The reliable basis was provided for the design earthquake prevention of Phase III Qinshan Nuclear Power Plant, China.
Keywords-regional stability; site stability; geologic structure; seismic wave test; dynamic parameter

Performance analysis of doubly excited brushless reluctance machine used in wind power generation system

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***Abstract*—The doubly excited brushless reluctance machine (DEBRM) is a new type of reluctance machine and is attractive for variable-speed constant-frequency wind power generation systems. The DEBRM system features not only simplicity, robustness and reliability of the reluctance or cage-rotor inductance machines, but a much smaller power electronic converter, compared to a conventional AC induction machine. This paper is intended to present a performance analysis of the DEBRM using 2D transient finite element analysis model. The magnetic fields and torque characteristics of the DEBRM are investigated. The results are used to reveal that the DEBRM is attractive for wind power generation system.**
Keywords: *doubly-fed, doubly-excited, wound rotor, brushless, induction machine, reluctance machine, wind power generation*

Study on Power Flow Calculation and Voltage Profile in Distribution System with Distributed Generation

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***Abstract*—The development of Distributed Generation (DG) has a great influence on the traditional power systems and received considerable attention in recent years. After interconnected DG, the voltage maybe to rise along the feeder, and has serious potential impacts on distribution system. This paper introduction the algorithm based on distributed slack buses model through adjusted Newton-Raphon, the participated DGs and thesubstation are common to allocate the power losses by the participation factors. The characteristic of power flow will change as DG paralleled, and researched the impact of DG on distribution system such as loss and node voltage. The results areanalyzed comparatively with traditional algorithm, and proved the feasibility of the method proposed.**
Keywords-distributed generation; distribution systems; power flow calculation; voltage profile; power losses sensitivity

Study on hydrogenerator’s temperature field through coupled field computation method

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***Abstract*— This paper presents a method to analyze the ventilation and heat rejection system of hydrogenerator. Firstly, coupled fields are identified. Then, a geometrical model through parametric analysis is established. Finally, the meshed model is input into FLUENT software to carry out a three dimensional numerical calculation, through which a temperature distribution can be obtained. In comparison with experiential calculations, the CFD result is proved feasible and effective. At last, through analyzing sensitive parameters and by adopting ISIGHT software the stator’s structure can be improved effectively by using optimized parameters. In addition, this paper will also benefit those who are in pursuit of designing complex product.**
Keywords-flow field; temperature field; ventilation and heat rejection; coupled fields; parametric analysis

Electro-hydraulic proportional Synchronous Control System of Ring gate

for Hydraulic Turbine

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***Abstract*-Based on the analysis of opening and closing control manner for ring gate of hydraulic turbine, the electro-hydraulic proportional control system for ring gate of hydraulic turbine was studied. A new control system, which combines mechanics, hydraulics and electrics, was presented. More particularly, the modules of speed control and multi-cylinder synchronous control for the movement of ring gate was designed. The modules include control valve group, flow dividing module consists of flow dividing motors, and oil distributing module. And the ring gate control system principle under different condition was also studied. By the engineering application in Yunnan Honghe Nansha hydropower plant, it was show that all functions and performances of the control system satisfied the designing requirements.**

***Keywords*-ring gate of hydraulic turbine; electro-hydraulic proportional control; multi-cylinder synchronous; flow dividing motor**

Numerical Simulation for Hydraulic Characteristics of Cylindrical Valve in Runaway Protection Process

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***Abstract*-In the present paper, numerical simulation about the emergency shut-down water process of cylindrical valve is performed in order to study hydraulic characteristics of three dimensional unsteady flow during runaway protection of cylindrical valve. The curves of the pressure distribution, the axial force exerting on the valve are given with the time passing under various openings. In addition, the pressure fluctuation caused by the unsteady flow of vortex tape through Francis turbine is provided and analyzed, which provides the reference for the installation and maintenance of hydro-generator unit along with the design of multi-cylinder synchronous motion system.**

***Keywords*-Cylindrical valve; numerical simulation; hydraulic characteristics; emergency shut-down water**

Study on Application of CSG Cofferdam in

Hydropower Station Construction

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***Abstract*—CSG method is a new technique proposed for RCC; the key of this technique is the application of CSG (cement sand and gravel) to dam construction. CSG is a material, which can be considered as a lean RCC, made by adding a little amount of cement to rock-like material such as riverbed gravel or excavation muck that can be obtained easily from dam sites, then mixing it briefly with simple equipments and rolling with vibration rollers. CSG dam is a symmetrical trapezoid-shaped dam; the strength of CSG is relatively weak compare to concrete. On the other hand, because the stress occurred in a symmetrical trapezoid-shaped dam is small; the required strength of its material can be low. Therefore, the CSG can be used to construct trapezoid-shaped dam. It has been proved by practice that CSG dam has the advantages of greater safety, shorter construction period, lower construction costs and better performance on environmental protection, so it attracts more and more attention in Europe and Japan currently. The upstream CSG cofferdam in Daotang dam project is the first time for China to put this technique into practice. This article introduces the design, construction and structural analysis of the CSG cofferdam in Daotang dam, and clarifies the characteristics of CSG method and the advantages of this method for temporary structure such as cofferdam. Based on the results of material test and site rolling experiments, the characteristics of CSG material and some useful technical parameters of CSG method are gotten. All these are accumulated experience for the application of the CSG method in China.**

Keywords-hydropower station construction; CSG method; cofferdam; experimental research; new technology

Experimental Research on Stability of Hydromechanical- electrical System in Hydropower Station

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Abstract—**Based on experimental simulation and numerical analysis, the effect of operation condition and load characteristic on unit's stability is further investigated in detail. An experimental system of single-unit and single-pipe hydropower station is designed and built including a simulated water pumping system (dynamic load) and a resistance (static load). Stability experiment research and further analysis is performed under two realized typical conditions that is grid interconnection operation or isolated operation. The experimental results indicate that, impact of large power grid is beneficial to operation stability, and regulation performance of unit running with dynamic load is superior to that of static load. Moreover, the solution and dynamic curves gained by experimental research is identical with that of further numerical analysis.**
Keywords-hydropower station; hydro-mechanical-electrical system; experimental research; stability

Optimal Operation of Cascade Hydropower Plants

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Abstract—**A new model is presented based on combined guide curves for optimizing hydropower production and for better storage distribution among cascade reservoirs. The model is optimized with the particle swarm optimization algorithm and storage distribution among cascade reservoirs is achieved by the storage effectiveness index method. The model is applied to the Qingjiang cascade hydropower plants and optimized combined reservoir operation chart is obtained for Shuibuya- Geheyan reservoirs. Comparing with the current design, the proposed model is capable to produce an extra amount of 201GW.h electrical energy (a 2.77% increment) and save 1067 Mm^3 of flood water resources (a 38.96% reduction) annually.**
Keywords-hydropower plants; cascade reservoir; power generation; optimal operation

BLAST DESIGN AND OPTIMIZATION STUDIES BASED ON VIBRATION CONTROL FOR EXCAVATION OF HYDROPOWER STATIONS

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Abstract—**It makes a systematic summarization on the key points of controlling blasting vibration for hydro-electric projects, including requirements of controlling vibration and prediction of vibration. Then it provides a set of blast design and optimization method on the basis of controlling blasting vibration. At last a case of blasting design by this method is introduced, which is from the project of Zhexi hydropower station. Results show that ground vibration is controlled effectively by this design method.**
Keywords- blast; optimization; excavation; vibration; hydropower.

Nonlinear Analytical Rules Based Fuzzy Control for the Hydro Turbine Governing System

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Abstract—**In this paper, a new fuzzy controller for hydro turbine governing systems is proposed by introducing nonlinear analytical rules into the fuzzy controller. The approach to tuning the rules of the fuzzy controller online is discussed and the parameters tuning method is proposed by comparing the proposed controller to conventional PID controllers. The simulation results show that the proposed fuzzy controller can obviously improve the dynamic performance of hydro turbine governing systems, and strengthen their robustness.**
Keywords-hydro turbine governing system; analytical rule; fuzzy control; nonlinear; PID algorithm

Improving Stability by Misaligned Guide Ganes in Pumped Storage Plant

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Abstract—**Misaligned guide vanes(MGVs) can improve the stability of the reversible pump turbines in no-load mode and turbine startup mode and cut down the surge pressure rises under turbine load-rejections.**

In order to achieve a more widely application of MGVs in high-head pumped storage plants, the internal characteristics of the reversible pump turbine with MGVs in turbine modes and reversed pump modes, the empirical formulae at runaway and zero-flow special condition point were proposed. The equivalent opening of guide vanes was defined for the interpolation of the new characteristic curves with MGVs from the original model characteristic curves. Finally, the investigations by the site tested results in Tianhuangping pumped storage plant confirm the presented theories and its engineering practice.
Keywords-Misaligned Guide Vanes (MGVs); internal characteristics; stability improvement; reversible pump turbine; surge pressure rise

Reservoir dam break flow and sediment simulation

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***Abstract*—Both finite volume method and finite difference method are adopted to disperse 1-D unsteady flow and sediment equations, for establishing 1-D dam-break flow and sediment numerical model. Based on the sediment data of Xinji reservoir of different operating years, the flood after dam-break is simulated by using this model. Compared with dam break results of initial impoundment period, it shows the influence of sediment on flood routing and river bed deformation.**
Keywords: reservoir; dam-break; numerical model

Long-term risk dispatching of cascaded hydropower stations in electricity market

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Abstract—in the first-stage of power market, hydroelectricity still participates in electricity market with long-term or short-term electricity contracts. So, there may be risk for hydroelectricity due to forecasted error of reservoir runoff or other uncertain factors. For cascaded hydropower stations, short-term risk can be avoid by utilization of flow in regulation reservoirs. But, how to reduce longterm risk is still a hard work by recent technologies. In this paper, long-term risk dispatching of cascaded hydropower stations in electricity market is developed. Risks are analyzed in detail. And two risk sources are identified, which are forecasted error of reservoir runoff and uncertain human factors. Their random simulation strategies are also proposed. Then long-term risk dispatching model is constructed with its solving approach. The objective function contains three parts: minimum possibility of surplus water, minimum possibility of default and maximum generation profit. Finally, with Three-gorges and Gezhouba cascaded hydropower station as a real case, suggestions for long-term dispatching of cascaded hydropower stations in electricity market with risk considered are proposed by analysis to the simulation results of 27 typical working conditions.

key words:Risk dispatching, Long-term, Cascaded hydropower stations, Electricity market

Characteristics of Gas-liquid Transport Flow through an Axial Flow Impeller

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***Abstract*—To elucidate transport properties of gas-liquid twophase flows with small initial void fractions in pump impeller, based on Reynolds averaged Navier-Stokes equations and standard k-ε turbulent model, flow simulation in an axial flow pump impeller was carried out under different operating conditions. Hydrostatic pressure and void fraction distributions were obtained and analyzed respectively. The results demonstrate that large flow rate makes the pressure distributions get uniform, but local high hydrostatic pressure gradient do not varies with the flow rate. And when initial void fraction reaches 10%, pressure discrepancy between blade pressure and suction surfaces becomes smaller and gas phase distribute unevenly with increased flow rate. Furthermore, pump performance gets worse compared with that under smaller initial void fractions.**

Keywords-gas-liquid two-phase flow; axial flow pump; impeller; numerical simulation

Analysis of Complex Flows in the Whole Passage of an Axial Flow Pump

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***Abstract*—To systematically study the spatial flow characteristics inside an axial flow pump, based on three-dimensional Navier- Stokes governing equation and renormalization group(RNG) k-ε model, computational fluid dynamics(CFD) work on rotating turbulent flows with complicated curved boundaries was practiced. Unstructured meshes and the semi-implicit method for pressure linked equation (SIMPLE) algorithm were adopted. Major attentions were placed on pressure distribution in inlet, impeller and vane zones under design operation condition. Three viewpoints are obtained. (1) From blade inlet to outlet, hydrostatic pressure decreases firstly and then increases on suction surface. On pressure surface, hydrostatic pressure increases radially from hub to tip. The total pressure on suction surface is obviously lower than that on pressure surface. (2) The lowest pressure appears near the leading edge of suction surface, approaching the blade tip, where cavitation occurs with great possibility.(3) From inlet to outlet of vane passage, there is no pressure lower than critical cavitation pressure and hydrostatic pressure increase along the bulk flow direction. Numerical simulation result here can be referred in axial flow impeller design and relevant flow analysis.**

Keywords-axial flow pump; flow field; whole passage; numerical simulation

Real-time load distribution control for the Geheyan hydropower plant

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***Abstract*──This paper investigates double objective real-time load distribution model in the mode of unit automatic control for the Geheyan hydropower plant. Temporally, unit commitment scheme of real-time operation is setting by combining unit priority list with unit startup and shutdown rules. A set of optimal solutions can be obtained using dynamic programming method to resolve spatial object function and assort with temporal**

object, from which the load distribution scheme rules were chosen in accordance with real-time control demand. The results of daily simulation operation during April to July, 2006 show that proposed operation model can save water more than 2%, and reduce frequency number of unit crossing vibration area by 17.27%. Furthermore, under the condition of giving four different reserve load modes, consumption of power production and frequency number of unit crossing vibration area are also reduced more than 1.38% and 17.13%, respectively.
Keywords-hydropower □ ***real-time load distribution; nonoperation area; unit commitment; reserve load***

FEM-based reinforcement design of surge shaft

Illustrated with a case study of Xiaowan hydropower plant

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***Abstract*—The method of FEM-based reinforcement design of surge shaft is proposed. As the concrete of surge shaft is applied after excavation and has to spend a period of time to exert its strength, the method to calculate and apply load to the concrete structure is put forward. As the design codes only provide linear solution of concrete with potent basis, the concrete is calculated elastically and the rock mass is calculated iteratively. In view that the design code only gives general principles for the reinforcement of non-member and mass concrete structures, the specific implementation approach based on FEM solution is put forward for these complicated structures. The maximum tensile stress principle is employed to conduct the reinforcement and maximum crack width estimation method is presented to assess the reliability of reinforcement design scheme. A case study is illustrated on the reinforcement design of the surge shaft concrete structure at Xiaowan hydropower plant. It is shown that the proposed method is rational and effective, providing the reinforcement design of complicated structures with direct convenience.**
Keywords-FEM; reinforcement design; surge shaft; nonmember; mass concrete

Analysis of Impact on the Irrigation at the Irrigated Area along the Yangtze River after the Application of Three Gorges Project

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Absract—*After the pplication of Three Gorges Project, the sediment amount in the lower reaches of the Yangtze River will be significantly decreased, which would cause long period, long-distance adjustment in the lower reaches and result in the drop of the same flow rate water level;At the same time,the flow rate in the lower reaches would significantly be changed because of the reservoir regulation. These changes will impact on the irrigation of the irrigated area along the Yangtze River.In this paper, according to changes of the water and the sediment conditions that after the application of Three Gorges Project, predicts hydrological change trends, analyzes the sluices intake water conditions and its variation of ability. and the impact on the irrigation.*
Key words-*Three Gorges Project Irrigated AreaImpact*

Pediction of Euler Energy at Channel Outlet of Runner

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***Abstract*—To layout the hydraulic geometry of an advanced runner, it is necessary to predict if the flow Euler energy at runner outlet is zero or not. By applying the concept of channel outlet, the Euler energy can be predicted from the vane's camber angle. A design criterion to satisfy the distribution of Euler energy along the channel outlet is proposed.**
Keywords-Euler energy; channel outlet; camber angle; runner; hydraulic layout

Numerical Simulation of Transient Flow in Pressurized Water Pipeline with Trapped Air Mass

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***Abstract*—The 2D VOF (Volume of Fluid) model is introduced in this paper to simulate the rapid filling process in pressurized water conveyance pipeline with trapped air mass. The movement of gas-water interface, the pressure distribution, the maximum pressure and the position of its occurrence during the**

filling process are modeled and analyzed. According to the results, the sudden pressure increase caused by the water striking on pipe wall could happen, and is sensitively influenced by the geometry parameters of pipeline. When the occurrence time of water striking on pipe wall is prior or close to that of the maximum air pressure, the maximum pressure of the system is obviously greater than the maximum air pressure numerically. With the increase of the diameter of pipeline, the maximum pressure of the system increases gradually, and the phenomenon becomes clearer when inlet pressure is higher. Obviously, the above-drawn conclusions are essentially different from those based on onedimensional model, such as "the maximum air pressure is the maximum pressure of the system" and "the maximum system pressure changes with the diameter of pipeline but slightly", which are caused by the inherent limitations of the simplification and the basic assumptions of one-dimensional model.
Keywords-transient flow; VOF model; conveyance pipeline; trapped air mass; numerical simulation

Research on Dynamic Properties of Long Pipeline Monitoring System of Air Cushion Surge Chamber

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***Abstract*—Air cushion Surge Chamber (ACSC) is a new type of pressure reduction device with some unique advantages like protecting the surface of the natural environment in hydropower plants. However, the inner air pressure of the ACSC could be as high as more than 3MPa, the monitoring system requires high accuracy and reliability to keep it working safely. In this paper, according to model test and numerical simulation, the dynamic response of the far distance monitoring system of ACSC with "long measuring pipelines" called Long Pipeline Monitoring System (LPMS) is studied, one new method to deal with the measured data and a simulation mathematical model are developed. Based on the model, the possible measured results of the major transition conditions of Muzuo hydropower plant in China have been simulated and forecasted. The corresponding conclusions have been applied in the design of ACSC, practical monitoring, analysis and operation in Muzuo Power Plant. So far, the power plant has been in safe operation for about two years, thus the rationality of the analysis method and the mathematical models developed in this paper can be well confirmed.**
Keywords- Air cushion surge chambe; monitoring system; model test; simulation; pipe parameters; filter

Simulation on Dam Concrete Construction Processes Using Dynamic Resources Matching Technology

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***Abstract*—Focusing on concrete construction process of arch dam by cable cranes, based on queued service system theory and dynamic resources matching technology, the simulation model with the core of dynamic resources allocating and matching is constructed, and then the simulation is carried on to optimize the construction processes. A sample shows that the simulation results carry more details of construction, which made by dynamic optimization model. And the time utilization of construction is optimized.**

Keywords ***concrete dam; construction simulation; dynamic resources matching***

Unit Consumption Anlysis Model of Distributed Combined Cooling, Heat and Power System

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***Abstract*—On the basis of the "unit consumption analysis" theory, this paper sets up a multi-heat-source and multi-coldsource unit fuel consumption model and a unit cost consumption model for natural gas distributed Combined Cooling, Heat and Power system (CCHP) running under two common operation modes. The unit consumption models are utilized in case calculation, the results of which are analyzed and are capable of demonstrating clearly the distributuion of the unit fuel consumption accrual of each subsystem (equipment) of the system. The models lay foundations for future energy savings and operation optimization of system equipments.**

Keywords- distributed CCHP system; the unit consumption analysis model; unit consumption accrual; cost;natural gas

Study on the Static Stability of A High Voltage Cable-Wound Generator

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***Abstract*— High voltage cable-wound generator Powerformer is a new kind generator, which can be connected to the power grid directly. In this paper, the expressions of power characteristics with excitation regulator and power limit of Powerformer are deduced. Combining with the parameters of Powerformer prototype and conventional synchronous generator, the power characteristics variation of Powerformer are obtained considering the effect of excitation regulator by the simulation. Then the power limit of Powerformer and conventional synchronous generator are analyzed contrastively, which proves that the static stability of Powerformer is better than that of conventional synchronous generator.**

Keywords-Powerformer; power characteristics; power limit; static stability

The Simulation Analysis of Leading Phase Operation of Powerformer

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***Abstract*—In order to study the leading phase operation performance of Powerformer, a simulation model of Powerformer is proposed in SIMULINK/SPS. The operation of Powerformer from steady-state to leading-phase state is simulated in a single-machine infinite-bus system. The simulations of stator voltage and current, power-angle and power factor under leading phase operation of Powerformer are obtained, and the depth of leading phase operation of Powerformer is analyzed. Comparison between simulation results and experimental results shows they are consistent.**

Keywords- Powerformer; leading phase; SIMULINK; modeling

Analysis and Calculation of the Operation Characteristics for Powerformer

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***Abstract*—A mathematical model of operation characteristics for generator is built through electric machines and electromagnetic field theory, and the method of solving the two-dimension electromagnetic field with FEM is given. To satisfy the demand of calculation of operation characteristics, the electromagnetic field with finite element method and external circuit of generator are coupled to calculate the operation curves for Powerformer under different conditions, including short-circuit characteristic, open-circuit characteristic, regulation characteristic, and external characteristic. Comparing with the experimental results, it is proved that the simulation results is right, which provides some references for the practical application of Powerformer.**
Keywords-Powerformer; operation characteristic; numerical calculation of electromagnetic field

Modal Analysis of Hydropower House by Using Finite Element Method

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Abstract: *In order to analyse the free vibration characteristics of hydropower house, finite element method (FEM) is used in the modal analysis. The main emphasis is placed on the problem of influencing factors of the modal analysis for hydropower house. The influencing factors include calculation model range, boundary condition and water in spiral case. Two practical cases are given. The study indicates that if the whole structure of one unit is taken as calculation model and the boundary condition is simulated properly, the calculation result is deemed to be precise enough to reflect practical situation. The mass of water does not affect the radical free vibration characteristics of concrete structure of powerhouses.*
Key Words: *hydropower station; powerhouse; modal analysis; finite element method; free vibration characteristics*

Analysis and Calculation of No-Load EFM Waveform for Powerformer

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***Abstract*— The field circuit coupling time-stepping FEM is proposed to calculate the no-load EMF waveform of salient pole machine, according to the Powerformer prototype, the no-load EFM waveform of Powerformer is calculated, and the effects of different damper windings constraints are considered during calculation, and then the results are compared with the experimental value. It shows that different**

constraints on damper winding produce different harmonic content in no-load EMF waveform of Powerformer, and the sine distortion rate also changes in some extent, these changes need to be considered in accurate calculation.
Keywords-Powerformer; no-load EFM; time-stepping FEM; field-circuit coupling

On Water Loads of Concrete Dams for Hydropower Generation

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***Abstract*—The water loads applied on concrete dams are the main loads in dam engineering design. According to the seepage theory, the action forms and the calculation formulas of water loads of concrete dams and foundations are proposed in many cases, which are analyzed and compared with the traditional calculation method of the hydrostatic pressure and the uplift pressure. An example is also given to show the comparison. It can be concluded that the traditional calculation method of water loads is just the one special case of the seepage theory.**
Keywords-seepage theory; concrete dams; water loads

Discussion □f Extended Drucker-Prager Yield Criterion in Slope Stability Analysis*

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Abstract**—**Strength reduction FEM is one of the main methods to analyze slope stability. Based on the extended Drucker-Prager yield criterion in ABAQUS, the plastic zone along a sliding surface from slope toe to the top is assumed as the flag to tell the slope sliding. And a typical soil slope stability is analyzed with extended Drucker-Prager yield criterion with different section circle of Mohr-Coulomb yield criterion, such as circumscribed circle, inscribed circle, internal tangential circle and equivalent area circle. When the material parameter *K* is 0.778, compared by the limit equilibrium methods, the safety factors of slope in extended Drucker-Prager yield criterion with circumscribed circle and inscribed circle of Mohr-Coulomb yield criterion are bigger and internal tangential circle less, and equivalent area circle closest. And with the increasing of *K*, the convergence of iterative computation enhances and the safety factor of slope becomes
bigger.
Keywords slope stability, safety factor, strength reduction FEM, yield criterion, ABAQUS

Optimization Design of the Powerhouse at the Dam toe

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Abstract**—In order to determine the reasonable design proposal of the powerhouse at the dam toe, combination with the practice of a hydropower station, the three-dimensional finite element method is used to study the rules of deformation and stress of the powerhouse under all kinds of working condition. It is shown that the sliding stability of the dam can be improved by counting in the interaction between dam and plant. The joining hydropower with dam can also reduce the deformation of the hydro turbine caused by high downstream water level. These investigations provide reliable basis for structural optimization design of the powerhouse.**
Keywords-powerhouse;optimization design;join of powerhouse and dam;flat joint grouting;sliding stability;

Numerical Simulation of the Flow Field to the Double Eccentric Butterfly Valve and Performance
Prediction

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Abstract **— The butterfly valve performance such as the curves of discharge coefficient is essential for predicting the ability of the valve to operate it along with other essential coefficients necessary for making sure the suitable operation. The availability of performance coefficients for incompressible flow is limited, and experimental testing can be cost prohibitive. However, the extrinsic ability of regulate on the valve mostly rely on the inherent structure of flow field and the law of changing. The capability of using computational fluid dynamics is tested to determine its viability for determining performance coefficients. The flow fields, curves of discharge coefficient, cavitations and pressure recovery factor of a symmetric double eccentric disk butterfly valve are studied under different opening angle in detail. The flow fields are predicted by using the semi-implicit method for pressure-linked equation SIMPLEC and the k-ε turbulence model based on the theory of isotropic eddy viscosity. The computational predictions for each factor were compared to test data and the numerical results were generally in good agreement with test data, although a few disparities existed.**
Keywords: Double eccentric butterfly valve; incompressible flow; numerical simulation; performance prediction

Study on slenderness coefficient of arch dams

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Abstract—In consideration of the fact that the former curves do not rely on that the damaged major cause of arch dams is the short of the concrete tensile strength but is related to the dam height and the concrete compressive strength, a new curve is brought forward in this paper, in consideration of factors of the concrete tensile strength, the dam height and the width of canyon. And the distributing chat of the slenderness coefficient of arch dams is presented.
Keywords—arch dam □ slenderness coefficient □ Lombardi Curve

Effect of turbine characteristic on the

response of hydroturbine governing system with surge tank

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***Abstract*—The water level fluctuation in surge tank causes lowfrequency fluctuations of unit's output power and frequency, which adversely affect the response of hydro turbine governing system. Turbine characteristic is one of the most important factors affecting unit's power and frequency during the governing. In this paper, based on the linearized model, the effect of turbine characteristic on the response of the hydro turbine governing system with surge tank, especially on the lowfrequency fluctuations of unit's power and frequency, is studied by numerical simulation with a given case. From the research, the main parameters of turbine characteristic which affect the response of the system have been pointed out, and the variations of these parameters in the comprehensive characteristics curves have been studied. Furthermore, different types of turbines have been analyzed, the results indicated that: the impact of turbine characteristic of medium or high specific speed turbine on the response of the governing system is more adverse than that of the low specific speed turbine.**

Keywords- hydraulic transients; turbine characteristic; numerical simulation; surge tank

Study on Nonlinear Dynamical Model and Control Strategy of Transient Process in Hydropower Station with Francis turbine

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***Abstract*—The transient process in conduits of hydropower stations is a very complicated dynamic procedure coupled with fluid, machines, electricity. In this paper, a whole nonlinear dynamical model of transient process in hydropower station with Francis turbine has been developed, and the control strategies of each transient process are studied. The nonlinear characteristics of hydraulic turbine and the elastic water hammer effect of pressure water supply conduit are considered in the model. The developed model is accurate enough to represent and simulate each transient process of the plant and may enable a plant operator to carry out economical, convenient study for the static stability and transient stability of the hydropower station under a wide range of transient processes. In addition, the literature takes a hydropower station as engineering case to simulate the transient processes of hydro-generator units' start-up, load variation, full load rejection from the grid and emergency stop. And the results of simulation are very satisfied.**

Keywords- hydraulic transients; nonlinear mathematical model; numerical simulation; control strategy

Flexible Multi-attribute Decision Method Based on Fuzzy Set Pair Analysis and Its Application

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***Abstract*—It's the emphasis and difficulty to understand various uncertain information effectively and depict it exactly in the flexible decision making process. The set pair analysis is a useful approach to analyze and research uncertain system. In this paper, it takes trigonometry fuzzy numbers to describe the identity, discrepancy and contrary degree of the connection numbers, and presents construction method of connection number of the set pairs in the format of trigonometry, and the set pair is composed of the alternatives and ideal schemes in the sense of the relative approach degree. With regard to the decision-maker's subjective weight, the comprehensive weights of each decision attribute can be calculated using entropy weight method. In the end, the proposed method is applied to the flood control decision making of the Three-George reservoir, which verifies its effectiveness and practicability.**

***Keywords*—set pair analysis; multi-attribute decision; uncertainty; entropy weight**

Unsteady Calculation in Hydraulic Turbine Induced by Rotor-stator

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***Abstract*—In the field of hydraulic turbine Computational Fluid Dynamics (CFD) is routinely used today in research and development as well as in design. A special attention is paid to the hydraulic turbine stability**

with the increasing of unit power and size. In order to get solutions to the stability problem an unsteady flow analysis is necessary. Different numerical schemes are discussed for the rotor-stator interactions and moving grid. The rotor-stator coupling by application of sliding mesh is shown on the example of a complete Francis turbine. Computational results are analyzed for part load point of operation.
Keywords- Hydraulic Turbine; unsteady flow; rotor-stator interactions; moving grid; numerical simulation

haiDigitized Hydroelectric Generating Unit Under the Framework of ICMMS and Its Application

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***Abstract*—The automation development degrees of control, maintenance and technical management which are the main three technical domains in hydropower industry are unbalanced. The research and development of the condition monitoring and fault diagnosis systems of Hydroelectric Generating Units (HGU) are ruleless and disorderly in nowadays. And the acquiring and using methods about expert knowledge have become the bottleneck of the development of fault diagnosis of HGU. In order to solving these problems, a new thought is brought forward in this paper: a Digitized Hydroelectric Generating Unit is constructed under the framework of Intelligent Control Maintenance and Management System(ICMMS); and then, the optimal measuring points located layout and some deep diagnosis knowledge are obtained from full-states simulation based on fullstates models of DHGU; furthermore, the equipment performance detecting and fault diagnosing can be carried through. This method can improve the maintenance automation of HGU and the integrated automation degrees of hydropower enterprises. The configuration of DHGU and its modeling methods are described in detail. The practice of these methods is indicated it can be applied widely.**
Keywords- Digitized Hydroelectric Generating Unit (DHGU; , full states modeling□□ fault diagnosis

Cavitation Vibration Monitoring in the Kaplan Turbine

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***Abstract*-- Cavitation is a common damage phenomenon in running hydraulic turbines. In order to meets the needs of hydraulic turbine cavitation monitoring, an experimental investigation, which according to high frequency vibration induced by cavitation, has been carried out on a Kaplan turbine. Four high-level accelerometers with 53 kHz natural frequency have been mounted on the turbine, and four data acquisition channels work at the same time. The investigations have been carried out on the output of noload, 30MW, 66MW, 100MW, 115MW and 130MW. The analysis results show that the adopted implements can accurately seize the cavitation signal, and the 115MW output in the 21.05-meter working head is suitable for the continued operation. This conclusion gives a reference for the hydraulic turbine stable running.**
Keywords-Cavitation; Vibration monitoring; Kaplan turbine

Simulation on Air Fuel Ratio Control Based on Neural Network

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***Abstract*—It is a challenge to control the transient air fuel ratio of gasoline engines accurately. In this work, the traditional PI controller was used to control the transient air fuel ratio by using the estimated signal.To verify the validity of the control strategy, a single cylinder gasoline engine model was built with GT (Grand Touring) -Power. Based on this, the simulation model for controlling the air fuel ratio of the gasoline engine was built, using GT-Power/Simulink. The neural network was programmed with S-functions. The simulation results showed a fair self- adaptability of this control strategy, which could effectively avoid enormous calibration experiments that are needed in the transient air fuel ratio control at present.**
Keywords neural networks; air fuel ratio; Simulation

Optimal Electric Energy Production scheduling for Thermal-Hydro Electric Power Systems

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***Abstract*—A method for optimal electric energy production of thermal-hydro power systems is presented in**

this paper. The electric energy produced by hydroelectric plants and coal-fired plants is divided into 4 components: potential energy, kinetic energy, water-deep pressure energy and reservoir energy. A new and important concept, reservoir energy, is proposed, based on which is divided into a number of water bodies, for example 3 water bodies, and a reservoir is analyzed in a new way. This paper presents a optimal scheduling solution of electric energy production of thermal-hydro power systems based on multi-factors analytic method, in which some important factors, such as load demand, reservoir in-flow, water-consumed volume increment rate of hydroelectric plants or converted from coal-fired plants, and so on are given to model the objective function and the constraints. A study example with three simulation cases is carried out to illustrate flexibility, adaptability, applicability of the proposed method.
Keywords- Thermal-hydro power systems; optimal electric energy productio; component and factor analysis; reservoir energy; hydro-energy conversion

Mathematical Model for Efficiency of the Hydraulic Transformer

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***Abstract*—A mathematical model is established to describe the efficiency characteristics of the hydraulic transformer, and the calculation and experimental results proved that the efficiency of the hydraulic transformer can be more than 75% in the range of transformation ratio between 0.5~1.75 and this efficiency value can be higher after optimization. The efficiency of the hydraulic transformer keeps invariant when supply pressure and fluid viscosity varying at the same rate. Both increasing the supply pressure and decreasing the fluid viscosity can extend the high efficiency area but can not conspicuously increase the maximum efficiency value.**
Keywords-hydraulic transformer; efficiency; model; hydrostatic

Developed a reduced kinetic model for HCCI combustion of DME and coupled with CFD Model

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***Abstract*: the paper presented a reduced dimethyl ether (DME) combustion model for Homogeneous Charge Compression Ignition (HCCI) using the sensitivity analysis and rate of production analysis approaches. This model consists of 28 speciesand 32 reactions. It shows great agreement with the detailed model in terms of**

ignition timing and species concentrations. Spatially three-dimensional calculations were conducted to couple with reduced model using the FLUENT code. The results show that the computation times are acceptable and the accuracy does not drop.
Keywords: sensitivity analysis; DME; HCCI; reduced mechanism; 3- dimensional model

Dynamic Characteristics Calculation Study of A Gas Turbine Rod Fastening Rotor

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***Abstract*—Stiffness design of rod fastening rotors is seriously concerned about by manufacturers. In order to reflect dynamic characteristics of rod fastening rotors accurately, elastic contact model is established on the axial contact surfaces between discs for rod fastening rotor firstly. This model assumes that a layer of uniform springs distribute on the contact surfaces and rod fastening rotor is a set of discs joint together by these springs. Then large numbers of rod fastening rotor models are designed and manufactured keeping main physical parameters such as contact stress between discs and contact surfaces roughness consistent with a certain actual gas turbine rotor. Natural frequencies and modes of these rotor models are studied through experimental measuring and finite element calculating methods. After that, mathematical relationship between contact stress and contact stiffness is established and verified using data of these rotor models. Finally, using this relationship, dynamic characteristics of the actual gas turbine rotor are calculated with finite element software and the calculated results coincide with experimental measured values very well. So the elastic contact model and the relationship of contact stress and contact stiffness is recommendable and contact stiffness determining method presented in this paper could be a good reference for stiffness design of rod fastening rotors.**
Keywords-rod fastening rotor; contact stress; contact stiffness; modal analysis; natural frequency

Study on the Alkalization Treatment of the Turbogenerator's Inner Cooling Water

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***Abstract*—The applied technical condition and the water quality of two alkalization treatments, which are adding alkaline chemicals and sodium ion exchange treatment, are studied by tests. It is a good way to use alkalization treatment to promote the quality of turbo-generator inner cooling water and prevent the hollow copper lead from corrosion, and to assure safe and economical operation of turbo-generator.**
Keywords-turbo-generator; inner cooling water; alkalization treatment; sodium ion exchange

NUMERICAL SIMULATION OF A LOW NOx PULVERIZED-COAL BURNER IN SAME VELOCITY OF TWO CHANNELS WITH 180 . SPIRAL SEPARATED PLATE

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Abstract—The velocity differences are 4.4~6.7 m/s of a horizontal biased pulverized-coal concentration burner with 180 . spiral separated plate, and it brings about many problems of operation safety, combustion stability and NOx emission, etc., so it is proposed of a low NOx pulverized-coal burner in same velocity of two channels with 180 . spiral separated plate. Velocity differences are less than 0.69 m/s of the low NOx pulverized-coal burner in same velocityof□ two channels with 180 . spiral separated plate, and its optimized structure parameters are upwind angle 30 , backwind angle 60 , and blocked cone area rate 15%. Pulverized-coal concentration of its dense jet channel increases 15~18%, meanwhile its dilute jet channel's decreases about 15%, the low NOx pulverized-coal burner in same velocity of two channels with 180 . spiral separated plate has more advantages than conventional biased pulverized-coal concentration burner in efficient combustion and low NOx emission etc..

Key words – a low NOx pulverized-coal burner in same velocity of two channels; velocity; solid-gas flow rate.

Application and Construction of Geothermal Pump Technology in Energy Efficiency

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Abstract**—**Ground source heat pump is a highly efficient, renewable energy technology for space heating and cooling. Ground source heat pump system (GSHPS) is receiving increasing interest because of their potential to reduce primary energy consumption and thus reduce emissions of greenhouse gases. The principiumn and characteristics of GSHPS including earth-energy and heat pump systems is introduced in this paper. Such geotechnical engineering technology as engineering drilling, thermal physical characteristic of ground layer, grouting engineering are also very important in the design and application of the GSHPS.
Keywords- Ground source heat pump; geotechnical engineering; Construction

Study on approximate calculation of cooling air allocation for gas turbine

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Abstract: Based on the informations of gas turbine used for power plant,this paper has researched the ways of calculation about cooling-air proportion of Sienens V94.3. According the cooling model and theorem to the blade of turbine gas,we can get the model of calculation about cooling-air

proportion.This method is easy to comprehend , and the precision is fulfill to realistic requirement.
Key Words: Gas turbine; Cooling air;Approximate calculation

Effect of Wind on Recirculation of Direct Air-cooled Condenser for a Large Power Plant

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***Abstract*—the paper introduces thermal buoyancy effects to experimental investigation of wind tunnel simulation on direct air-cooled condenser for a large power plant. Recirculation ratio of each measuring point is calculated by measuring temperature at the inlet of fans and outlet of finned tubes under different velocities and wind direction angles. The influence of wind velocity and wind direction on recirculation ratio is investigated. And the relationship between heights of wind wall and recirculation ratio under cooling tower is also discussed.**
Keywords- direct air-cooled condenser; effect of wind; recirculation ratio; power plant

Analysis of Water-Fuel Ratio for Supercritical Boiler Based on Association Rule

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***Abstract*--According to the characteristics of supercritical unit, we present the importance of the water-fuel ratio and the intermediate point temperature. Aiming at the features of the water-fuel ratio control system that can not give attention to celerity and veracity, we put forward association rule arithmetic in data mining to analyze the underlying relation of the water-fuel ratio, the intermediate point temperature□main steam temperature and steam flow, in order to improve the quality of control system.**
Keywords□□water-fuel ratio; intermediate point temperature; main steam temperature; data mining; association rule arithmetic

Hybrid Systems Analysis Based on an Existing 2kw Molten Carbonate Fuel Cell

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***Abstract*□This paper addresses the thermodynamic analysis of different hybrid systems basing on an exiting 2kw molten carbonate fuel cell (MCFC). Various possible system layouts, with the major difference among these layouts being the compression and heating method of the MCFC inlet, are proposed. The energy efficiency and output power are studied for comparison purposes. The energy efficiency of the different system can change between 30% and 40% because of the different layouts. Hybrid system based on MCFC and a regenerated micro-gas turbine is analyzed. The effect of cycle design parameters, such as the compression ratio and turbine inlet temperature, on the performance of a MCFC/MGT hybrid system is investigated. General design is found tha higher compression ratio and turbine inlet temperature leads to higher energy efficiency.**

Key words- MCFC; hybrid systems; hydrogen; regenerated gas turbine; turbocharger

The influence of slant cracks on rotor's torsional shear stress

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***Abstract*—In order to study the influence of slant cracks on rotor's torsional shear stress, the mode □ stress intensity factors in different positions of slant crack rotor, with dip angles (the angle between crack surface and axial line) greater than 60 degrees and at different depth ratios of shafting, are analyzed and calculated .The results show that: the stress intensity factor of the same position and dip angle grows with the increase of depth ratio, in the case of the same depth ratio and dip angle, the stress intensity factor decreases with the growth of the distance to the crack center, and the greater the dip angle is, the faster it declines nearby the crack edge. The corresponding curves of stress intensity factor under different depth ratio and dip angle are drawn out, and a critical relative difference concerning the torsional shear stress between slant cracks and transverse cracks is defined. Furthermore, the critical dip angle with regard to**

different engineering allowable errors is confirmed, which would be used to decide when the transverse crack could be used to substitute the slant crack model in engineering applications.
Keywords- *steam turbine unit; rotor;slant crack; torsional shear stress; stress intensity factor*

Numerical Optimization Method For Turbine Blade Design Based On Condensation Theory

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***Abstract*—A method for controlling homogeneous nucleation and reducing degree of flow separation in high-speed transonic wet steam flow is presented. The spontaneous nucleation flow in a turbine cascade was numerically studied. The model was implemented within a full Navier–Stokes viscous flow solution procedure, and the process of condensation was calculated by the quadrature method of moments which show good accuracy with very broad size distributions in nucleating steam flow. Results shows in wet steam flow, degree of flow separation is greater than in superheated steam flow and the loss can't be neglected. The suction side profile of turbine cascade impacts the nucleation rate distribution leading to different droplet distributions and affects the degree of flow separation. Flow separation and wake vortices can influent the unequilibrium state of flow. The numerical study provides a practical design method for turbine blade to reduce losses.**
Keywords-wet steam; two-phase flow; flow separation; condensation; blade profil*e*

Numerical Simulation of Turbulent Flow in Recycled Water Pump Intake Sump of Thermal Power Plant

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Abstract: The numerical simulation of flow in recycled water pump intake sump of thermal power plant is carried out by *k*-   turbulence model. According to the results of numerical simulation, the influence of different sump sizes combination on the flow flied is valuated. On the basis of ensuring the water flowing in the sump with a good flow pattern, the optimal ranges of main sizes saving the project investment as far as possibly are recommended.

Key words: Thermal power plant, Pumping station, Intake sump, Flow field, Numerical simulation

Structural theory and thermoeconomic diagnosis: application to a supercritical power plant

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***Abstract*—In this paper, the new diagnosis method based on the structure theory and thermoeconomic is introduced—Fuel impact.□ It is applied to diagnose the causes of the additional fuel consumption of a steadily operating plant, due to the inefficiencies of its components. For a 1000MW supercritical coal-fired power plant, by using the Fuel impact method analyze the #5 and #6 LP Out of Service condition performance data based on the THA condition performance data. Furthermore, it will be able to quantify the effect of a component malfunction in the other components of the plant. As a result the validity of the methodology is proved and quantified. The methodology is validated quantifying its accuracy.**

Keywords: Thermo-economics, Structure Theory, Thermal power system, Exergetic cost

Description of Exergy Transfer in the Power Plant Boiler's Heat Transfer Process

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Abstract-**This report reviews the development of the theoretical framework for the exergy transfer analysis, and proposes a time and space-dependent exergy transfer equation**. **The exergy transfer equation, together with the energy equation,** the **law of conservation of mass, N-S equation, constitutes the theoretical**

fundament for exergy transfer analysis. With these transfer equations, the exergy transfer analysis model for the power plant boiler surfaces is therefore derived, expounded. And some criterions for analyzing and evaluating the surfaces and the heat transfer chain are raised and defined. In terms of the dynamic analysis, exergy transfer analysis provides some new information including not only the design parameters, but also the impacts on the performance of the energy usage under the situation with the random running of the equipment system. It can provide the detailed suggestions to improve on the boiler design and direct the device operation.
Keywords: energy transfer，exergy flux，exergy transfer coefficient; The Power Plant Boiler

Computer Monitored Control And Data Acquisition System of Centralized Heat Supply Network

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***Abstract*-The article introduces the computer Supervisory Control And Data Acquisition system（referred to as SCADA systems ）of the centralized heat-supply network,including the scheme and functions,structure and composition,and shows the energy-saving control strategy and functions of the thermal Station.**
Keywords：SCADA, Heat Transfer Station, Energy Control.

New Technology of Thermodynamic Cycle for Waste Heat Recovery of Vehicle Gasoline Engine

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Abstract—**In this paper, the exothermic distribution of fuel was studied detailedly through conducting thermal equilibrium experiment when the vehicle gasoline engine was at different working conditions. Considering the characteristic of the exhaust temperature of the vehicle gasoline engine, the Organic Rankine Cycle (ORC) was adopted for the exhaust recovery. The thermodynamic parameter and thermodynamic performance of the main state points in the ORC were theoretically calculated via computer program. The optimal parameter was determined. On this basis, the organic working fluids were selected. In the last part, a new thermodynamic cycle configuration which can be used to recover the heat from exhaust gas, cooling water and lubricant of vehicle gasoline engine was put forward and introduced.**
Keywords-vehicle gasoline engine; exothermic distribution; heat recovery; working fluids selection; thermodynamic cycle configuration

Study on combustion characteristic of coal-char in oxygen-enriched environments

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***Abstract*- Oxygen-enriched (O_2/CO_2) combustion in circulating fluidized bed(CFB) is one of the most promosing clean coal combustion technology which shows good gaeous pollutants control, especially greenhouse CO_2. In the paper, the thermogravimetric experiments of Hennan lean coal-char under O_2/CO_2 and O_2/N_2 atmosphere have been carried out, the influence of atmosphere, O_2 concentration and heating rate on the combustion characteristic of coal-char being analysed. The results of the experiment show that O_2 concentration and heating rate have a great influence on the coal-char combustion characteristics in oxygen-enriched environment. The coal-char combustion characteristic ameliorates with increasing the O_2 concentration and improving the heating rate. Under the same O_2 concentration, the coal-char combustion characteristic in O_2/CO_2 atmosphere is a little poorer than that in O_2/N_2 atmosphere. A reaction kinetic model for coal-char combustion in oxygen-enriched environment was also deduced and it agreed well with experimental data.**
Keywords- oxygen-enriched combustion; thermogravimetric analysis; coal-char; kinetic

Experiment Study of Stratified Combustion at Different Boost Pressure

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***Abstract*— A study was undertaken to examine the effect of charge stratification on combustion on a optical engine in this paper. Planar laser induced fluorescence was employed to view charge stratification, together with on-line combustion analysis. Using intake manifold pressure as a means to govern the dilution ratio of air to charge in the cylinder, and therefore the level of stratification, it has been found that as the global AFR of the combustion increased, the stratified charge structure could maintain reasonable combustion stability in lean condition. The reduction in AFR in the vicinity of the spark event ensured rapid kernel development, the overall bulk combustion duration benefited form the richer mixture and the reduction in propagation length required in order to consume the vast majority of fuel.**
Keywords-Boost Pressure; Stratified Combustion; PLIF

Application of Eddy Dissipation Concept Model in Simulation of Gas Turbine Combustor

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***Abstract*—Non-premixed combustion flow with C16H29 fuel in gas turbine combustor was simulated by commercial software Fluent. Under a design condition, the turbulence was solved by the RNG** k **– . two-equation model, the physical nozzle was simulated by the discrete phase model (DPM) and discrete random walk (DRW) model, the reaction and NOx exhaust were analyzed by different reaction models as eddy dissipation concept (EDC)-2Step model, EDC-5Step model and thermal & prompt NOx models respectively. The result shows that there is a lower peak temperature, a better uniformity of temperature in outlet as 28%, a lower NOx exhaust as 728 ppm with EDC-5Step model including exothermic reactions.**
Keywords-gas turbine combustor; turbulent combustion model; numerical simulation; eddy dissipation concept (EDC) model

Numerical Study on Coal Gasification in Texaco Entrained-flow Coal Gasifier

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Abstract—**Numerical study of the slurry gasification process inside of Texaco entrained-flow coal gasifier was carried out in this paper. The Eulerian-Lagrangian approach was used for calculating the gas-solid two-phase flow. And the complicated slurry gasification process was divided into several stages, such as slurry-water evaporation, coal devolatilization, heterogeneous reactions and homogeneous reactions, coupled with the changes of particle size. The predicted result of product gas compositions was in well agreement with the experimental data in literature, which verified the validity of the model. The simulation results indicated that there exist four main reaction zones inside of the gasifier which are evaporation/devolatilization zone, combustion zone, reduction zone and outlet zone. The content of effective compositions ($CO + H_2$) in product gas increases with the increasing slurry concentration. The calculation is helpful for designing the operating conditions of the gasifier.**
Keywords-numerical study; coal gasification; entrained-flow coal gasifier; slurry concentration

Numerical Simulation of Ash Deposition in Entrained-flow Gasifier

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Abstract—**To study the ash deposition behavior in slagging mode gasifier, a comprehensive three-dimensional model proposed in the previous paper was applied to a two-stage dry feed entrained flow gasifier. The Eulerian-Lagrangian approach was used in the model for calculating the gas-solid two-phase flow. And the PDF combustion model was used to simulate the complicated gasification reactions in the gasifier. The simulation results indicated that a majority of ash particle are deposited on the wall areas between the injectors in the same level to provide a well protection of the wall from the highest temperature there, and the temperature condition of gas and particles inside of the gasifier can ensure a smooth discharge of the molten slag along the wall. The throat wall should be protected specially.**
Keywords-numerical simulation; ash deposition; entrained-flow Gasifier

Nonlinear system identification based on piecewise linear Wiener model and its application to drum-boiler turbine dynamics

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***Abstract*—A Wiener model with a series connection of a linear dynamic system followed by a static nonlinearity is proposed in this paper, based on extended MOESP (Multivariable Output-Error State Space) class of subspace model identification (SMI). Then a simple identification example is presented to validate the effectiveness of the algorithm.**
Keywords-Wiener model; nonlinearity; identification

Effect of Operation Parameters on High Temperature Air Gasification

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***Abstract—**A kinetics model and a experimental rig for high temperature air coal gasification(HTAG) research were set up. The effects of important operation parameters, such as air-coal ratio, steam-coal ratio and specific gasification rate, on gasification indexes were studied through the kinetics model and gasifier. The results show that: the model can accurately predict the gas composition. And when air-coal ratio increases from 1m^3/kg to 1.25m^3/kg, the syngas yield increases from 2.27m^3/kg to 2.82m^3/kg, carbon conversion increases from 73% to 94% and gasification efficiency increases from 68% to 82%, but the calorific value changes little. When air-coal ratio is larger than 1.25m^3/kg, the combustion zone extends much because of the excessive air and as a result, the calorific value and gasification efficiency decrease a lot. Thus the proper air-coal ratio should be 1.25m^3/kg. With steam-coal ratio increasing from 0.6kg/kg to 0.7kg/kg, calorific value of the syngas increases little at first and then decreases, but syngas yield increases a little, gasification efficiency and carbon conversion*

change little. When steam-coal ratio is larger than 0.7kg/kg, the gasification temperature decreases and as a result, the gasification condition gets worse. Thus the steam-coal ratio should be 0.7kg/kg. When specific gasification rate increases from 260kg/(m^2· h) to 335kg/(m^2 · h), carbon conversion, gasification efficiency, calorific value and yield of the syngas change little. When pecific gasification rate is larger than 335kg/(m^2·h), the contact time of gasifying agent, gasification products and carbon is shortened and as a result, the gasification condition gets worse. Thus the specific gasification rate should be 335kg/(m^2·h).
Keywords-coal gasification; high temperature air; mathematical model; operation parameter; gasification indexes

Transformation Technology of Mix-burning Poor Bitumenite with Lignite on 1025 t/h Boiler

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***Abstract**—Due to a serious shortage of the coal source for Tonghua area, power plant needs technology transform on 2×1025t/h boiler to achieve mix-burning with lignite to the maximum extent and burn independently local poor bitumenite. Mixing the hot flue gas from reversing chamber into drying medium of the milling system and adding conditioning wind to hot air pulverized coal feeding system, the technology program can reduce the content of oxygen at the end of milling system, as well as medium temperature of carrying the power, raising pulverizing capacity, explosion prevention capacity for the delivery system and drying capacity of milling system. And dual-channel coal burner is transformed into horizontal bias PCfired burner. Though the transformation, boilers reach the capacity of mix-burning lignite with 50% so as to improve the performance of the boiler.*
Key words- mix-burning lignite; warm flue gas; milling system; explosion prevention; drying capacity

Research on the Anthracite Pyrolysis Property by Thermogravimetric Analysis

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Abstract-**Experiments were performed in a TGA apparatus to investigate the pyrolysis properties of one kind of anthracite from Leiyang Power Plant, which has been used by several boilers. The effects of pulverized coal particle size, heating rate and final pyrolysis temperature on the volatile release property are presented. Experimental results confirmed that high heating rate could promote the volatile release rate at the primary period of pyrolysis. However, the complete pyrolysis still needs enough time. The final pyrolysis temperature also strongly affects the amount of volatile matters, while the effect of particle size can be ignored. So the total volatile yields are effected not only by the heating rate but also by the final pyrolysis temperature. The conclusion is different from the former results that volatile yields are independent of the heating rate. These results indicate the anthracite's volatile matter come out parallel with the char combustion, which are similar for the different size pulverized coal particles**
Keywords- Anthracite; pyrolysis; thermal Analyse

Research on the three different kinds of technologies to achieve flameless combustion and their applications

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Abstract—Flameless combustion was first to developed suppress thermal NOx formation and raise the efficiency of combustion. Now in further research, three different combustion technologies can be used to achieve flameless combustion those are high temperature air combustion (HTAC), normal temperature air combustion (NTAC) and oxy-fuel flameless combustion. This paper presents a description of the three different technologies, the development of their application in gaseous, liquefied and solid fuels combustion as well as their industrial applications at a research stage. These flameless combustion applied combustion technologies guarantees the uniform temperature distribution, fuel consumption reduction and productivity when applied, for example, to coal gasification, and to low calorific fuel combustion.
Keywords- high temperature air combustion; normal temperature air combustion; flameless oxy-fuel combustion

Numerical Simulation of

Three-dimensional Flow in A Multistage Centrifugal Pump Based on Integral Modeling

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***Abstract*—The whole flow passage model of a multistage pump is built. The three-dimensional turbulent flow through the model is simulated using standard □-□ turbulence model and wall function based on the Navier-Stokes equations. The influence of the grid number on the simulation results is studied by comparison. The velocity and pressure distributions within the impellers, guide vanes, etc are analyzed according to the results. The predicted performance of the multistage pump is also obtained through the numerical results. It shows that the numerical simulation of flow in the multistage centrifugal pump based on integral modeling is reasonable and feasible because the prediction values are consistent with experimental ones.**

Key words-multistage centrifugal pump; integral modeling; numerical simulation; performance prediction

Design and Operating of the Maximum Capacity 330MW CFB Boiler in China

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Abstract—In order to promote Circulating Fluidized Bed(CFB) Boiler powerplant efficiency, the pressure and temperature of the steam and the boiler capacity should be increased, and this idea is realized widely in the

world. The maximum capacity 330MW CFB boiler in China is developed and operates since 01.09.2008. The boiler is designed by Chinese self-technology. The main parameters are researched and determined, boiler general arrangement is introduced, the design of the boiler key parts is researched, at last, the boiler operating are introduced in this paper. It can be considered when Chinese self-technology supercritical CFB boiler is developed.
Keywords- Circulating Fluidized Bed Boiler boiler design furnace structure Compact split circulating ash heat exchanger, thermal parameter

The research of the influence of primary air ratio on the combustion in a lignite-fired Ultra Supercritical boiler

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Abstract*—The Computational Fluid Dynamics (CFD) code PHOENICS was applied to evaluate the combustion process in the furnace of a 1000MW dual circle tangential firing single furnace lignite-fired Ultra Supercritical (USC) boiler. The influence of different primary air ratios (35%, 39% and 43%) on the flow and mixing characteristics of the gas-solid two-phase flow and the combustion process in the furnace was focused on. The results indicate that in the furnace with double tangential firing, the flow field shows two well-symmetrical ellipses at different primary air ratios. The surface temperatures of the burners at which, the long axis of the ellipses pointed, are much higher than those in the other four corners. Thus the phenomena of 'Hot corners' and 'Cold corners' arise. In practical operating, the flow erodes the walls in the hot corner which may lead to high temperature corrosion and slagging. With the increase of primary air ratio, the average concentration of NO_x at the outlet of furnace rises while the char distributions in the furnace are similar. By the comparisons of the characteristics of the airflow, the temperature distributions, the NO_x formation amounts and the char burnout rates, the situation with the 35% primary air ratio is preferable. The results of this paper have great value because of the support they lend to the design of USC lignite-fired boilers.
Keywords- primary air ratio; combustion; NO_x; numerical simulation; dual circle tangential firing

On the characteristics of creep damage and rupture of dissimilar heat-resistant steel welded joint

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Abstract—**The mechanical properties, creep rupture strength, creep damage and failure characteristics of dissimilar metal welded joint (DMWJ) between martensitic (SA213T91) and bainitic heat-resistant steel (12Cr2MoWVTiB) have been investigated by means of pulsed argon arc welding, high temperature accelerated simulation, mechanical, creep rupture test, scanning electronic microscope (SEM). The results show that there is a marked drop of mechanical properties of undermatching joint, and low ductility cracking along weld/12Cr2MoWVTiB interface is induced due to creep damage. Creep rupture strength of overmatching joint is the least. The mechanical properties of medium matching joint are superior to those of overmatching and undermatching joint, and creep damage and failure tendency along the interface of weld /12Cr2MoWVTiB are lower than those of overmatching and undermatching joint after accelerated simulation 500h, 1000h, 1500h, and the creep rupture strength of medium matching joint is the same as that of undermatching joint. Therefore, it is reasonable that the medium matching material is used for dissimilar welded joint between martensitic and bainitic steel.**

Keywords-Martensitic heat-resistant steel; Bainitic heat-resistant steel; Dissimilar metal welding joint, Creep damage; Interfacial failure

Waste tires disposal by thermal plasma for power generation and carbon black recovery

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***Abstract*-Pyrolysis of waste tires in thermal plasma is studied for the purpose of power generation and recovering carbon black filler. The results of a series of experiments have shown that the main components of the gaseous product are H_2, CO, C_2H_2, CH_4, and C_2H_4; the heat value of the gas is about 5-9 MJ/Nm^3, therefore, it can be used as an efficient fuel source for industrial processes such as power generation. The solid product contains more than 80 wt % elemental carbon, has a surface area of about 65 m^2/g, and is referred to as pyrolytic carbon black (CBp). X-ray photoelectron spectroscopy (XPS) analysis has revealed that the CBp has mainly graphitic carbon structure similar to those of commercial carbon black. Thus thermal plasma pyrolysis is potentially a useful way of treating waste tires for power generation and carbon black recovery.**

Key words-thermal plasma; waste tires; power; carbon black; Recovery

Applied Research of Solar Assisted Air-Source Heat Pump System

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***abstract*-It is established that the thermal model of the main accessories of the solar assisted air-source heat pump system,and the running simulation software is empoldered by using VC language.The simulation examples was performed in Beijing areas,and the simulation data that reflected the thermal characteristics of the system was attained,and determines the matching relation of the main equipment capacity,as a result,the run conclusion data provides technical guidance for the design and operation regulation of the system.**

Keywords: solar,air-source heat pump,simulation software,thermal characteristics data, equipment capacity match

Simulation of Turbulent Combstion Using Various Turbulent Combustion Models

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***Abstract*—The Reynolds-averaged Navier-Stokes (RANS) method nowadays still is the major tool for gas turbine chamber (GTC) designers, but there is not a universal method in RANS GTC spray combustion simulation at present especially for the twophase turbulent combustion. Usually there are two main steps in two-phase combustion: the liquid fuel evaporation and the gas mixture combustion. Thus, two widely used turbulent combustion models: the Eddy-Break-Up (EBU) and Eddy- Dissipation-Concept (EDC) turbulent combustion models are firstly tested against a methane-air turbulent gas jet flame (Flame D) measured by Sandia Lab, then against two-phase turbulent swirl spray combustion in a complex GTC. In the jet flame simulation, the prediction results are in good agreement with the experimental results in most regions, while sometimes EBU model overestimated the turbulent effect. Though EDC model takes the chemistry effect into account, the turbulence seems be overestimated sometimes too. The simulated GTC performed well in**

experiments especially when the fuel-air mixture equivalence ratio (MER) in its main-reaction-zone (MRZ) is 0.7, so the two combustion models are all applied in this case, with the same 90° spray angel, same material properties and the same discrete ordinates (DO) radiation model. Generally, the EBU and EDC results are good: the high temperature regions are mostly in MRZ when MER is 0.7. The EDC model also has good predictions of different MERs in MRZ. When MER is 1.3, the unburned kerosene continue reaction after primary-air-holes; when MER is 0.3, there is nearly no kerosene there. Additionally, effects of the spray angle, material property are studied.
Keywords-gas turbine combustor; two-phase flow; spray combustion; numerical simulation; turbulent combustion model

Study on the Heat to Power Ratio of CHP Based on SOFC/GT System

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***Abstract*—A conceptual CHP system based on SOFC/GT is presented and how the parameters effect on the heat to power ratio is investigated. As SOFC reactors are still under development, a flexible simulation tool is presented to be adapted to different cell geometries and operating conditions. The simulation model is based on mass and energy balances coupled with appropriate expressions for the reaction kinetics, thermodynamic constants and material properties. Simulation results show the SOFC/GT CHP system's advantage over other conventional engine is that it can achieve low heat to power ratio with low stack running temperature.**
Keywords- Heat to Power ratio, SOFC, Gas turbine, Simulation

Test and Correlative Formula of Boiler Superheater Inner-flue and Outer-flue Tube Wall Temperature

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***Abstract*-In order to monitor tube wall temperature of boiler superheater, a new method was put forward to observe inner-flue tube wall temperature by long-term measuring outer-flue tube wall temperature. The method was based on the relation between inner-flue tube wall temperature and outer-flue tube wall temperature that was build up through testing data. The testing points were settled on the inner-flue and the outer-flue of same tube. According to the experimental data, the inner-outer flue tube wall temperature relation modeling was build up and checked.**
Keywords-Boiler,Superheater, Tube wall temperature test, Relation modeling

Numerical simulation on the flow fields downstream nozzles with tabs by modified turbulent model

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***Abstract*—Firstly, the flow fields downstream one axisymmetric nozzles and a nozzle with four tabs were simulated with four different turbulent models, and the results were compared with experimental data. Then the flow fields downstream nozzles with tabs of varied orientation angles were predicted for different orientation angles of the tabs while the projected blockage of tabs was kept unchanged. The predictions were also compared with that of the nozzle without tabs. The decrease of potential core length was remarkable when tabs were affixed. As the orientation angle increased, the potential core length decreased firstly and then increased. The streamwise vortices strength increased straightly with the orientation angle. Both entrainment gain and thrust losses of the nozzles decreased as the orientation angle increased.**
Key words: tab; modified turbulent model; orientation angle; streamwise vortices; thrust loss

Boundaries of Power System Frequency Regulation Ability

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***Abstract*—The upper and lower boundaries of power system frequency regulation ability are defined in this paper. System stability limits the upper boundary, and system safety limits the lower boundary. It is recommended that the best power system regulation ability should not exceed the upper boundary or the system will be unstable, and that the worst regulation ability should not exceed the lower boundary or the system will be out of control due to a large sudden load change. The upper boundary, i.e. Stability Boundary, is the emphasis of this paper. The effects of some possible factors including the linear and nonlinear factors and the system oscillation on Stability Boundary are explored.**
Keywords- Frequency regulation ability boundary, Primary frequency regulation, Secondary frequency regulation, Dead band, Oscillation.

Effect of Burner Offset Angles on Outlet Metal Temperature of Vertical Water Wall Tube in Supercritical Boiler

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***Abstract*—When the supercritical boiler operates, it's easy to lead the metal temperature of outlet of the vertical water-cooling wall tube to fluctuate considerably, and even makes the pipe wall overheating and fatigue damage on adjusting the running parameters continually. With studying the sensitivity of the running parameters for the metal temperature of vertical water wall tube, the running parameters could be adjusted to control the fluctuate range of the outlet metal temperature under different burner offset angles. The LS-SVM (Least Square Support Vector Machines) was proposed to construct a model for the outlet metal temperature, based on this model, the relation between the running parameters and the outlet metal temperature was analyzed under different burner offset angles. So the sensitivity of the running parameters for outlet metal temperature could be obtained under different burner offset angles. There is instructional meaning exists in the result for the control and the adjusting, which are on the outlet metal temperature of vertical water wall tube in supercritical boiler.**
Key words- supercritical boiler; temperature of vertical water wall; burner offset angles; least square support vector machines; sensitivity analysis

The Performance Optimization of a Thermoacoustic Refrigeration Micro-cycle

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***Abstract*—Performance analysis and optimization of the thermoacoustic refrigeration micro-cycle which is important to the energy conversion between thermal and acoustic through the thermoacoustic effect has been performed using finite time thermodynamics. The analytical expressions about the ecological function, as well as the relation between the ecological and the COP are derived. The relations between the cooling load and the COP, exergy output rate and the COP, the exergy loss rate and the COP, as well as the ecological criterion and the COP relation of the micro-cycle are investigated by numerical examples. The results obtained herein can provide some theoretical guidance for the design of a real thermoacoustic cooler.**

Keywords- thermoacoustic cooler; micro-cycle; optimal performance; finite time thermodynamics; ecological function

Cylinder Process Simulation with Heat Release Analysis in Diesel Engine

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***Abstract*—The use of thermodynamic models for the simulation of the cylinder process from analyzing heat release has been a common practice as a way to predict the performance of internal combustion engines. However, it is of importance to apply a suitable heat release model, as well as the gas properties, fuel properties, heat loss models, etc. In this paper, in order to distinguish two stages of combustion process, a double Vibe model is used to determine the heat release rate and a systematic investigation of the influence**

of several parameters in it to the pressure and temperature in cylinder is carried out. In addition, the Woschni heat transfer coefficient model is used to determine the heat loss to the cylinder wall during combustion. The gas properties, such as gas constant, specific heat and lower heat value are acquired by determining the components of air, stoichiometric gas and fuel, and using the mass fraction of air in the working gas as parameter. The reliability of the model has been verified by using a 4-stroke diesel engine MAN 4L20/27 to simulate in MATLAB/SIMULINK and the result of the simulation model is coincident with the actual operating condition of this engine.

Environmental/Economic Operation of Thermal Units in Electricity Market using Differential Evolution Algorithm

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***Abstract*—Having studied the linkage between the unit output change and the power price fluctuation, and synthesized the bidding risk exponent, environmental protection cost, generation cost and unit valve point effect, the optimal response model of thermal units to the electricity spot market was established. The objective is to guarantee generating and bidding of generating side in electricity market with minimum emission, low risk and maximal profit. A differential evolution algorithm with jitter variation was designed for the solution of this model with nonlinear and non-convex characteristics, and the environmental economic operation plan of units and a reasonable scheme of generating and bidding were achieved to maximize profit. The feasibility and validity of the proposed method was demonstrated with the results of the environmental/economic operation simulation calculation and analysis using an applied example.**
Keywords-environmental/economic operation; differential evolution algorithm; electricity market; generating and bidding

Thermodynamic Cycle Analysis of Mars CO_2 Thermal Rocket

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Abstract—In-situ resource utilization (ISRU) is recognized as an enabling technology for exploration of Mars. The collection methods of CO_2 on Mars are analyzed, and an implementation scheme of propulsion utilizes Mars CO_2 in raw form, CO_2 thermal rocket, is proposed. It can be used for attitude control and main propulsion during landing or takeoff, and it may be the potential propulsion for Mars airship, a promising Mars aerial platform capable of flight within the Martian environment. This paper illustrates influencing factors and potential application approaches of the new propulsion, and the cycle characteristic of the new propulsion is analyzed, the results show that the thrust specific power consumption (*TSPC*) is about the order of magnitude of 1N/kW, and variation of performance is mainly concerned with the high side pressure, electric heat temperature etc, and the new propulsion exist an optimum temperature.
Keywords-Thermodynamic analysis; CO_2 thermal rocket; ISUR; Freezing

Conversion of NO in $NO/O_2/N_2$ system by Dielectric Barrier Discharge Plasma

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***Abstract*—An experimental study on the conversion of NO in the $NO/O_2/N_2$ system has been carried out using Dielectric Barrier Discharge (DBD) Plasma at atmospheric pressure. The emphases are on energy consumption and the efficiency for NO conversion in the system. By measuring the concentration of NO and NO_2 as a function of specific energy density (SED), it is possible to determine the energy consumption for NO conversion and the effect of O_2 concentration and NO initial concentration on the efficiency for NO. It is conformed in this study that NO to NO_2 is the main reaction in the $NO/O_2/N_2$ system; the efficiency for NO conversion is reduced with the increase of O_2 concentration, the yield of NO_2 increases with the increase of O_2 concentration; initial concentration of NO is smaller, the efficiency for NO conversion is higher. When initial concentration of NO is 260×10^{-6} in the system, 75—95% NO can be conversed in the SED range of 440—700J/L.**
Keywords*—*Dielectric barrier discharge; Non-thermal plasma; SED; NO

Designing of a New Induction Heating Shaft Bearing Replacer by Using FEM

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***Abstract*—This paper designed a new shaft bearing replacer using for bearing inner race based on the induction heating technique by finite element method (FEM). The regularities of distribution of the electromagnetic and thermal field in the replacer had been simulated during the course of induction heating, the FEM simulation results not only proved the existence of the eddy skin effect, but also achieved the**

design parameters of the replacer by coupling the electromagnetic and thermal field. By experimental verification, the replacer can realize fast disassembling of the bearing inner race, which assembled on an axle with magnitude of interference.
Key Words: Induction heating; Shaft bearing replacer; Bearing inner race; Skin effect; Finite element method (FEM)

UHF Radar Designed for Inshore Wave Watcher and Ocean Power Application

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***Abstract*—this paper presents a remote sensing method for the measurement of inshore wave energy, which can be used for the investigation of some regional coast for building wave power plants and monitoring the waves near dykes. It is designed to operate at UHF channel, and it is a portable and low power system, it can measure the movement of sea surface simultaneously without probing into the water. The field test on the beach of Zhujiajian Island proved that the system can be used successfully.**
Keywords- UHF radar system; ocean power energy; wave farm.

Numerical Study on Heat Transfer in A Geothermal Heat Exchanger of An SCW System

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***Abstract*: A mathematical model of the mass and heat transfer in the Standing Column Well (SCW) system is established and studied by means of a numerical solution described in this paper. Comparing the numerical**

solution results with test data shows that the mathematical model and numerical solution method established in this paper can reasonably describe the characters of heat and mass transfer in geothermal heat exchangers of the SCW system no matter whether there is seepage in the well wall or not. And the results of the numerical solution will meet requirements for engineering applications.
Key words: standing column well, heat and mass transfer, numerical simulation

Research and Analyse for Pressurized Water Reactor Plant into Power System Dynamics Simulation

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***Abstract*—The nuclear power plants are being constructed and operated widely in recent years. Consequently, it is necessary to study nuclear power plants (NPPs) dynamic characteristics and power system dynamics simulations with nuclear plant after NPPs has been introduced into power system. At first, the paper presents functional description of NPP. Then a detailed and new models of generating plant with PWR have been developed in PSASP through user-defined modeling program for mediumterm and long-term power system transient stability analyse. In the end, the results for power system dynamics simulation with nuclear plant are presented.**
Keywords-nuclear power plant; pressurized water reactor; model; power system

Simulation research on radionuclide transport under severe accident

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***Abstract*—In this paper, the behavior of fission product is studied for 900MW PWR. Especially, the radionuclide released from core under severe accident is simulated. The program is based on models in MELCOR, elements with similar chemical behavior in the reactor are treated as one class, 15 classes are used in the program. The core**

is divided into 33 cells altogether. For each cell and each class, radionuclide released from core at different time is calculated.
Keywords-radionuclide; severe accident; MELCOR; release

The Numerical Simulation for the Film Surface Wave Under Resonant Case

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Abstract—**The effects of resonant flow case, on the nonlinear surface waves of film with uneven bottom were analyzed. From the potential flow theory, fKdV equation for the nonlinear surface wave was obtained by perturbation technique. The simulation has been made by pseudo-spectral method, and the waterfall plot of the surface wave was draw with Matlab. The flow is an incompressible, inviscid fluid with surface tension and different boundary; the results show that the different boundary: the positive boundary, the negative boundary has different effect on the film surface wave.**
***Keywords: film; surface wave; waterfall plot; resonant case; simulation*□**

Experimental study on evaporation pan isotopic variations

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Abstract—**Lake participates in water cycle through inflow and outflow of surface water and groundwater, precipitation and evaporation. Stable isotope technique is a very useful tool for studying variation of lake water . This paper briefly introduced the isotopic theory of lake, and studied the isotopic variation of atmospheric water vapor □A through indoor and outdoor evaporation pan experiments. The experimental results showed that □A values estimated from isotopic mass balance method were suitable to study the short-term isotopic variation of lake at**

time interval of six days; the slope of pan evaporation line of outdoor experiment was lower than that of indoor experiment due to kinetic fractionation factor of outdoor experiment being higher than that of indoor experiment.
Keywords- stable isotopes; isotopic composition of atmospheric water vapor; evaporation fractionation

Numerical Simulation on Wet Steam Flow in the Last Stage of Steam Turbine in Nuclear Power Plant

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***Abstract*—High-capacity, low inlet parameters and huge flow are the characteristics of the nuclear steam turbine. As a result of adopting saturation steam and long blade, water erosion of last stage blade become more prominent. The secondary droplets' continuously dynamic impact to the movable vanes in the wake of hollow stationary blade is the main reason for water erosion. So, it is necessary to research wet steam flow, vapor-liquid two phase flow, movement of droplets of different size and volume of sediment. The results of numerical simulation on wet steam two-phase flow in the last stage of nuclear turbine based on FLUENT software can show the flow characteristics of the wet steam. The most effective measure to prevent or mitigate the water erosion is that slotting suction ports in suitable locations of the hollow stationary blades' concave surface or convex surface. Research shows that, suction slot should be set up in and around the hollow stationary blades, in a relatively wide of the near 0.8.**
Keywords-Steam turbine; Hollow stationary blade; Numerical simulation; Suction slot

Concept Design of the Multi-application Integrated Light Water Reactor and

Normal Operation Analysis

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***Abstract*—According to the currently developing status of the integrated light water reactor, a multi-application integrated light water reactor concept design is proposed in this paper. The arc-shaped reactor core fuel elements are adopted, and oncethrough steam generator is used to produce steam. The pressurizer is located outside the reactor vessel which uses electric heating method. There are pumps in the reactor vessel used to drive the coolant flow to remove the nuclear heat. This paper also designs the startup bypass system of the once through steam generator and passive residual heat removal system. And the system code RELAP5/SCDAPSIM is used to simulate the process during the power change. The normal operation process of the reactor coolant system is introduced in detail.**

Keywords-integrated light water reactor; concept design; RELAP5/SCDAPSIM

Modeling and Dynamic Analysis of Nuclear Power Plant Reactor Based on PSASP

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***Abstract*—In this paper, we propose a dynamic mathematical model for nuclear power plant (NPP) reactor, and give an implementation in Power System Analysis Software Package (PSASP) through a user-defined program. NPP is modeled with a bipartite model that consists of the neutron dynamics module and thermodynamics module. Through the simulation results of NPP reactor under different disturbances, a conclusion can be drawn that the temperature effect and poisoning effect are crucial to the self-stability of reactor, which is not only the basis of safe operation of the nuclear power plant but also the aim of the designing. The simulation validated the proposed NPP reactor model, and it can be packaged with the other parts of the NPP detailed model in PSASP for further usage in dynamic calculation of the power system.**

***Index Terms*—NPP reactor, modeling, self-stability, PSASP.**

User-defined Modeling of Pressurized Water Reactor Nuclear Power Plant Based on PSASP and Analysis of its Characteristics

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***Abstract*—Established the mathematical modules of pressurized water reactor (PWR) nuclear power plant (NPP) for the studying of the interactions of the power system and the nuclear power plant after its connecting to system, then set up the user-defined model of PWR NPP using the user-defined modules of the Power System Analysis Software Package (PSASP). Calculate the dynamic traits of PWR NPP without regulating system of reactor and responses to faults in single machine infinite bus system. The results showed the self-stabilization and self-regulation of PWR NPP due to the negative feedbacks of fuel temperature and coolant temperature and the small interaction between power system and NPP if the fault of power system can be eliminated quickly which proved the validity of the model. The model can be used to calculate the influences of the NPP induced by disturbances of voltage or frequency of the system also the influences of the system induced by the change of the output of the NPP after NPP connecting to the power system.**

Keywords-Pressurized Water Reactor Nuclear Power Plant; PSASP; User-defined Modeling; Characteristics

Improving the Yield of Crude Oil from *Jatropha curcas* Seeds by Solvent Tolerant Fungus in Solidstate Fermentation

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***Abstract*—Solid-state fermentation was used as a pretreatment before oil extraction to improve the oil**

extraction yield from *Jatropha curcas* seed kernels. Maximum oil yield (87.84%,wt) was obtained when *Jatropha curcas* seed kernels pre-fermented by solvent tolerant fungus at 28 C for 72 h. Oleic and Linoleic were found to be the major components in the crude *Jatropha curcas* oil, and the C_{16} and C_{18} fatty acid accounted for more than 99% (w/w) of total seed oils. When *Jatropha curcas* seed kernels were pre-fermented, the density and viscosity of crude *Jatropha curcas* oil were decreased by 1.23% and 84.53%, respectively.
Keywords-Jatropha curcas oil; solid-state fermentation; oil extraction; biodiesel feedstock

Investigation on Combustion Characteristics of Direct Injection Nature Inhale Diesel Engine Fuelled with Biodiesel

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***Abstract*—This paper analyzed chemical and physical properties of diesel fuel and biodiesel. The influence of B20,B50,B100 and 0# diesel fuel mixture on diesel engine performance has been studied in a HF495Q3 engine. Test results show that the driving force of the engine is weaker with the adding of methanol, miximum power, miximum torque reduced about 9.8%,5.6%;For better evaluated engine economic, in this paper used rate of fuel consumption of energy equal value to analyze engine economic. Test results show rate of equal energy fuel consumption change little; NO_x are increase. diesel smoke, HC and CO emissions are reduce.**
Keywords-Dieselengine;Biodiesel;Colnhustion;Emission

Reduction of Biodiesel Cost Indirectly by Biological Treatment

Improving the nutritive value of deoiled *Jatropha curcas* seed meal for potential feed use

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***Abstract*—The deoiled *Jatropha curcas* seed meal (DJSM) was fermented by mixed strains of *Candida utilis* and *Geotrichum candidum* under solid-state fermentation to improve their nutritive value. Maximum crude protein (CP) content in substrate was observed at 100% (w/w) substrate moisture and a growth period of 4 days. The statistic analysis results showed that the CP growth rate, in vitro CP digestibility, ammonia nitrogen content and protease activity in fermented DJSM was enhanced significantly ($p<0.05$) when the substrate supplemented with carbon source. Compared with non-fermented DJSM, the CP content, in vitro CP digestibility and ammonia nitrogen content of fermented DJSM were increased by 0.48-fold, 15.6-fold and 37-fold, respectively, and the protease activity was enhanced up to 2100 U/gds. In addition, the total amino acids (TAA) and essential amino acids (EAA) contents were raised by 18.55% and 20.47%, respectively. Especially, the levels of valine, lysine and isoleucine were increased greatly ($P<0.05$). These results demonstrated that the nutritive value of DJSM was improved significantly after solid-state fermentation by mixed strains.**
Keywords- Deoiled Jatropha curcas seed meal (DJSM); solidstate fermentation; nutritive value

Research of Biogas as Fuel for Internal Combustion Engine

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Abstract The component, physical & chemical characteristics of biogas and the problems of engines running on it are introduced briefly in this paper. The two main steps that are diesel injection ignition and fast-burning system, which are used to solve the problems of the low burning velocity, serious back burning, high exhaust temperature and severe heat charge for biogas engines are expatiated. Then the authors develop two kinds of biogas engines: biogas-diesel dual fuel engine generators and spark-ignition biogas engine generators. The authors also put forward to use biogas as the fuel for vehicle by purified and compressed.
Keywords: Diesel-Biogas Engine, S.I. Biogas Engine, Fast Burning, Biogas Fueled Vehicle

Hydrogen Production from Manure by Low Temperature Gasification

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***Abstract*— Livestock manure disposal is becoming a problem due to its increasing production and potential pollution. Low temperature gasification can be applied to convert the manure quickly into valuable products (H_2, syn-gas and char). The pyrolysis behavior of pig and hen composts is presented in the paper. Because of the difference in the organic materials and minerals, the large difference in the pyrolysis behaviors of the pig and hen manure char is observed. The low temperature gasification of the two manures was also investigated in the study. The results show that Ni/Al_2O_3 catalyst can promote the tar cracking into little molecules and the volatile matters can be converted into H_2, CO, CH_4, CO_2 and carbon completely.**
Keywords- manure, pyrolysis, gasification, hydrogen production

Metamorphic Grain Pyrolysis and Its Kinetic Parameters by Different Methods

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***Abstract*—Metamorphic grain is one kind of biomass. Thermogravimetric analysis is used to study the pyrolysis characteristics of two metamorphic grains, metamorphic rice and metamorphic wheat in China, at different heating rates of 5 □/ min, 10□/ min, 20□ / min in a stream of N_2.Three methods: Coats-Redfern, Doyle and Kissinger, are used to determine the kinetic parameters, including reaction order, frequency factor and activation energies. The results indicate that the kinetic parameters are different with different methods. The pyrolysis process can be described by first-order global model for both metamorphic rice and metamorphic wheat, and activation energy adds along with the increase in heating rates and value of n, with the method of Coats-Redfern. Activation energy in Doyle model is a little smaller and changes in the range of 25kJ/mol to 50kJ/mol.**
Keywords-biomass; metamorphic grain; thermo-gravimetric analysis; kinetics

Kinetics of Pyrolysis of Straw Bales by

Microwave Heating

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***Abstract*—The direct pyrolysis of large size biomass is a difficulty, and it seems to be that microwave pyrolysis is a novel process to overcome the problem. This paper presents the experimental results of microwave pyrolysis process for straw bales in a microwave thermogravimetric analyzer the first time. TG and DTG analysis techniques are adopted to study the pyrolysis behaviors of straw bales systematically. The experimental results show that the input power of microwave, heating time and temperature have important effects on pyrolysis process. Reaction kinetics for microwave pyrolysis of straw bale is analyzed theoretically. A one-step comprehensive model is used to describe the microwave pyrolytic reaction in this experiment. The activation energies for the corn and wheat straw under microwave power of 334 and 668 W/ (kg straw) are 24.4, 26.8 kJ/mol and 67.2, 70.3 kJ/mol, respectively, the pyrolytic reaction is first order. The activation energy and pre-exponential factor increase with the increasing of microwave power. The experiment of microwave pyrolysis provides a new method for the wide uses of straws.**

Keywords- Microwave Pyrolysis; Thermogravimetric Analysis; Kinetic; Straw Bales

BIOMASS : A SUSTAINABLE SOURCE OF ENERGY

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Abstract- Biomass is a primary source of energy. This paper discusses about the vital role played by biomass energy in meeting the energy demand. The paper also presents the brief description of technologies involved in extracting energy from biomass. Biomass is very versatile in terms of variety of forms and number of options available for its utilization.

Key words: Biomass, Pyrolysis, Incineration, Fermentation, Embedded Generation.

VARIATION IN CORN STOVER YIELD AND FULE QUALITY WITH HARVEST TIME

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***Abstract*—The objective of this investigate is to evaluate the variation in yield and fuel quality of corn stover under different harvest time and to determine appropriate harvest time. Using Zhengdan 958 as research material, the effect of harvest time on yield and fuel quality of corn stover was studied under field conditions in Baicheng Academy of Agricultural Sciences, during 2007-2008. Results showed that with the delayed harvest time, yield of corn stover decreased, and the proportion of leaves reduced gradually, reduction of leaf biomass was the main reason for lower yield. With the delayed harvest time, moisture, ash, and mineral elements contents of corn stover significantly decreased, cellulose and lignin contents increased, but hemicellulose content decreased. Heating value of corn stover was maximum at filling stage and minimum at maturity, it was slightly higher after maturity. Heating value was significantly correlated with cellulose and lignin contents; ash content was significantly positively correlated with mineral elements contents, and was significantly negatively correlated with Si/K ratio. Delayed harvest reduced the yield of corn stover, but significantly improved its fuel quality. Fuel quality of corn stover was better when harvested in winter and spring.**

Keywords-Corn stover; Harvest time; Bioenergy; Fuel quality

Pilot-scale tests of direct dimethyl ether synthesis from biomass-derived syngas

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***Abstract*—Direct conversion of biomass-derived syngas to dimethyl ether(DME) at pilot-scale of 100t/a was carried out in a fixed-bed tubular reactor over Cu/Zn/Al/HZSM-5 catalyst. The bio-syngas was obtained by pyrolysis and gasification of corncob under O_2-rich air in fixed-bed reactors. The effects of gasification, synthesis temperature and gas hourly space velocity(GHSV) of bio-syngas on DME synthesis were investigated with the corncob feedrate of 45~50kg/h. The results shows that H_2/CO ratio of the obtained bio-syngas was around 1. CO conversion was 75.2% under optimized synthesis temperature of 270□ and GHSV of 1200h^{-1}. CO conversion and space-time yield of DME were in the range of 82.0~67.7%, 124.3~281.2$kg\cdot m_{cat}^{-3}\cdot h^{-1}$ respectively when GHSV was between 650h^{-1} and 3000h^{-1} under 4.3MPa and 260 □ . Cu (111) was considered to be the active phase for DME synthesis, confirmed by X-ray diffraction(XRD) characterization.**

Keywords-Pilot-scale;Synthesis; Dimethyl ether; Bio-syngas

Study on characteristics in combustion process of cornstalk and wheat straw

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Abstract: **The TG-DTA-DTG thermal analysis technology was applied to study on combustion experiments of cornstalk and wheat straw.. Combustion characteristics of the two biomass was analyzed according to combustion characteristics parameters such as ignition temperature ,peak temperature at maximum weight loss rate, burnout temperature etc. By analyzed the combustion process of the two with the heating rate of 20_/min, the bi-component phased reaction model is appropriate to describe the combustion process. A proper combustion mechanism was proposed. Comparitions of experimental results shows that there are some differents in kinetics parameters of the two kinds of biomass**

Keywords: cornstalk;wheat straw, bi-component phased reaction model; combustion kinetics

Kinetic analysis of NO reduction by biomass pyrolysis gas

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Abstract—**Reburning for NO reduction by simulated biomass pyrolysis gas ($H_2/CO/CH_4/C_2H_2/C_2H_4$) has been studied by using detailed improved kinetic modeling. A reaction set including 66 chemical species and 448 elementary gas-phase reactions was applied. The improved mechanism can reasonably simulate the evolution of the mole fractions of NO and HCN in Dagaut's experiments. According to this study, HCCO, C and CH_i(i=1,2,3) radicals have important effect on NO reduction. The effect of CO on NO reduction is inferior to that of simple hydrocarbons including CH_4, C_2H_2 and C_2H_4, etc, and CO mostly converts into CO_2. H_2 plays an important role in accelerating reaction process. NO reduction by biomass pyrolysis gas reburning is primarily through the following sequence: CH_4□CH_3□CH_2(s)□CH_2□CH□C; C_2H_4□CH_3,C_2H_3; C_2H_3□C_2H_2□CH_2,HCCO; HCCO□CH_2(s); C+NO□CN□NCO; CH_i(i=1,2,3)+NO□HCN□NCO,CN; HCCO+NO□HCNO□HCN □ NCO□HNCO,NH,N_2O □ HNCO□NH_2□NH,NNH □ NH,NH_2+NO□NNH□N_2; NH_2+NO□N_2□N_2O□N_2.**

Keywords-kinetic analysis; NO reduction; biomass pyrolysis gas

Isothermal pyrolysis of biomass by

macro-TG

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***Abstract—*Isothermal Pyrolysis of biomass such as rice straw, pelletized corncob and pelletized corn straw are studied with the furnace temperature of 700℃, 800℃, 900 ℃ by macro-thermal gravimetric(macro-TG) apparatus. The results indicated that biomass type, particle size, ash contents are influential in biomass isothermal pyrolysis characteristics, larger particle size made inadequate pyrolysis of char and longer residence time inhibited char yield, high ash contents conduce high char production. Pyrolysis reaction time can be significantly reduced by rising the pyrolysis temperature. However, it is more fast and more gas/liquid productions in a higher temperature condition.**

Keywords- isothermal pyrolysis, macro-TG, biomass

Experimental Investigation of Smoldering Gasification in Woody Biomass

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***Abstract—*The experiment on smoldering gasification in woody biomass has been carried out with a horizontal packed bed. Gas chromatography is employed to analyze the concentration of CH_4, H_2, CO, CO_2 and O_2 in gas products of smoldering gasification. The affects of temperature, moisture concentration and air condition on the flammable compositions of gas products are discussed. It is concluded that gas products of smoldering gasification in woody biomass can be used for fuel gas based on the feasibility analysis.**

Keywords- Smoldering;Gasification;Biomass;Gas chromatograph

EXPERIMENT ON RICE STRAW GASIFICATION IN A TWO-STAGE GASIFIER

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Abstract—The technical features and innovative structure of the two-stage gasifier developed by Shanghai Jiao Tong University are introduced. Experiments of straw gasification have been taken on this gasifier. The effect of equivalence ratio (ER) on gasification performance is detected under a certain condition: feeding rate is around 100 kg/h, char bed height is kept about 100 cm high. Results show that: within the experimental condition, when ER is between 0.3 to 0.35, the heat value of product gas can reach as high as 7247.7 kJ/m$_3$, gas yield rate is 1.84 m$_3$/kg, carbon conversion rate is 91.3%, the overall gasification efficiency is 84.6%.

Keywords- biomass gasification; two-stage straw gasifier; ER

Structural Evolution of Maize Stalk Particles during Pyrolysis

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***Abstract*—The structure evolution of maize straw (MS) particles during pyrolysis was studied. The samples were characterized by ultimate analysis, Fourier transform infrared spectroscopy (FTIR), true density measurement and N_2 isothermal adsorption/desorption method. The H/C and O/C atomic ratios decreased from 1.59 and 0.84 in the raw MS to 0.21 and 0.33 at 1173K respectively, which implied that the char became progressively more aromatic with increasing temperature. Above 773K, the H/C ratio decreased dramatically compared to the O/C ratio, suggesting a direct dehydrogenation of the char at high temperatures. FTIR results showed that the hydroxyl, methylene, carbonyl and olefinic C=C functional groups were lost at high temperatures. The aromatization process started below 673K andcontinued to higher temperatures. The BET surface area reached a maximum value at 773K, and at higher temperatures,**

the specific area dropped significantly, probably due to thermal annealing. The moderate shrinkage of the carbon structure occurred when the temperature was higher than 773K, which was concurrent with the aromatization process. The loss of volatile matter produced pore opening, whereas the structural shrinkage was responsible for pore narrowing.
Keywords-maize stalk; pyrolysis; ultimate analysis FTIR; adsorption/desorption

Study of the Bed Agglomeration during the Fluidized Bed Combustion of Rice Straw

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***Abstract*—The fluidized bed combustion of rice straw was investigated in a lab-scale reactor. The influence of fluidizationvelocity and bed temperature on the fluidization time was investigated. The effect of regulating running parameters on the fluidization recovery after the defluidization had occurred was studied. Experimental results showed that the fluidization time decrease with the increase of the bed temperature or decrease of the fluidization velocity. Fluidization can be recovered only by means of decreasing the bed temperature. The SEM/EDS analysis results showed that the molten materials in the agglomerates are formed by the burning fuel particles. At last a new agglomeration mechanism was proposed. The results are lpful for the design and operation of biomass-fired fluidized ed and further understanding of the agglomeration mechanism.**
Kywords- ***fluidized bed; fluidization time; agglomerate; agglomeration mechanism; molten material***

Mathematical Modeling of Drying Characteristics of Sewage Sludge

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***Abstract*—Drying characteristics of sewage sludge were investigated using hot air of a temperature range of 50~80℃ and an air velocity range of 0.60~1.48m/s at a laboratory scale dryer. Several mathematical models available in the literatures were fitted to the experimental data by multiple nonlinear regression analysis. Four statistical parameters: coefficient of determination (R^2), reduced chi-square (χ^2), root mean square error (*RMSE*) and mean relative deviation modulus (*P*) were used to evaluate the fitting of these models to experimental data. The Page model gave the better predictions than others. Then a modified model based on Page model was developed and the new model could fit the drying characteristics of sewage sludge well with R^2 over 0.9993 at widely drying conditions.**
Keywords- sewage sludge; moisture content; drying characteristics; mathematical model

Nonisothermal TGA Study on the Combustion Reaction Kinetics of Biomass

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***Abstract:* The combustion reaction kinetics of two Chinese straws were investigated by a differential thermal balance , volume fraction of reactive gas was N_2: O_2 = 80:20 and heating rate was 30℃/min. Reaction of samples were mainly composed volatile and fixed carbon combustion phase, ranges of them were 425K-650K and 650K-810K in round numbers according to TG, DTG and DTA curves. Reaction kinetic parameters were calculated with Coats-Redfern method. Ranges of Activation Energy in volatile combustion phase were 20 kJ.min^{-1} or so, fixed carbon combustion phase were different，they were 145 kJ.min^{-1} and 66 kJ.min^{-1}. Results showed that the order of reaction of volatile combustion phase and fixed carbon combustion phase were zero and second, respectively. The reaction initial temperatures of two samples ranged from 420K-460K and reaction final temperatures ranged from 780 K -810K.**
Keywords- Straw; Biomass; TGA; Reaction Kinetics

Dynamics of Methangens during Steady-state of Anaerobic Baffled Reactor Using Single Strand Conformation Polymorphism

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***Abstract*—To investigate the physiological and ecological characteristics of methangens in the steady-state of anaerobic baffled reactor (ABR), a laboratory-scale ABR with seven compartments was operated with molasses wastewater as substrate. Chemical analyses were done to evaluate digester performance. In parallel, Archael community dynamics were monitored by single strand conformation polymorphism (SSCP) analysis targeting the V3~V5 region of 16S rRNA genes and further characterized by partial sequencing of 16S rRNA genes. The result showed obviously niche separation between the acidogenic phase (1st to 4th compartments) and the methanogenic phase (5th to 7th compartments). The acidogenic phase obtained richer diversity and the dominant genus up to 15 OTUs, among which, *Methanobacterium* and *Methanosarcina* were dominant genera. At the same time, in the methanogenic phase, the dominant status of *Methanobacterium* was replaced by *Methanogenium* and some new *Methanosarcina* sp. that can utilize acetate as substrate, and the dominant genus reduced to 8 OTUs. 95% sequenced bands belong to three genera, i.e. *Methanobacterium,* 53%; *Methanosarcina,* 24%; *Methanogenium*, 18%.**

Keywords-Single strand conformation polymorphism; Archaea; methangens; anaerobic baffled reactor ; niche separation

Electricity Generation in Microbial Fuel Cells at different temperature and

Isolation of Electrogenic Bacteria

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***Abstract*—Microbial fuel cell (MFC) is a novel device using biomass and microorganism to produce electricity. Three groups of cube-shaped microbial fuel cells were constructed and operated in fed batch at 30oC, 20oC and 15oC, respectively. The Bacteria present in domestic wastewater were inoculated as the biocatalyst, and 1 g/L glucose was fed as substrate during set-up. While the system was stable, the substrate was replaced with domestic wastewater (320mg COD/L) as sole carbon source. Voltage was affected by temperature obviously: compared to that operated at 30oC (434.3mV), the voltage reduced to 382.8mV at 20oC, and 297.0 mV at 15 oC, which was tested under the external resistance of 1000□. Power density was decreased 54.9% from 30oC to 15oC (Pmax=367.7mW/m^2 at 30oC). The coulombic efficiency of 42.2% at 30oC was over two times higher than that in 15oC (CE=18.4%). However, the COD removal rate was only a slight reduction, decreased from 71.4% (30oC) to 66.2% (15oC). The efficient reactors at different temperature were selected and the biofilm attached on the anode was separated with roll tube method under the facultative anaerobic condition. The same configuration of MFCs was used to evaluate the electrochemical activity of electrogenic bacteria with nutrient broth as substrate. 41 strains were totally separated, whose voltage and power density were measured. Two excellent isolates were obtained, FLL2 and FLL3. The voltage of FLL2 and FLL3 were about 210mV, of which the maximum power density were over 65mW/m^2. The colony characteristic of excellent electrogenic bacteria were generally smooth, flat, round, yellow and opaque. All obtained strains were brevibacteria with pilus, with the topographic height of several microns, observed under scanning electron microscope (SEM).**

Keywords- Microbial fuel cells (MFCs); Tube isolation method; Electrogenic bacteria; Voltage; Power density

Study on Bioenergy Recovery of Chemical Components of *Bambusa blumeana* by Py-GC/MS

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***Abstract*—*Bambusa blumeana* is the one of the most impotent bamboo species in South China. In order to**

exploit the highgrade resource utilization as bioenergy, determination of chemical components in Bambusa blumeana was made by using Py-GC/MS. Results indicated that the main components of Bambusa blumeana by Py-GC/MS analysis were carbon dioxide (30.99%), acetic acid (13.67%), tuaminoheptane (9.81%), diazene, dimethyl- (9.62%), 2-propanone, 1-hydroxy- (8.39%), butanoic acid, 2-oxo- (5.26%), 1-propanol (4.11%), 2,4(1h,3h)- pyrimidinedione, 5-(trifluoromethyl)- (2.81%), 6-anhydro-.beta.-d-glucopyranose (2.49%), 1,6-anhydro-.beta.-d-glucopyranose (2.02%), 9h-carbazole, 9-methyl- (1.7%), 2-fluorenamine (1.42%), bis(2-ethylhexyl) phthalate (0.9%), 3-methylcarbazole (0.83%), phenol, 2-(1,1-dimethylethyl)- (0.75%), benzofuran, 2,3-dihydro- (0.71%), methylcarbazole (0.69%), etc. Thus, the pyrolysis byproducts of Bambusa blumeana may be used as raw materials of bioenergy.
Keywords-Bambusa blumeana; Py-GC/MS; Chemical components, Bioenergy Recovery

Study on Extraction Technology of Hemicellulose from *Pinus massoniana* Waste Wood for Bioenergy

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Abstract—**Much waste wood causing pollution and energy waste was produced in the processing of *pinus massoniana* wood. However, hemicellulose extracted from *pinus massoniana* waste can be transformed into bioenergy by means of pyrolysis, gasification, liquefaction, etc. Therefore, effects of deresination technology on extracting hemicellulose from *Pinus massioniana* were investigated by orthogonal and the whole factors test. The results show that 1) effects of deresinating temperature and time on quantity of dissolved resin is highly significant, but effects of deresinating pressure and volume fraction of degreasing agents on dissolved oleoresin volume are lightly significant. 2) Effects of deresinating temperature, time, pressure, volume fraction on removal volume of hemicellulose from pinus massioniana are lightly significant, removal volume of hemicellulose from deresinated wood is larger than that from untreated wood, but both increase in response to the increase of quantity of dissolved resin.**
Keywords-bioenergy; Pinus massionianas; hemicellulose; wood extractives;Extraction Technology

Py-GC/MS Analysis on Bioenergy Resource of *Eucalyptus urograndis* Wood

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***Abstract*—As the most abundant renewable forestry resource in South China, *Eucalyptus urograndis* wood is most suitable for bioenergy. Therefore, Py-GC/MS was used to analyze the components from pyrolysis products of *Eucalyptus urograndis* wood. After treated with freeze-drying, the comminuted power of *Eucalyptus urograndis* wood was pyrolyzed in He atmosphere at 590_, then the pyrolysis product was analyzed by online linked GC/MS. Relative content of each component was determined by area normalization, and 38 compounds representing 99.35% were identified. The main and abundant constituents were arbon dioxide (59.93%), ethene, ethoxy- (18.73%), 1,6-anhydro-.beta.- D-glucopyranose (4.58%), phenol, 2-methoxy-4-(1-propenyl)- (4.19%), cedrol (3.14%), thylene oxide (2.33%), glycidol (1.23%), 1H-3a,7-methanoazulene, 2,3,4,7,8,8a-hexahydro-3,6,8,8- tetramethyl- (1.16%), butanal (1.13%), ethanone, 1-phenyl-, oxime (0.59%), and so on. So pyrolysis products of *Eucalyptus urograndis* wood could be used to bioenergy, bio-pesticides, expensive chemicals, and so on.**
Keywords-Eucalyptus urograndis; wood; PyGC/MS; bioenergy; bioactive components

Charge-Discharge Mechanisms of Ammonium Vanadium Bronze $NH_4V_4O_{10}$ Nanobelts as Cathode for Lithium-ion Battery

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Abstract—Ammonium vanadium bronze $NH_4V_4O_{10}$ nanobelts show potential interesting properties for an application as the cathode in lithium-ion batteries with an original discharge capacity of 171.8mAh/g. Charge-discharge mechanisms of the material was investigated by using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) analysis. Results show that the discharge process passes through three different steps of lithium ion intercalation into the material, whereas the charge process can be completed via two steps of lithium ion deintercalation out the material. And that the causes of discharge/charge capacity attenuation can be ascribed to the increase of the charge transfer resistance, and further resulted in decrease in cycle life of the cell.
Keywords- ammonium vanadium bronze; Lithium-ion battery; Electrochemical impedance spectroscopy (EIS); Equivalent circuit

Modeling of Lithium-Ion Battery for Energy Storage System Simulation

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***Abstract*—Batteries are the power providers for almost all portable computing devices. They can also be used to build energy storage systems for large-scale power applications. In order to design battery systems for energy-optimal architectures and applications with maximized battery lifetime, system designers require computer aided design tools that can implement mathematical battery models, predict the battery behavior and thus help the designers search for the optimal schemes. This paper presentss a lithium-ion battery model which can be used on SIMPLORER software to simulate the behavior of the battery under dynamic conditions. Based on measured battery data, a mathematical model of the battery is developed which takes into account battery operating temperature and the rates of the battery charge/discharge currents. In addition, thermal characteristics of the battery are also studied.**

Keywords- Lithium-ion battery; dynamic model; energy storage system; SIMPLORER

Semiconductivity Variance of Polypyrrole(PPy) Films in HCl Aqueous Solution

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Abstract-Metals, as sheets, are potential candidates for bipolar plate materials of proton exchange membrane fuel cell (PEMFC). However, metal oxide formation and metal dissolution under operating conditions of PEMFC cause considerable power degradation, which can be solved by coating metallic plates with corrosion resistant and electrically conducting layers. Conductive polymer coatings have potential for application in PEMFC. In this study, polpyrrole films doped with short-chain SO_4^{2-} and long-chain dodecylsulfate (DS^-), respectively, were prepared on Pt, and the semiconducting behavior of the polymers during exposure to 0.01M HCl solution was examined in the potential range of -800mV to 600mV vs. SCE by Mott-Scottky curves. The PPy(SO_4^{2-}) films exhibit p-type semiconducting behavior in the potential region above 100mV vs. SCE and n-type semiconducting behavior below this potential. The PPy(DS^-) films behave like a p-type semiconductor at the potentials higher than 150mV vs. SCE and lower than –400mV vs. SCE, while in the potential range from –400mV to 150mV vs. SCE, the n-type semiconductor is observed, but not so marked.

Keywords: Proton Exchange Member Fuel Cell; polypyrrole; counterions; semiconducting properties; Mott-Schottky plots

The Utilisation of Lithium-Ion Batteries in Substations

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Abstract -- Nowadays, most transmission and distribution substations are equipped with batteries. These batteries are used as an emergency power supply for critical loads and therefore play a crucial role in substation availability. At present vented lead-acid batteries are deeply entrenched in the market but are big, heavy, and require regular maintenance. These disadvantages inhibit substation development in areas which have limited space and also need more emergency capability due to having more DC motors and actuators connected. With technology development and cost reduction, relative to lead-acid, lithium-ion batteries now offer an attractive combination of "greener" materials, compact, light, maintenance free, long life and high power and energy density. This paper presents the lithium-ion battery characteristics and the integration of lithium-ion batteries into substations. Simulation and experimental results are also presented and discussed.

Keywords--Lithium-ion, Battery, Substation

A comparative study on synthesis methods of LiV_3O_8

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***Abstract*—With $LiOH \cdot H_2O$ and NH_4VO_3 as the identical starting materials, several diverse methods were introduced to prepare lithiated vanadium oxides LiV_3O_8 which are promising as the cathode material for secondary lithium batteries. The crystalline phase were characterised by powder X-ray diffraction. The electrochemical properties of prepared samples were systematically investigated and compared. The maximal initial specific discharge capacity belongs to the material produced by hydrothermal route which can attain 338 $mAh \cdot g^{-1}$ at a current density of 0.2C. While the sol-gel route produced sample exhibit the best cycling behaviour among these lithium trivanadate, which kept 93% of its initial capacity as 209 $mAh \cdot g^{-1}$ after 20 cycles.**

Keywords-lithium ion batteries; cathode material; synthesis; lithium trivanadate; Electrochemical performance

Heat Transfer of Natural Convection Flow Between Inclined Plate with Heated Face Upward and Air

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Abstract—**the study for the natural convective heat transfer from an inclined plate with the different angles submerged in air, with heated surface upward, is performed experimentally. The plate was heated with electric heating, the average surface temperature of plate was measured by the thermocouple embedded in back surface of plate, the electric heating current and voltage were measured. The comparison and analysis are performed between the experiment results and calculated results. And all data obtained in this experiment were correlated as an equation. The results show that the Nusselt number deviations of the experiment and calculated with the classical relation increase gradually when the plate approaches the horizontal or the vertical. The deviation of data from the correlation was within ±27%.**

Keywords-inclined plate; heated surface upward; natural convection heat transfer; fitted

A New Air-conditioning System of Liquid Desiccant and Evaporation Cooling

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Abstract*—*This paper describes the design of a liquid desiccant air conditioning system using low-grade heat resource, which employs environmental-friendly, ozone-safe working substance – LiCl solution as the desiccant and is able to treat the ambient air at a high temperature 35℃ to the air conditioning supply air at a low temperature 18℃. It can handle both latent and sensible heat load of the room without any other refrigeration method. The paper analyzes the complicated heat and mass transfer process of individual components theoretically and establishes a numerical simulation for the whole system. Based on that, a liquid desiccant air conditioning device which can offer 40kw cooling capacity is worked out and built up. The Coefficient of the Performance (COP) of the device can be up to 0.8 when the heat source temperature is about 70℃. The

experimental data well consist with the numerical computation results.

Keywords-Liquid desiccant air conditioning system; mathematical model; COP

Applying Analysis of Solar Composite Wall

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***Abstract*—In this article, the heat model with solar panel composite wall structure was set up. simulation on heat resistance of solar composite wall was carried out , associated with three air flow patterns which refer to stillness, natural convection and forced convection, and compared with common wall without solar panel. It was found that the conditioning load was decreased remarkably due to the wall's reducing heat gain. Besides, the heat resistance was affected by interlayer thickness, the optimum interlayer thickness of different conditions of natural convection was given .**

Keywords- Solar composite wall, Heat resistance, Heat transfer Performance

Experimental Study on the Novel Solar Adsorption Refrigeration Cooling Tube

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***Abstract:* Using solar light as energy and compound adsorbent/water as working pair, the novel solar cooling tube was made and experimental studied in this paper. The experimental results show that, when the solar radiation was about 19.6-21.9 MJ·d^{-1}m^{-2} at the daytime, the temperature of adsorbent bed could reached to 220℃, the condensation temperature was about 45℃. In the nighttime, the evaporator temperature was about 15℃, the novel solar cooling tube could supply cooling mass about 300-390 kJ and the COP is about 0.23-0.25 and the refrigeration power was varied from 15W to 2W.**

Keywords: solar energy; adsorption refrigeration; compound adsorbent; cooling tube

A Calculation Method for Evaluating Thermal Loss of Solar Cavity Receiver

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***Abstract*—One of the most important components of solar thermal power system is the solar central receiver, which performance is in direct relation to the efficiency of the whole power generation system. The calculation of internal surface heat flux and thermal efficiency of receiver therefore plays a very important role in receiver design. A calculation method of heat loass of a cavity receiver is put forward in this paper. The first step of this method is to use the Monte Carlo method to simulate the track of solar beam and compute surface heat flux inside the receiver. The second step is to employ the correlations of flow boiling heat transfer to figure out the convective heat transfer coefficient inside the tubes and then the wall temperature of the boiling tubes laid inside the receiver. The last step is to simulate the air flow field inside the receiver to calculate convective thermal loss of the receiver. As every step can not be independently done, all steps are coupled and an iterative scheme is needed. Internal surface heat flux and thermal efficiency of the receiver can be finally gained with this method, and the result can provide theoretical guide for receiver design.**

Keywords-component; solar cavity receiver; Monte Carlo method; convective heat transfer; heat loss

The application of field-syergy theory in enhancing convective heat transfer of solar wall

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Abstract: The field-synergy theory has been applied for convective heat transfer analysis of fluid flow inside solar wall, the facters affected convective heat transfer was discussed. The results indicate that increasing the gradient of

heat flux along the vertical direction of solar wall□increasing the ratio of vertical velocity u to horizontal velocity v(u/v>5) □ and changing the direction of temperature gradient to get access to vertical direction (increasing the angle □) can enhance convective heat transfer of solar wall in the actual condition. In order to provide guidance for designer on practical project to improve heat transfer performance of solar wall, this paper give three improved measures based on analysis.
Keywords: field-synergy theory; solar wall; convective heat transfer enhancement

The Development and Application of the Solar Lights in Wuhan city, China

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***Abstract*—Traditional illumination lights are energyconsumption and not economical in the long term. While the solar lights are safe, easy to maintenance, independent of conventional energy, no pollution to environment. With the cost of the solar cells decreasing, the solar lights have been applied widely. Meanwhile photovoltaics are one of the fastest growing solar energy technologies. Photovoltaic devices, commonly called solar cells or modules, use semiconductor material to directly convert sunlight into electricity. In this paper, firstly the development of solar light in Wuhan city is introduced. A comprehensive analysis on the principle and the structure of the solar light is conducted, and the mathematical model of solar cells is proposed. Through tests on the solar cells, the I-V and PV characteristic curves are obtained which verify the theoretical curves.**
Keywords- solar lights; Photovoltaic cell; I-V curve; energy

Optimal Operating Temperature for Solar Thermal Power System

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***Abstract*—Solar thermal power is currently one of the important trends and research hotspots of solar energy. In present paper, basic physical model is proposed to investigate the solar thermal power, and the operating temperature is optimized to maximize the electricity generating efficiency. As the incident energy flux rises, the wall temperature almost linearily increases, while the heat absorption efficiency will first increase and then decrease. The increasing of flow velocity will benefit the heat receiver performance by decreasing the wall temperature and increasing heat absorption efficiency. Since the heat loss of infrared radiation increases with the temperature, the heat convection flux and local absorption efficiency of the heat receiver will evidently decrease along the flow direction. As the operating temperature increases, the Carnot efficiency of the steam turbine cycle obviously increases, while the average absorption efficiency of heat receiver decreases, so the electricity generating efficiency will reach maximum at optimal operating temperature.**
Keywords- solar energy; heat receiver; operating temperature; electricity generating efficiency

Preliminary Determination of Heliostat Field Range and Research of Receiver Depression Angle in Solar Power Tower

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***Abstract*—In solar power towers, the determination of heliostat field range is the groundwork of heliostat field layout, which is one of the most significant parts in plant design. The objective of this paper is to analyze the relationship between the heliostat field range and the receiver depression angle to obtain the optimal plant design proposal. Considering receivers with different shape apertures, heliostat field ranges were preliminarily determined by calculation based on the geometrical optics theory. Moreover, receiver depression angle, the most important parameter in field range determination, was deduced by a simplified formula with the only independent variable of latitude. Then, the rationality of this formula was demonstrated by comparing the heliostat field data calculated with different receiver depression angles based on the case study. From the simulation results, the layout scheme of heliostat field is relatively optimal when the value of the receiver depression angle is determined according to the formula developed in this paper. Also, once the value of the receiver depression angle was chosen in some reasonable range around the optimal value, the installed capacity of plant is mainly dependent on the tower height, the receiver aperture area, the heliostat dimension and the heliostat placement. The above-drawn conclusions indicate that the**

formula deduced in this paper may greatly simplify the design work of the heliostat field layout.
Keywords- solar power towers; heliostat field range; receiver depression angle; installed capacity of plant

Study on the Continuous and Stable Running Mode of Solar Thermal Power Plant

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***Abstract*—This article introduces the three kinds of solar thermal power systems existing in the world, and analyzes the key technologies affecting the continuous and stable running of solar thermal power plant (STPP). According to the fact that STPP can't operate stably and continuously, the article puts forward a new running mode with an auxiliary boiler. The auxiliary boiler plays three roles in the system, which is stable combustion, reheat and acting as a heat source.**
Key words: solar thermal power; key technology; heat accumulator; auxiliary boiler

Performance of a solar-air source heat pump system for water heating on different weather conditions

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Abstract—A new type of solar-air source heat pump water heating system was developed for space heating and

residential hot water supply. The specially designed multi-source collector/evaporator (C/E) using spiral-finned tubes could absorb heat from both solar radiation and ambient air. A prototype was designed and tested on different weather conditions in October in Nanjing, China. The experimental results showed that the prototype could heat water from 40 ˚C up to 55 ˚C efficiently both in the daytime and at night. It operated in the solar-source mode with a high averaged COP of 5.1 in the daytime when the solar radiation was 731 W/m2. Meanwhile, it operated in the air-source mode stably with a averaged COP of 3.5 at night, avoiding using electricity as a backup energy source.
Keywords- solar energy; heat pump; water heater; collector/evaporator

The Thermodynamic Analysis of Chemistry Stability of Eutectic Salt Phase Change Materials

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***Abstract*— This paper analyses the chemistry stability of eutectic salt phase change materials according to chemical thermodynamic principle, and introduces the methods and steps of thermodynamic calculation and analysis during the process of confecting eutectic salt materials. The paper takes thermodynamic calculation according to the two phase-change materials, Na_2CO_3-SiO_2 and Na_2SO_4-SiO_2. By comparing the relational graph of Gibbs free energy and the temperature, we found out that Na_2SO_4-SiO_2 bears a more stable chemical and thermal performance, which indicates the important role of thermodynamic calculation in studying the eutectic salt storage phase-change materials.**
Keywords-eutectic salt; chemical stability; thermodynamic calculation; Gibbs free energy

Study on the Application Potential of Solarwall System in Northern China

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***Abstract*—There is a growing, government-led trend of applying renewable energy in China. One area of interest lies in the wider use of solar energy systems. Solar air heating system based on unglazed transpired collector (UTC, also known as solarwall) is a simple and inexpensive technique that results in reduced energy consumption and operating costs resulted from outdoor air ventilation requirements. Solarwall is easy to be integrated in building. This paper establishes the mathematical model of solarwall systems and presents an evaluation of the application potential of solarwall in five northern cities of China. Simulation results showed that energy savings rate for the subject building in Beijing, Shenyang, Changchun, Harbin, and Lanzhou is 22.9%, 19.3%, 18.8%, 16.4%, and 20.8%, respectively. The payback period is 9.3 years, 7.8 years, 6.4 years, 7.1 years, and 10.7 years, respectively. The actual payback period will be even shorter if the energy savings resulted from the reduction of heat transmission through the building envelope due to the increase of R-value of the exterior walls is taken into account. Solarwall system is viable for China to reduce heating energy consumption and improve indoor air quality in winter.**
Keywords- solar energy; solarwall; heating; indoor air quality; building integration

Cosine efficiency distribution of heliostats field of solar thermal power tower plants

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***Abstract*—Mathematical model of cosine efficiency of heliostats field of solar thermal power tower plants was established, while the distribution of cosine efficiency of traditional and rotating heliostats field for latitude of 40.4° in the northern hemisphere defined by essential staggering layout with no blocking radial spacing was analyzed. The results show that, at given condition, the incident angles for traditional tracking heliostats during equinox are comparatively smaller, and from 8 a.m. to 16 p.m., the zone of higher cosine efficiency moves from northwest side to northeast side, and the distribution at 12 o'clock is quite similar to that of the average level of whole working hours, choosing equinox noon as layout point for the traditional heliostats field is therefore a good first choice. However, the rotating heliostats field is more powerful in concentrating solar energy for higher cosine efficiency at almost any individual hours than that of the traditional field. While in common, the average cosine efficiency distribution of the traditional and rotational field is symmetrical along the north direction to the tower, while the collective performance is better for those heliostats with less azimuthal angles and with shorter distance to the receiver. Based on this principle, placement and maintenance strategy of heliostats should be made so as to collect more solar energy.**

Keywords- solar thermal power tower; heliostats field; incident angle; cosine efficiency

Feasibility Analysis of Constructing Parabolic Trough Solar Thermal Power Plant in Inner Mongolia of China

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***Abstract*—Constructing of parabolic trough solar thermal power plant can provide scientific basis for future large scale application and industrialization evaluation in Inner Mongolia of China. Feasibility of constructing parabolic trough solar thermal power plant was analyzed in Inner Mongolia of China in this paper, and come to a conclusion that Inner Mongolia has the advantages such as solar energy, land, water, natural gas and electric network for constructing parabolic trough solar thermal power plant.**

Keywords-feability analysisi; solar energy; power plant

Economy analysis of the solar supported coal-fired power generation (SSCPG) system

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***Abstract*—Integrating the solar utilization system with the coalfired power plant into the solar supported coal-fired power generation (SSCPG) system shows an effective way for the largescale utilization of solar energy and energy conservation in coalfired power units currently in China. Two SSCPG systems integrating solar utilization system with C50-8.83/0.294 heat and electricity cogeneration unit are taken as examples to analyze its economy. Firstly, thermal performances of these two SSCPG systems are given by using solar heat electricity efficiency, solar heat input fraction, solar electricity generation fraction and so**

on as thermal economy evaluating indicators. The influence of location, operation mode on their thermal performance is also discussed. Then unit electricity generation cost of the SSCPG system is calculated, in which investment cost is involved. The results show that, on the condition assumed in this paper, the unit electricity generation cost of the SSCPG system of reducing 1# bled steam individually is 0.0386$/kW□h, a little higher than that of the coal-fired only system, 0.0356$/kW□h. But the unit electricity generation cost of solar part of it is 0.082$/kW□h, lower than that of solar only electricity generation system, 0.14$/kW□h. Finally, sensitivity analysis on the unit electricity generation cost is conducted. And the conclusion is that when collector price drops to 48$/m2 and coal price increases to 368$/t meanwhile, the unit electricity generation cost of the SSCPG system of reducing 1# bled steam individually will be equal to that of the coal-fired only system as the discount rate is 12%.
Keywords-Solar utilization system; Coal-fired power unit; thermal performance analysis; Economy analysis;

Technology Research Of Novel Energy Storage Control For The PV Generation System

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Abstract-- **Recent years, technologies for new energy have developed rapidly since the energy crisis and the environmental pollution got worse. And the solar energy generation technology tends towards the stage of a large number of applications in engineering from the research stage. This paper designed a gridconnected PV system firstly, then introduced the operation principle of the various parts as well with the control strategy of the power flow. The design of energy storage is of great significance as the output power of PV cells array is greatly affected by the light intensity and the temperature change. Battery is used as the energy storage device normally in the traditional energy storage system. In this paper, it used the Ultracapacitor as the energy storage device after comparing with the battery, and designed the charge-discharge control strategy according to the characteristics of the Ultracapacitor. Finally it verified the feasibility of the energy storage control strategy through the simulation models which was built based on the PSCAD/EMTDC platform.**
Index Terms—**PV generation; energy storage; Ultracapacitor; hysteresis control; constant voltage charge; grid-connected**

Research on the coordinated control method to obtain the maximum irradiation

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Abstract—**This paper presents a form of concentrating the solar radiation---employing multi-mirror to reflect the sun's radiation continuously on to the solar cell module. First, the basic structure, tracking control principles and methods of the Multi-Mirror concentrating solar radiation photovoltaic system are described. By the analysis of Multi-Mirror array of solar radiation concentrating system omnidirectional tracking control, the tracking movement equations of azimuth angle, tilt angle, space position of solar cell module and Multi-Mirror array are deducted. By establishing the tracking motion relationship between solar cell module and Multi-Mirror array, the tracking coordinated control between solar module and Multi-Mirror is achieved. The correlative quantitative analysis and numerical calculation are done for this system.**
Keywords-coordinated control; Multi-Mirror; maximum irradiation; tracking; focusing

Synthesis and Characterization of PbTe Nanoparticles under Ultrasonic/Microwave Co-irradiation

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***Abstract*—The lead telluride (PbTe) nanoparticles have been synthesized under ultrasonic/microwave co-irradiation. These PbTe nanoparticles were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FT-IR) and DSC.**
Keywords--Synthesis; Characterization; PbTe; Ultrasonic; Microwave; co-irradiation

The research on distributed fully

automatic control □cheme of solar monocrystal silicon CZ grower

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***Abstract*— A distributed fully automatic control scheme integrated with the advanced measurement sensors is designed to fulfill the precise control to growth process of the monocrystal silicon growers distributed in different locations. This scheme may meet the demand on large scale industrialization and high productive yield of bulk-material in solar energy applications.**

Keywords- solar energy; monocrystal silicon; photovoltaic effect; distributed control.

Forecast of Power Generation for Grid-Connected Photovoltaic System Based on Markov Chain

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***Abstract*—A grid-connected photovoltaic system has the characteristics of time-varying and random. A Markov Chain model of the power generation forecast was built based on the Markov decision theory according to the 6kW PV system operating data. The initial formation probability matrix and transition matrix for power generation forecast have been obtained. After considering the weather conditions, solar radiation and other specific factors, if the statistical sample is large enough, the theoretical calculations are very close to the actual results. The results show forecast of power generation for grid-connected photovoltaic system based on Markov Chain is feasible, correct and effective. The initial state and termination status have the character of good correlation between the transfer matrix and the results are**

more relatively reliable.
Keywords- discrete time system; distribution of electric powe; forecasting; Markov processe; mathematic; matrix; mode; photovoltaic power systems; probability; power generation

Research of Single-Phase Inverter for PV modules with MPPT

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Abstract—**In the real world, the AC load is more common than the DC load, so many PV power systems have an inverter. Although has various structure type inverters, but Speaking of the simulation research, single-phase inverters in all structures are the same. The stand-alone inverter model has established in this paper, the open-loop and close-loop simulation results are shown. The simulation results indicate that the capacitor value parallel PV has an important influence on MPP tracing precision. In order to reach high MPP tracing precision, small ripple peak amplitude on capacitor is necessary, and usually this means a capacitor with large capacitance. The expression of ripple peak amplitude on capacitor is derived.**
Keywords-Single-phase inverter; PV module; inverter model; P-V trajectory; simulation

Modeling for Two-stage Dish Concentrating Spectral Beam Splitting Photovoltaic/thermal System

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Abstract—**Detailed optical and electric models are presented to evaluate the performance of the two-stage dish concentrating spectral beam splitting photovoltaic/thermal (TDCS) system. It mainly consists of parabolic concentrator, spectral beam filter, heat receiver and the cell component. The beam filter coated**

with 38 layers is designed and manufactured. Three-dimensional optical model, considering the effect of solar intercept angle and tracking error, is developed using ray trace method. The spectral and spatial distribution of radiant intensity is investigated. The optical and splitting efficiency of the system at AM1.5 is 66.1% and 78%, alternatively. The total power generating efficiency of the system in theory is 18% with silicon solar cell with geometric concentration ratio 80. Beam splitting can reduce the solar cell temperature and increase concentration ratio together with photoelectric conversion efficiency.
***Index Terms*—PV system, dish concentrating solar system, spectral beam splitting technology, optical model**

Implementation of a Novel Fuzzy Controller for Grid-Connected Photovoltaic System

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***Abstract*—To meet the requirement of the output power of grid-connected photovoltaic (PV) power generation system□the inverter should be controlled according to the output power of PV arrays. In this paper proposed method of a novel fuzzy logic control for grid connected photovolatic system. The system composed of boost converter and a single-phase full-bridge inverter connected to utility grid. The system control is based on variable universe fuzzy logic to control MOSFET switch of boost converter and single phase full-bridge inverte for grid-connected. The novel fuzzy control is analyzed in detail, which can modify universe according to the change of inputs.The simulative results show the output power of PV inverter has good quality and can provide energy with low harmonics and high power factor.**
Keywords-solar energy□a novel fuzzy control□photovoltaic system□grid-connected

Simulation of Solar Power System of Building Vertical Photovoltaic Glazing

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***Abstract*—The experimental system of photovoltaic window generation was installed on the test chamber. The mathematic model of Photovoltaic module, used in an integrated building simulation tool ESP-r, was verified with the measured solar power. On the basis of the model validation, Photovoltaic window generation systems, used on façades of an office building located in Beijing, Shanghai and Hong Kong, were simulated, and the relationship between the electricity output and the vertical glazing azimuth and building site value was discussed.**
Keywords- simulation, solar power,building, photovoltaic Glazing

Numerical Simulation of Electric-Thermal Performance of A Solar Concentrating Photovoltaic/Thermal System

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Abstract-Combined photovoltaic/thermal system with Concentrator is an efficient way to convert more solar radiation into thermal and electric energy and make it in practicable. In this work, A single-pass photovoltaic/thermal solar system with three trough concentrators and fins is designed and its electric-thermal performance over arrange of operating conditions is analyzed. The steady state heat transfer models are developed for various components of the solar system. The effects of various important designing and operational parameters on the temperature distribution for mainly components, the thermal and electricity as well as system efficiency of the PV/T system are analyzed. The results show that the temperature of the air stream and solar cell increases with an increase in the length of the system. The thermal, electrical and system efficiency of the hybrid photovoltaic/thermal system increases with increasing the air mass flow rate, the length and the packing fraction of the system. The performance of the system with the CPC is more perfect than without. The results are valuable to design and operate this type of concentrating PV/T system.
Keywords-hybrid photovoltaic/thermal system; CPC; fins; thermal and electricity performance;

Design and Application of Off-grid Solar PV System in Inner Mongolia of China

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Abstract—**Utilization of off-grid solar PV system is one of the availability approaches that can provide electricity to these villages from the remote area. The successful application of offgrid solar PV system reached the electricity demand and improved the living condition of local people in the remote area in Inner Mongolia. According to design and application of offgrid solar PV system, valued experience was gotten for popularizing off-grid solar PV system in the remote area of Inner Mongolia, which played an important exemplary role for utilization of solar energy in future.**
Keywords-design; application; solar PV system

Integrated Control of Energy Management for Stand-alone PV System

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Abstract—**The operating characteristics of stand-alone PV system are analyzed in order to improve the efficiency of PV arrays and prolong battery life in this paper. The transition diagram of its various working states is also established. An energy management method that integrates maximum power tracking control, load power tracking control, fast charge with variable current and discharge control for battery is presented. Simulation results show that working states are reasonably switched according to the load and weather condition, and the operation status of battery is also improved. Thus the suggested control method is helpful to optimize stand-alone PV system operation.**
Keywords-stand-alone PV system; energy management; power control; battery; fast charge with variable current

Resonant Energy Transfer from Organics to Quantum Dots and Carrier Multiplication

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Abstract—**It was shown in the recent experiments that the hybrid organic/inorganic resonant structures**

could provide a flexible materials platform aimed at the design of novel light emitting devices. The applications of hybrid structures for photovoltaic solar cell can also be useful. We pay attention in this note that the resonant energy transfer in hybrid structure from the organic thin layer to the semiconductor nanostructures can drastically increase the intensity of the free carrier generation. To demonstrate this idea we use the results of recently published paper by Zhang et al. [1] demonstrating the highly efficient resonance energy transfer from J-aggregates layer to semiconductor nanocrystals. It is known that the semiconductor nanocrystals with small energy gap represent a promising route to increased solar conversion in single–junction photovoltaic cells. We argue that the using of nanocrystals with small energy gap in the hybrid organic/inorganic structures similar to create in [1] can increase tens times the total intensity of carrier multiplication. The organic part in such hybrid structures will play a role of the peculiar organic concentrator of the light energy.
Keywords: Excitons (Frenkel, Wannier-Mott), hybrid organic/ inorganic structures, J-aggregates, F鰎ster-like excitation transfer, carrier multiplication, solar cells

A PV Grid-Connected Inverter with Optimized AFD and MPPT Performance

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***Abstract*—Anti-islanding protection and maximum power point tracking for a two stage photovoltaic grid-connected inverter is designed in this paper. A new algorithm based on the traditional active frequency drift method is proposed to decrease none detection zone of the islanding detection. Perturbation and Observation method is adopted for the maximum power point tracking of the boost converter of the input stage. The stored energy in the filter capacitor changes under the voltage perturbation and it decreases the precision of MPPT. With stored energy change feed forward control, the precision of the MPPT method is improved.**
Keywords*—Photovoltaic Grid-Connected Inverter; Active Frequency Drift; Islanding Detection; Perturbation and Observation; Maximum Power Point Tracking.*

Maximum Power Point Tracking of Photovoltaic Generation Based on the Optimal Gradient Method

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***Abstract*—Photovoltaic (PV) power has been successfully applied for over three decades. PV cell provides power for systems in many applications on earth and space. PV cell exhibits nonlinear voltage-current characteristics and its maximum power point varies with solar illumination and ambient temperature. With the development of power electronics technology, it is now possible to operate photovoltaic system with its maximum power point (MPP) in order to increase the overall system efficiency. This paper presents a novel algorithm for maximum power point tracking in PV systems based on the optimal gradient method. The algorithm can track maximum power point quickly and accurately. In this paper, the method of optimal gradient for maximum power point tracking (MPPT) is deduced, and the algorithm has been verified based on simulation results in Matlab. The simulation shows the novel algorithm significantly improves the efficiency during the tracking phase compared with a conventional algorithm. The novel algorithm is especially suitable for fast changing environmental conditions. The proposed algorithm can be implemented on any fast controller such as the digital signal processor.**
Keywords-photovoltaic generation; maximum power point tracking (MPPT); the optimal gradient method; simulation

Photovoltaic Grid-connected Inverter Harmonic Compensation and Grid-connected Unified Control

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***Abstract*—On the basis of the research on grid-connected technology of distributed generation system, in order to extend the full advantage of single-phase photo voltaic grid-connected energy and gain rapid electric energy conversion and high quality electric energy and achieve accurate control and reactive power and harmonic compensation, a control scheme of grid-connected in conjunction with harmonics presented. Based on instantaneous reactive power theory, algorithms of current decoupling in the single-phase system are derived for performing the reactive power control of single-phase photovoltaic grid-connected inverter. The method proposed effectively solves the difficulties of the current detection in single-phase connection.**

The paper derives the algorithm and duty factor of pulse width modulation(PWM) and duty factor of grid-connected inverter. With this system used in the two grade single-phase photovoltaic grid-connected inverter, instantaneous harmonic and reactive current will be compensated and photovoltaic grid-connected system has the energy that take advantage of solar module rapidly. Power quality will be improved and the practicability of photovoltaic grid-connected system will also be enhanced. On the basis of analysis , a experiment prototype was excogitated. IN conclusion, not only the system has the function of supplying active power, but also can perform reactive power and harmonic compensation .It will be of great reliability and dynamic performance in the near future and the algorithm is very simple and easy to achieve.
Keywords: active power filter(APF); solar energy generation; instantaneous reactive power theory; photovoltaic grid-connected; harmonics detection

Fabrication and Luminescent Properties of Eu^{3+} Doped Lanthanide Oxide Nanowires and Nanotubes by Electrospinning

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***Abstract*— This paper described a novel approach for preparing singly-distributed 1D nanostructures of Y_2O_3, YVO_4 and YBO_3 doped with europium by electrospinning. The morphology and the crystal structure were investigated by SEM, TEM, and XRD. The luminescence properties of the 1D lanthanide oxide nanostructures were also** characterized. **These nanowires and nanotubes exhibited good** luminescent properties. **The fluorescence lifetimes $^5D_0$ level for Eu^{3+} in Y_2O_3:Eu nanowires and YVO_4:Eu nanowires and YBO_3:Eu nanotubes were determined to be 560 s and 493 s and** 1.63 ms, respectively. These **nanowires and nanotubes will be probably applicable to make** photovoltaic **devices, solar cell and other photoelectric devices.**
Keywords- Electrospinning; Luminescence; nanostructures

Design of PV Array Model Based On EMTDC/PSCAD

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***Abstract*-- Along with consuming of fossil energy step by step, crisis of energy has been appeared. The solar energy, which is endless, is a kind of renewable energy. Radiation of sun coming to earth in a day is equal to the energy, which is released by trillion buckets of oil. The research of solar energy generation has stepped into a very activity period. This paper analyses the physics characteristic of photovoltaic array firstly, then researches the mathematical model applying in engineering, and designs the total simulation model based on power electronic**

circuit in the end. In order to validate the correctness and validity, this paper makes a simulation as an example. The scheme can express the V-I characteristic of photovoltaic array very well.
Index Terms—photovoltaic array; model; PI tracing; simulation; EMTDC/PSCAD

Numerical simulation of the transient aerodynamic phenomena associated with a van running into a road tunnel

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***Abstract*—When a vehicle is driven into a road tunnel, the appearance of tunnel wall influences the flow field around the vehicle and generates additional aerodynamic forces acted on the vehicle, which may alter its road holding and thus result in safety problems. That is one of the reasons why road accidents are more liable to take place in tunnel. In this paper, dynamic mesh technique was adopted to realize the three-dimensional transient numerical simulation of a van running into a road tunnel, and then the aerodynamic forces acting on a van during the process of entering a road tunnel were investigated. The results show that the van's aerodynamic characteristics being in and out of the road tunnel are obviously different. The drag coefficient Cz in road tunnel increases more than 13% compared with out of tunnel, the lift force coefficient Cy also has a considerable increase of 50%, and side force coefficient Cx caused by unsymmetry distances from van side faces to tunnel wall changes slightly. During the process of the van running forwards, aerodynamic forces changes sharply near the entrance of the tunnel.**
Keywords-dynamic mesh technique; aerodynamic characteristics; transient; van; road tunnel

Wind turbulence characteristics analysis of Near Sea Area, Rudong, Jiangsu Province, China

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Abstract—**The wind characteristics of coastal area are analyzed with the whole year observations of 2005 at a wind observation tower locating at Rudong County, Jiangsu Province, China. In this area both turbulence intensity and gust factor vary with time, height and wind speed. Gust factor and turbulence intensity share a strong linear relationship. Turbulence intensity is of medium-level at low levels and decrease with height. Results in this paper can help selection and design of wind farm, wind generator selecting and safe production.**
Keywords: Turbulence intensity, Gust factor, Jiangsu coastal Area

The Assessment of Wind Energy on Complex Topography

Micro-Selecting Sites of Wind Farm on HAILING Island

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Abstract—**There are some areas which in abundant of wind power on the complex topography due to the specific topographic forcing. However, it is very difficult to select the sites of wind farms on the complex landform because the distribution characteristics of wind energy potential are asymmetric. The wind patterns on the Hailing Island, which as an example of complex landform, have been investigated using observational analysis, linear theory and non-linear numerical simulation. The results indicate that the location with higher wind speeds at 60m above the ground emerge on the south slope closing the peak of the Island A, on the peak of Island B, and on the south peaks of Island C and D.**
Keywords-wind energy; complex topography; assessment

A Novel Approach for Wind Speed Forecasting Based on EMD and Time-Series Analysis

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***Abstract*—Wind speed forecasting is significant to the security and stability of electric power system. Aiming to forecast wind speed more efficiently, a hybrid forecasting method based on empirical mode decomposition(EMD) and time-series analysis has been presented in this paper. Employing the EMD technique to decompose the original data into a residue and many intrinsic mode function(IMF) components, which represent the oscillation modes embedded in the data. Afterwards each IMF is modeled and forecasted using time-series analysis, so does the residue. The forecasting value for each decomposed component is summarized as that for the original data. A set of wind speed data from a given wind farm were modeled using the proposed method and the forecasted data were compared to those of measured wind speed as well as those calculated with other conventional methods. The results obtained indicate that the building model is simple and the forecasting precision has been greatly improved using the proposed method.**

Keywords-wind speed; forecasting; EMD; time-series analysis;

Sea Wind Power Energy Evaluation by HF Radar System

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***Abstract*—□This paper presents a remote sensing method for wind energy measurement and evaluation on**

sea surface, which can be used for the investigation of wind farm. It provides a valid proof for building wind plants or monitoring wind farms on the sea surface. The wind speed and direction can be derived from radar echo spectrum as well as wind profile, and it can cover a large area (thousands of square-kilometers) and measure wind simultaneously. It provides a real-time, all-weather remote sensing measurement and it is a new method for wind evaluation comparing to conventional methods.
Keywords- Ocean wind energy; Wind farm; HF radar system;

A New Calculation Model of Wind Power

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***Abstract*—Wind Power calculation is a key work in wind farm construction. At present, most company use WASP to evaluate the wind power. WASP is designed on the basis of European landform. In china, the landform is so complex that it is need to take a new calculation way to get a more practical result. Here weibull density function is regarded as wind frequency distribution and a simple generation calculation formula is deducted. Based on Chinese complex landform, a constraint condition is added to the calculation expression and a new feasible calculation model is given. VC++ and matlab are used to implement this calculation model. At last, Nordex N80 and N90 are took as an example to evaluate the wind power of an island. The result shows that the performance is better than WASP.**
Keywords- *Windfarm; Weilbull distribution; Wind speed frequence distribution,mixed programming*

Evaluation coupling Model of Mine Ventilation System Based on RS and ANN

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Abstract—***The broad masses of coal mining enterprises have been very concerned about how to effectively***

evaluate safety and reliability of mine ventilation system. Domestic and international scholars in this regard have also carried out a substantial amount of research and made a variety of different types of evaluation methods, but because there are many complex factors that affect the safety and reliability of mine ventilation system, it is very difficult to evaluate the ventilation system accurately using traditional methods. In view of this, this paper established an evaluation system based on rough sets and Artificial neural network theory(ANN), it can complete a multi-level and multifactor evaluation system and have self-learning capabilities. The coupling model is tested in actually projects, it shows that the model has a high accuracy, so that the model can be applied to the safety evaluation at the scene.
Keywords- mine ventilation system; evaluation; RS; ANN

Using the MM5 model for wind energy resources evaluation over a fuel-poor region, East China

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Abstract—**For the sake of wind energy exploitation, the Fifth Generation Mesoscale Model (MM5) has been applied to downscale 2.5° reanalysis data provided by the National Centers for Environmental Prediction (NCEP) and the National Center for Atmospheric Research (NCAR) onto a 3.3-km grid covering the fuel-poor Jiangsu Province for the three representative years, 1972, 1997, and 2000 respectively. The simulated 10-m above ground level (AGL) mean wind fields are compared with observations at 64 stations comprehensively, by using the analog deviation. This score shows that the simulated wind pattern agrees well with the observed. More local characteristics can be found in the high-resolution simulated wind atlas. The wind speed is higher along the eastern coast and around inland lakes, while lower in urban and mountainous areas. Wind energy calculations have shown that the vicinities of big water bodies, such as Luoma Lake, Hongze Lake, Gaoyou Lake, the mouth of the Yangtze River and Tai Lake, are regions with rich wind energy resources. The average wind power densities in these areas are above 140W/m2. The wind resources decrease steadily when moving away from the coast, and the wind power densities are between 80 and 90 W/m2. Mountainous and urban areas are short of wind energy resources. The average wind power densities in Zhangba Mountains and cities of Xuzhou, Huai'an and Nanjing are less than 60 W/m2. Moreover, it is indicated that there are significant seasonal variations in wind energy resources in Jiangsu Province. The wind power densities are larger in winter than in summer. The values in rich regions increase to 200 W/m2 at 30-m-AGL and 320 W/m2 at 60-m-AGL.**
Keywords-wind energy resrouces evaluation; MM5; dynamical downscaling; representative year; analog deviation

Long Term Dynamic Behavior Analysis for Power System Including Wind Farms

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***Abstract*—The increasing capacities of wind power bring a great influence on power system stability because wind power can produce in stochastic behaviors due to special fluctuant characteristics of natural wind. There is lack of research on longterm dynamic behavior simulation for power system including wind farms. This paper adopts mathematic dynamic model of induction wind generating set, and makes use of flexible selfadjustment method to analyze long term dynamic behavior for power system including wind farms under different wind condition and operating mode. Numerical example shows that flexible self-adjustment method is suitable for long term dynamic simulation of power system including wind farms, and also shows that random variations of wind power bring extra fluctuation to power system voltage, frequency and tie-line power.**

Keywords-power system; long term dynamic behavior; wind Farms

Aeroelastic Stability of Wind Turbine Blade Section Based on Beddoes-Leishman Model

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***Abstract*—In view of the computing complexity of aerodynamic coefficients and the complicacy of aeroelastic stability analysis for large wind turbine blade section of multiple DOF, the paper developed an**

approach of fitting aerodynamic coefficients to simplify aerodynamic forces computation, and to reduce order of nonlinear equation, so as to linearize and simplify aeroelastic stability analysis. The paper gave simplified aerodynamic model and simplified aerodynamic coefficients, and made stability analysis based on Beddoes-Leishman model. The analysis results are reaffirmed by another approach of system response. The fitting approach shows certain of reliability and can also be used for some other blade sections of NACA.
Keywords-aeroelastic stability; Beddoes-Leishman model; eigenvalue analysis; aerodynamic coefficients; wind turbine blade section

Wind Speed Prediction Using OLS Algorithm based on RBF Neural Network

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***Abstract*—The growing revolution in wind energy encourages more accurate models for wind speed forecasting as the wind is fluctuate, periodic and volatile. An artificial neural network (ANN) method is used to predict the average hourly wind speed. Different from the multilayer perception network (MLP) which is more conversant, this paper presents a novel technique based on Radial Basis Function (RBF) network using the orthogonal leastsquares (OLS) algorithm, and also discusses how to organize the inputs of the network. The results reveal the effectiveness and accuracy of the proposed new approach to forecasting. Furthermore, the future work perspective is present at the end of this paper.**
Keywords-Wind Speed Prediction; Radial Basis Function (RBF); Artificial Neural Network(ANN); orthogonal least-squares (OLS)

Comparison of wind energy integration into a 110kV and a 380kV transmission system - Impact on power quality of MV and LV networks

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***Abstract*— the amount of electrical energy produced by wind farms is constantly increasing. Nowadays detailed analyses considering the impact of wind energy integration on the transmission system are required. Therefore several wind impact studies have been carried out. The conclusions of these studies are related to different aspects of wind power, such as it's fluctuating nature, distributed location of wind farms, generator technologies, generator control etc. The goal of this study is to compare the power quality behavior of the MV and LV network in case of integration of different amounts of wind energy at different locations of the 110 kV and 380 kV transmission systems.**
Keywords-component; aggregated wind farms, 110 kV and 380 kV transmission system with MV and LV subsystems, power quality analysis, wind energy integration

Research on wind power generation application on the ships and offshore structures

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***Abstract*—Wind power energy is a renewable resource which is clean without pollution. The early research on wind power energy mainly focused on the on land utilization. The application on the sea is infrequent. Much less to find the application on the ships and offshore structures. Based on the fact that the energy crisis becomes more and more severe, this paper puts forward the idea to install wind power generation sets on the ships and offshore structures widely, and also gives the problems to be resolved and the solutions.**
Keywords-wind power energy, renewable resource, offshore structures, energy crisis

The fixed price model and applied analysis of reproducible energy sources' on-grid electrovalence

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Abstract—**The dissertation expounds questions such as basic principium of reproducible energy sources electrovalence mechanism, the effect of implement and applicability etc. based on the analysis of the overseas experience, at the same time, researches to set up the fixed price model of reproducible energy sources' on-grid electrovalence; Secondly, selects a example of a wind farm to carry out a analysis of demonstration, combining with the actual situation of China; Finally analyses the effect factors of electrovalence and the favorable measures that can be adopted under the existing policy frame**.

Key words: Renewable energy generation; Pricing model; Price factors*； *Empirical analysis

Research On Grid-connected Power Control for Double-fed Generator

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Abstract—**This paper first introduces the double-fed wind power generation system's basic theory, and builds the mathematical model of the double-fed generator in the rotary coordinate system. In order to deal with the strong coupling problems in motor control field, the motor vector control technology is researched**

and the idea of dual-fed generator stator-flux-oriented vector control strategy is presented by application of vector control. Based on that theory and the characteristics of double-fed generators' grid-connected power control, a dual-channel and double-loop control method with current inner-loop and power outer-loop is presented. In Matlab /Simulink environment, the simulation results show that the control strategy can achieve the decoupling of the active power and reactive power in double-fed power generation system.
key words□Wind energy generation; stator-flux-oriented control strategy; dual-channel and double-loop

State Space Averaging Modeling and Analysis of Disturbance Injection Method of MPPT for Small Wind Turbine Generating Systems

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***Abstract*—Based on a configuration with low cost and high reliability, disturbance injection method is employed to achieve the maximum power point tracking (MPPT) for the small wind turbine generating systems(SWTGS) in this paper. State space averaging method is used to model the whole system, and its nonlinear and linearization model are given. The choosing principle of two crucial parameters of disturbance magnitude d_m and angular frequency are proposed by the frequency response analysis of the system. Experiment results show that the modeling of SWTGS and theoretical analysis of disturbance injection method of MPPT are correct and practical. Results obtained in the paper lay the foundation for the application of disturbance injection method of MPPT to SWTGS, and have theoretical significance and practical value in engineering.**
Keywords-disturbance injection method; maximum power point tracking(MPPT); small wind turbine generating systems (SWTGS); state space averaging modeling

Dynamic Responses of DFIG Fault Currents Under Constant AC Exitation

Condition

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***Abstract*—In wind power system, the fault ride-through capability of doubly fed induction generators (DFIG) has become the focus of study. The analysis and calculation of fault currents are of important directive significance for implementing DFIG fault ride-through. This paper analyzes dynamic responses of DFIG stator and rotor currents when three phase short circuit occurs at stator terminal, and also proposes a new approach, which transfers DFIG into an induction machine with rotor excitation and an idle squirrel-cage induction machine, to calculate the fault currents. The rotor excited induction machine and idle squirrel-cage machine respectively represent the particular solution and general solution of DFIG differential equations in physical meaning. Furthermore, main components of short-circuit currents as well as their relations are presented. The stator and rotor currents contain $_s$ component and s $_s$ component respectively, which relate to steady state, and both comprise DC component and (1-s) $_s$ component, which relate to transient state. The maximum rotor and stator short-circuit currents as well as the times when they appear are derived in this paper. Finally all above results are validated in Matlab/Simulink.**

Keywords-wind generation; doubly fed induction generator; short-circuit current; fault ride-through

Sliding Mode MPPT Control of Variable Speed Wind Power System

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***Abstract*—The paper analyses the wind turbine characteristics and doubly-fed induction generator (DFIG) stator magnetic field orientation vector control principle, realizes DFIG active power and reactive power decoupling control. After the decoupling, the paper adopts sliding mode(SMC) control theory, proposes a control strategy to track the maximum wind energy. The method can increase the system robustness and realizes VSCF control and MPPT tracking control. The method improves the system fast tracking, stability, and makes wind power generation system capture more wind energy. Finally, the simulation results of controller verify the accuracy and effectiveness of the control strategy proposed in this paper.**

Keywords-DFIG; power decoupling; MPPT; SMC control

Experimental Research on Vertical Axis Wind Turbine

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***Abstract*—In China, researches on vertical axis wind turbine focus on aerodynamic design mostly. This paper presents the wind tunnel test data of a Darrieus wind turbine. The output powers of wind turbine systems with and without optimal power controller are tested separately. The factors influencing the output power of the wind turbine are analyzed and design methods for wind turbine with high efficiency are proposed through the optimal matching of rotor and generator.**

Keywords-Vertical axis wind turbine; Matching of rotor and generator; Optimal power controlling

Low Voltage Ride-through of Directly Driven Wind Turbine with Permanent Magnet Synchronous Generator

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***Abstract*—A model of the directly driven wind turbine with permanent magnet synchronous generator (D-PMSG) was described in this paper. The D-PMSG was connected to a host AC power grid by a full scale power converter system which comprised two back-to-back PWM voltage source converters (VSCs) and a common DC-link. Active and reactive power of the two VSCs were controlled independently by employing PI current controllers with cross-coupling decoupling. In order to enhance its capability of low voltage ride-through (LVRT), the control strategy was proposed, the generator power was reduced according to the ratio of actual and rated grid voltage when the power characteristic of windmill was analyzed. Simulation results show that during voltage dip the proposed strategy can limit DC voltage and the rotational speed to their reference values, respectively, by adjusting the power of the generator and the pitch angle of the windmill, and supply reactive power for the grid.**

Keywords- Directly Driven Wind Turbine, Permanent Magnet Synchronous Generator(PMSG), Voltage Dip, Low Voltage Ridethrough, Reactive Compensation

The Design of Automatic Control System for Wind Turbine

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***Abstract*—According to the special form and structure of concentrated wind energy turbine, and based on the idea of largely use of wind energy, the author designed an automatic control system, which can control the wind facing of wind turbine and change blades' pitch angle. Under the control this system, the concentrated wind energy turbine can not only meet the demand of wind facing under normal conditions, but also work normally when the wind speed become bigger than maximum permissible wind speed of common concentrated wind energy turbine. So the utilization efficiency of the concentrated wind energy turbine can been enhanced.**

Keywords- concentrated wind energy turbine; MCU; facing wind control; pitch angle

Equipment utilizing automobile wind pressure energy

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***Abstract*—In the process of automobile driving, the carbody withstands great inflow pressure; if the pressure energy is used, it will create a new way for energy utilizing. In this paper, the equipment utilizing wind pressure is designed which composed of the device collecting energy of wind pressure, the generator, the commutating and rectifying steadying voltage circuit. By the power of wind pressure, the equipment produces the torque driving the generator; and the electrical energy is generated and supplied to the electric appliance and the battery on the automobile; thus it doesn't consume other energy including the power of automobile. In designing, the S wind wheel has been boldly selected because of its low power factor, moreover two groups of wind wheels are used simultaneously to drive one generator, and its structure is designed to be more reasonable, simple, and easy to be realized..**
Keywords- automobile wind pressure energy, generator with horizontal shaft, wind pressure energy collect

FPGA Based Multiplex PWM Generator for Multilevel Converters applied wind power generator

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Abstract—**With the direct-drive wind power system, full-power converter technology has been developed and applied. However, most of wind generators operate at rated voltage of 690V in wind field at present while direct-drive power system needs the fullscale power converter. For the high-power output, power devices must support higher current. Before the breakthrough of the present level of the current rating, multi converters can meet the low-voltage, high-current condition under the parallel operation. In full-scale power converters of direct-drive wind power system, we combine carrier phase shifted technique and parallel converters successfully, and realize the normal operation in low frequency.More and more multilevel converter used in the larger wind power plant. With the development of multilevel converter , multi-pulse generator is needed. In this paper, a twelve-pair PWM generator based on FPGA is designed for three-phase voltage source 5-level inverters. Carrier phase shifted SPWM (CPS-SPWM) is applied as switch modulation strategy. CPSSPWM can achieve a high equivalent switching frequency effect at rather low real**

device switching frequency, which is very suitable for high power equipments. A three-phase voltage source 5-level cascade inverters prototype is accomplished by this twelve-pair PWM generator. The experimental results verify the correctness of the design. Other modulation strategies, such as multilevel space vector modulation and sample time staggered space vector modulation, can also be accomplished by FPGA. This is of much significance to the further application of multimodular converters and multilevel converters.
Keywords-wind powe;high power;multilevel;PWM,Converter

Direct-drive wind power generator system based on Interleaved Boost converter

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***Abstract*—Direct-drive wind power generator has been receiving increasing attention due to their inherent efficiency. By eliminating the need for a gearbox between the wind turbine and generator, these systems are less expensive and also require less maintenance. This paper outlined a procedure of adapting a small, standard, readily available PM synchronous machine for direct coupling to a small wind turbine. This was achieved through a two-cell interleaved Boost converter (IBC), which is composed of several identical Boost converters connected in parallel. The converters are controlled by interleaved switching signals, which have the same switching frequency and the same phase shift. By virtue of paralleling the converters, the input current can be shared among the cells or phases, so that high reliability and efficiency in power electronic systems can be obtained. In addition, it is possible to improve the system characteristics such as maintenance, repair, fault tolerance, and low heat dissipation. Moreover, the overall performance of the compromised design was shown to be quite good. All this was verified by simulation and experiment.**
Keywords- direct-drive; wind power generator; gearbox;interleaved boost converter (IBC); sharing current

Comparison of Voltage Sag Generators for Wind Power System

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***Abstract*—Low voltage ride through (LVRT) capability is required by new power system operating codes, then voltage sag generator (VSG) is generally used to simulate different voltage sag faults. The work principles of transformer and bidirectional switches based VSG and full-power converter based VSG are explained and discussed, the former can choose relay, thyristor or IGBT as bidirectional switches, and the comparison research of several VSG solutions is carried out by analysis and experiment. The experiment results make out that the full-power converter based VSG is powerful but its control is complex; the transformer and bidirectional switches based VSG has simple structure and high reliability, can simulate various types of voltage sag faults, and the voltage transition between normal and fault operation is smooth, then provide favorable conditions to verify the LVRT capability of wind power system.**
Keywords-wind power system; low voltage ride through (LVRT); voltage sags; voltage sag generator (VSG); autotransformer; bidirectional switches; full-power converter

Analysis on stability of integration of wind farms into power systems

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***Abstract*—By case study, an in-depth study on the characteristic of transient stability is made when wind farms are connected to the power grid. Combined with the transient characteristics of wind turbine, the impacts on the power system and wind turbine have been studied when the three short-circuit fault occurring in the power grid. The different impacts on the stability of power system and the bus voltage are analyzed and compared on condition that different capacity of wind farms are connected at the same point of the power grid, as well as the varying degrees of influence when wind farm connected at different points. The impact of the bus voltage is studied when the access point between the wind farm and power grid broke down. Under the premise of guaranteeing the safety of static binding of the power grid and dynamic security requirements of large disturbance cases, it will provide the basis of the best wind power capacity connected to the power grid.**
Key words- Power system, Transient stability, Wind power generation, Wind turbine

Research on Sensorless Control based Back-to-back Converter for Direct-driven WECS

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***Abstract*—The development of back-to-back full power converter based direct-driven wind energy conversion system (WECS) using permanent magnet synchronous generator (PMSG) is very fast, and the sensorless control applied in WECS has been paid much attention for its low cost, high reliability and good capability to interference and poor environment compared with conventional encoder. Based on analysis to the principle of backto- back converter for direct-driven VSCF WECS, the PLL based sensorless control strategy is adopted to determine the speed and phase of the PMSG. The experimental results prove that the back-to-back converter using sensorless control based on PLL has good performance. Therefore the validity of the proposed strategy is verified, which illustrate that the conventional encoder can be substituted by sensorless control for direct-driven WECS.**
Keywords-direct-driven wind energy conversion system; permanent magnet synchronous generator; sensorless control; back-to-back converter; PLL

Power Control Strategy Investigation on Small-Scale Wind Turbine

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***Abstract*—The curve of power-rev of wind turbine is divided three parts, which is before-peak peak value and behind-peak . Through the research of the power match of wind turbine and generator, a new strategy based on the controlling power for the wind turbine was proposed .The new strategy is validated by designs and experiments of the 300W wind turbine.**
Keywords- wind turbine; match characteristic ; power control

Competitiveness Analysis for China's Wind Power Industry: Based on a Dynamic Diamond Model

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***Abstract*—Nowadays, power generation from renewable energy has been more concerned, and it represents the future development of the electrical industry. As a newly developed sector with large resource potential and good commercial prospects, China's wind power industry is blowing past expectations. By 2007, China has been the fifth largest producer of wind power in the world. However, there is still a gap with foreign leading countries in many aspects. This paper is to analyze the competitiveness of China's wind power industry based on an improved Dynamic Diamond Model. The better solution on how to integrate and take advantage of the elements included in the model would be feasible to strengthen the wind power industry.**
Keywords-wind power; competitiveness; Dynamic Diamond Model

Navier-Stocks Computations of Wind-Turbine Airfoil using Low Mach Number Preconditioning

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Abstract**—***Wind turbine airfoil is numerical simulated by using the governing equations of compressible fluids in this paper. The Reynolds Averaged Navier-Stocks computations are combined with low Mach preconditioning and implicit matrix-free Lower-Upper Symmetric Gauss-Seidel(LUSGS) iteration on unstructured meshes□ and the results are improved at the very low velocity speeds which are representative of the flow field around a wind turbine airfoil. Detailed LUSGS algorithm with preconditioning is present in this paper, which is improved to cost less data storage and computational time for steady flow. The steady and unsteady characteristics of static 2D-S809 airfoil are analyzed by the numerical results and compared between calculations and tests. Aerodynamic coefficients have been got using the algorithm of this work at all angles of attack. The unsteadiness induced separation bubble shedding has been captured by this method finally.*
Keywords: wind turbine airfoil; preconditioning; unsteady flow; LUSGS

Modal Analysis Comparison of Beam and Shell Models for Composite Blades

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***Abstract*—The composite blades of wind turbines are made up of composite shell components. However, blades are often simplified as Eulerian beam in finite element analysis. In design both special and general purpose finite element codes are used worldwide. The verification of a special finite element code BModes vs. a popular general purpose finite element code ANSYS are performed via a uniform blade in both still and spinning cases in this paper. The test reveals that general finite element codes like ANSYS might overestimate the lag frequencies in spinning case. After verification of beam model, the approach is applied to complete the modal analysis of a practical wind turbine blade. The results are compared with a known shell model from literature. The comparison validates the simplified Eulerian beam model. Finally a guideline of usage for these two models is given.**
Keywords-modal analysis; wind turbine blade; beam model; shell model

A Novel Control Strategy for DFIG based on Magnitude and Frequency of Rotor Voltage for Wind Power Generation

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***Abstract*— A magnitude and frequency control (MFC) strategy has been proposed for a doubly fed induction generator (DFIG). The proposed MFC is to make the DFIG equivalent to a synchronous generator in power system. It is found that the stator active and reactive powers depend on the phase and magnitude of the internal transient electro-magnetic field (EMF). The relationship between the rotor voltage and the internal transient EMF is also described. Unlike traditional control strategies such as stator-flux-orientation vector control and FMAC, the proposed MFC method manipulates the magnitude and frequency of the rotor voltage which can simplify the control system design and improve system reliability. Thus, complex coordinate transforms, rotor position detection, and rotor currents are not required in the proposed MFC for the DFIG control system. Furthermore, the rotor speed signal is also not required in the proposed MFC, but it is needed for MPPT. Simulation results are provided to demonstrate the correctness of the control scheme.**
***Index Terms*--doubly-fed induction generator (DFIG) control, magnitude and frequency control, synchronized model, wind turbine**

Life Cycle Analysis on Economic Operation of Wind Farm

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Abstract—**With the development of wind industry, influencing factors for economic operation of wind farm is attracting more and more attention. The internal and external factors during wind farm's life cycle are discussed. For external factors, wind electricity price, taxes, repayment load, tempo of wind power industry are analyzed; as to internal factors, evaluation of wind resource, site selection, feasibility study, project bidding, project design of wind farm, design and manufacture of wind power equipments, construction, operation and maintenance of wind farm are analyzed in this paper. According to the analysis, we can obtain the conclusion: the external factor, i.e. wind electricity price, taxes, repayment load, tempo of wind industry leave little selection room for wind power enterprise, as to internal factors, wind resource is the precondition, design and manufacture of wind power equipments, design and construction of wind farm are the pledge, operation and maintenance is the last stage but not the least important stage to achieve economic benefit.**
Keywords-wind farm; economic operation; life cycle

Buckling Analysis of Wind Turbine Blade Using Pressure Distributions Obtained from CFD

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Abstract—**Buckling analysis of a rotating wind turbine blade using FEM(finite element method) is presented here. This study is distinct from its counterparts in adopting the pressure distributions obtained from CFD(Computational Fluid Dynamics) calculations to perform the buckling analysis. A code is developed to feed those pressure distributions into the FE(finite element) model of the blade. Through the analysis, load factors and buckling shapes of the first four buckling modes of the blade under six different wind speeds are computed. Buckling analysis of the blade with the reduced pressure distributions adopted in an open literature has also been performed in this paper and the results are compared with present analysis. It is concluded that CFD techniques can effectively predict the load characteristics of wind turbines and it is reasonable to employ pressure distributions obtained from CFD calculations as load conditions to perform buckling analysis or other structural analysis of wind turbine blades, while the reduced pressure distributions can not reflect the inherent stall phenomena because of its artificial assumptions and it should be abandoned in the design of future wind turbines.**
Keywords-wind turbine blade; buckling analysis; CFD calculation; finite element method.

Application of the Value Analysis Method on Economic Operation Evaluation of Wind Farm

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Abstract□□Because the management of wind farm is complex, any single evaluation index can not synthetically and objectively evaluate the economic performance of wind farm's operation. This paper proposes to adopt the value analysis method to synthetically evaluate the economic performance of wind farm's operation. Using this method, we can synthetically evaluate main part of the economic performance of wind farm's operation, such as power generation circumstances, power using circumstances, loss circumstances and reactive loss circumstances.

Keywords□wind power generation; wind farm; evaluation index; value analysis.

A Novel Maximum Wind Power Capture Strategy For The Doubly-Fed Induction Generator

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***Abstract*—The doubly-fed induction wind power generator is composed of mechanical and electric subsystems which have different time-scales□so the subsystem control strategy can be designed individually. Because the pneumatic power is difficult to measure directly, the real-time estimation is done based on the extended state theory. Then the maximum power capture strategy is designed for the mechanical subsystem. According to the intrinsic electric characteristics of the doubly-fed induction generator, the power decoupling control for the electric subsystem is realized by the lyapunov stability theory. The model of the doubly-fed induction wind power generator with two control loops is established. Simulation results prove the effectiveness of the control strategy which is simple and fit to the engineering application.**

Keywords-wind power; doubly-fed induction generator; maximum wind power capture; decoupling control

Predicting Wind Farm Electricity Output

A Neural Network Empirical Modeling Approach

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***Abstract*—Wind energy is rapidly emerging as a substantial contributor to the electricity generation capacity of utilities around the world. While the use of wind power both adds to the electricity supply and offers significant environmental benefits as a renewable source of energy, the stochastic nature of forces that produce wind energy prevents relying on it to meet base load requirements. Intermittent availability also presents stability and control issues which grid operators must address before the potential benefits of wind energy can be fully realized. A fundamental requirement for successful control strategies is an accurate short-term prediction of wind farm output. Over the longer term output predictions also provide the foundation for revenue forecasts critical to enterprise operations. Inherent variability in key inputs suggests the use of empirical models. Neural networks comprise a collection of algorithms that yield robust empirical models. A neural network engine that incorporates a genetic algorithm for variable selection and employs cascade correlation to dynamically define the neural network architecture is introduced. Preliminary results obtained from prediction models for an operating wind farm are presented, along with directions for future work.**
Keywords-wind energy; energy forecasting; neural networks

STATCOM's Effects on Stability Improvement of Induction Generator based Wind Turbine Systems

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***Abstract*— Large number of wind turbines are being installed and connected to power systems. In some countries or networks, the penetration level of wind power is significant high so as to affect the power system operation and control. Consequently, the stable operation of wind turbine systems is very important for power system stability. This paper studies the effect of STATCOM on stability improvement of a wind**

turbine system. The function of the STATCOM in improving the system stability has been demonstrated.
Keywords- wind turbine, induction generator, STATCOM, power system stability

Development of Small Wind Generator Based on Hybrid Magnetic Bearing

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***Abstract*—In the world, there exists a lot of wind energy, so through wind generator the energy crisis can be partly solved. In the traditional wind generator, the mechanical frictional resistance is too big, as the wind speed in the city is not so high, usually it can't start up when the wind speed is not big enough. Hybrid magnetic bearing has the features of no mechanical contact, no friction etc. minimizing the damping in the small wind generator based on hybrid magnetic bearing (HMB), which enables the wind generator start up with low speed wind and work with breeze. This paper introduces structure and principle of the proposed hybrid magnetic bearing of small wind genrator. The geometric parameters are optimized using FEM analysis. The system dynamic analysis is performed. The modeling and implementation of an axial position controller is presented, the simulation results show stable levitation and good levitated rotation.**
Keywords- Small Wind Generator; Hybrid Magnetic Bearing; FEM; Rotor Dyanamic

A New Wind/Photovoltaic Hybrid Power Generator

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***Abstract*—A new kind of wind/photovoltaic(PV) hybrid generator was designed for effectively and reliably utilizing the renewable resources. It was designed to be an auto-interference controller. To capture the wind**

and the light in the greatest degree, the method of nonlinear transform of aerodynamic force was used, as well as the theory of brushless double-fed wind generator and the principle of extremum control on solar inverter were adopted. The hierarchical fuzzy controller algorithm was presented for controlling the loading and unloading of wind generators, solar cells and the grid, considering the multi-input and multi-output of the distributed hybrid power system. It's shown by the simulations that: on the premise of utilizing renewable resources to the greatest extent, system can realize the equilibrium between the supply and demand of the electric energy automatically according to its load.
Keywords—*wind power; photovoltaic power; hybrid power system; generator; optimization algorithm; fuzzy control*

The Impact of SCIG Wind Farm Connecting into a Distribution System

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Abstract- Increasing capacity of connected wind power generation to utilities brings new opportunities and also problems to the utilities and customers. Evolution and analyzing of the connection conditions and effects of wind farms especially on remote areas are the main aspects of developing wind power on the utilities, because the impact will be more serious. The problem is that these wind turbine that mostly uses induction generators, tend to drain large amounts of VArs from the grid, potentially causing low voltage and maybe voltage stability problems for the utility owner, especially in the case of large load variation on distribution feeder. Focus on researching and discussing the impact ahead of time, and find the way out to supply higher power quality, this paper chooses Matlab/Simulink as analyzing tool, and uses SCIG model of asynchronous generator and a 33-bus distribution system of Tai-Power Company for simulation. Case study includes choosing different connected location and installed capacity of wind generators (WGs) and adopting fixed capacitors, SVC and STATCOM, respectively, for compensation to observe the influence on the moment of the wind generator connected and the period of the wind speed variation. Finally, from the simulation results, some discussions and suggestions are proposed for utilities in this paper.
Keywords**:** Renewable Energy, Wind Generation, System Impact, FACTS, SVC, STATCOM

A New Super-Productive VAWT

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Abstract**—This paper introduces the GWIT EHD VAWT and the logic and history behind its development. We develop a simplified model to compare the performance of EHD VAWTs with conventional propeller**

machines. GWIT is engaged on a path to optimize the performance of its wind turbines in a wind farm setting. The paper details the characteristics of its first two prototypes – JJ and JJ3. The turbines are designed to meet the atmospheric conditions prevailing in China. While the EHD VAWT concept can be implemented in many configurations, GWIT has developed its turbines to operate over the broadest possible atmospheric conditions with an absolute minimum of moving mechanical components. We focus on turbine designs that more than double energy capture from the wind site. More than 90% of the turbine's content is of local manufacture.

An Economic Analysis of Wind Energy Harvest

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***Abstract*—In this paper we develop a novel approach that simultaneously optimizes a wind farm and its financing for an improved economic analysis of wind energy projects. In our analysis we compare the energy yield of optimal wind energy projects with different turbine technologies under varying electricity price and wind speed scenarios. We perform extensive simulation studies and build statistical confidence intervals for the annual energy yield as well as the project's net present value at risk. The proposed approach eliminates the need for a trialand- error financial feasibility study and, consequently, improves the harvest of the wind energy.**

Impact of Fault and its Effect on Reactive Power in Power Evacuation from Wind Turbines

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***Abstract*- Application of Distributed Generation (DG) to supply the demands of a diverse customer base plays a vital role in the renewable energy environment. Various DG technologies are being integrated into power systems to provide alternatives to energy sources and to improve reliability of the system. Power Evacuation from these remotely located DG's remains a major concern for the power utilities these days. The main cause of concern regarding evacuation is consumption of reactive power for excitation by Induction Generators (IG) used in wind power production which affects the power system in variety of ways. This paper deals with the issues related to reactive power consumption by Induction generators during power evacuation. A Wind farm is modeled and simulations are carried out for studying the various impacts it has on the grid & nearby Wind Turbines during system event especially on 3-Phase to ground Fault.**

Keywords: Distributed Generation, Wind Turbine, Grid, Induction Generator Point of Common Connection, 3 Phase to Ground Fault.

NUMERICAL SIMULATION OF SURFACE ROUGHNESS EFFECT ON WIND TURBINE THICK AIRFOILS

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Abstract: *The full two-dimensional Navier–Stokes algorithm and the* k-ω *SST turbulence model were used to investigate incompressible viscous flow past the wind turbine two-dimensional airfoils under clean and roughness surface conditions. The NACA 63-430 airfoil is chosen to be the subject, which is widely used in wind turbine airfoil and generally located at mid-span of the blade with thickness to chord length ratio of about 0.3. The numerical simulation of the airfoil under clean surface condition was done. As a result, the numerical results had a good consistency with the experimental data. The wind turbine blade surface dust accumulation according to the operation periods in natural environment was taken into consideration. Then, the lift coefficients and the drag coefficients of NACA 63-430 airfoil were computed under different roughness heights. The role that roughness plays in promoting premature transition to turbulence and flow separation has been verified by the numerical results. The trend of the lift coefficients and the drag coefficients with the roughness increasing was obtained, and*

the critical value of roughness height was proposed. Furthermore, the effect of the different roughness locations on the performance of NACA 63-430 airfoil was studied, and the critical value of roughness location was proposed.
Keywords: NACA 63-430 ***airfois, lift coefficient, drag coefficient, roughness height, roughness location***

DSP-based doubly fed induction generator test bench using a back-to-back PWM converter

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Abstract:-Present Paper describes the design of a doubly fed induction generator (DFIG) test bench with active crowbar, using a PWM voltage-fed inverters connected between the grid and the rotor. A vector control scheme is proposed in order to control the power-side and the rotorside of the converter. A control board, based on a digital signal processor (DSP) and a FPGA, has been developed to manage the overall equipment. Real time system supervision is implemented by a monitor program.

Improving a composite wind turbine blade considering minimizing the prospect of flutter with the method of modal analysis technique

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Abstract—A preliminary method has been provided in designing composite blades, with requirement to meet the ultimate- and buckling-strength criteria. This method lies in examining the sections alone and focuses on getting the number of plies required to meet the criteria mentioned before. In recent years, with the concept of load alleviation and twist-coupled, the coupling between degrees of freedom, such as flapwise bending and twist, has become a matter of importance to modern twist-coupled blades. Attempts at capturing the mechanical properties and dynamic behaviors by inspecting the sections alone will inevitably neglect important threedimensional effect such as warping and shear deformation. In this situation, dynamic behavior will not be correctly predicted. In this paper, a blade built with the preliminary method was rebuilt by Ansys. As one of Modes-coupled instabilities, Pitch-flap flutter was considered for improving the blade to behave a more stable property with the method of modal analysis. We focused on the ratio of the blade's 1st torsional to 2nd flap-wise natural frequency, due to it's especially significance to minimize the prospect of flutter. Two different ways

(sweep the blade along the span or named 'presweep' and change the direction of primary load-bearing fibers) implemented for a passively adaptive blade design was also studied here for their Modal Characteristics. Additional studies are performed for blades to have some degree of 'pre-curve' to increase the blade-tower clearance. This study will focus on determine these parameters' sensitivity to this ratio, which have a significant meaning to design a twist-coupled (adaptive) blade.
Keywords- composite blades; flutter; modal analysis

Control of Brushless Doubly-fed Machine for Wind Power Generation Based on Two-stage matrix converter

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***Abstract*—This paper analyses the rotor speed d-q mathematical model for brushless doubly-fed machine (BDFM). Applying stator flux-oriented vector control technology based on double synchronous reference frame, and adopting maximal wind energy capturing mechanism, the simulation model of BDFM wind generation system is obtained. To optimize the control scheme of the converter for the system, a voltage and current double closed-loop control method for two-stage matrix converter is presented in the paper. Simulation results verify the validity of the model and proposed control schemes.**
Keywords- wind power generation; brushless doubly-fed machine; maximal wind energy capture; two-stage matrix converte.

Power Dispatch Strategy for Wind Farm Based on Virtual Market

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***Abstract*—In this paper, we propose a decentralized control strategy to dispatch and control the output power for wind farm. In this strategy, the power control system is supposed to operate as a virtual market place. Every wind generator is treated as a buyer agent or a seller agent. The buyer and seller agents cooperate and compete to process transactions for setting value of power, The market place manager acts as a facilitator by giving necessary information to agents and managing communication between agents, and also as a mediator by proposing solutions to agents or stopping them to get into infinite loops bargaining back and forth. The aim of this work is reduce output power variation and balance the generator fatigue index by using the decentralized control scheme. Simulations demonstrate the effectiveness of the scheme.**
***Index Terms*—Virtual market place, multi objective optimization, fatigue index, power dispatch.**

Dynamic Characteristics Analysis of DFIG Based on IMC

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***Abstract*—A detailed mathematical model of doubly-fed induction generator (DFIG) is derived according to generator convention. A novel S-Function is proposed to describe the mathematical model of DFIG. The simulation subsystems of noload operation and generator operation are developed based on state equations. The control of the rotor current inner loop and the rotating speed outer loop are designed based on internal model control (IMC) strategies, respectively. A full variablespeed constant-frequency (VSCF) DFIG wind power generation system model is developed based on MATLAB. The dynamic response of an 850kw for grid connection system under rotating speed variation and large three-phase disturbance conditions is studied. The results reveal that the proposed simulation model is effective in regulating rotational speed and dynamic response under various run conditions.**
Keywords- internal model control (IMC); doubly-fed induction generator (DFIG); simulation; S-Function

Wind Farm Stabilization with

Dual-purpose Doubly-Fed Asynchronous Machine

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***Abstract*—This paper investigates the function of proposed dualpurpose DASM (Doubly-fed ASynchronous Machine) with emphasis placed on its ability to the maximum power tracking and to the stabilization of the power system including IG wind generators. P(active power) and Q(reactive power) compensation from DASM can be regulated independently through secondary-excitation controlling. Simulation results by PSCAD show that DASM can restore the wind-generator system to a normal operating condition rapidly even following severe transmission-line failures. Comparison studies have also been performed between IG-alone wind farm and proposed system.**

Keywords- *Wind Farm Stabilization, Dual-purpose Doubly-Fed Asynchronous Machine , PSCAD/EMTDC*

The Research on the Characteristic of Fault Current of Doubly-Fed Induction Generator

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***Abstract*- Recent years, more and more wind power plants with the doubly-fed induct generation (DFIG) are built in China. With the development of the distributed sources, it was critical to present the new protection schemes and the key point is understands the characteristics of DFIG fault current. Because the complex in the generator's structure, the related references about this topic were relatively less. The DFIG generator has a three-phase wound rotor, which was supplied by a pulse width modulation (PWM) converter. When a fault occurs, the transient process was not only determined by machine itself but also the outer exciting system. So the waveform of fault current has variety. Only use the theory analysis was hard to describe the characteristic of fault current. The author adopt the simulation method combined theoretical analysis to investigate short-circuits current. In order to delineate various waveforms of current accurately, the emphasis lay on building the whole system model completely and precisely. This paper first analyzed the component of fault current in theory, and then built the specific model of rotor side exciting PI controllers and the active crowbar protections. Based on the various fault current waveforms, the characteristic of fault current were presented at last.**

Key words: Wind power, DFIG, fault current, crowbar protection

Effect of Wind Farm Based-on Wound Rotor Induction Generator on Transient Characteristics of Transmission Grid

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***Abstract*-With rapid development of wind power generation, large capacity wind farms are connected into the transmission system. Comparing with traditional power plant, the transient characteristics of transmission grid including wind farm are worthy investigating. The wind farm based-on wound rotor induction generators (WRIGs) shares high market occupancy in China, but academic researches on this grid-connected wind generation are few. So in this paper, the transient characteristics of the power system, adding a WRIGs wind farm and adding a traditional power plant, are compared. Effect of a WRIGs wind farm on transient performances of transmission grid is discussed. And the control effect on transient stability, when the WRIGs wind farm participating in system control during system fault, is investigated. Finally, simulation results are validated by using CIGREB4-39 grid. It is concluded that the transient□performance of WRIGs wind farm is better than that of traditional power plant.**

Keywords-wind farm; wound rotor induction generator; transient characteristics; transmission grid; traditional power plant

Design of DC Architecture for Large-Scale Non-Grid-Connected Wind Power Generation System

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***Abstract*—In this paper, a dc architecture for large-scale nongrid- connected wind power generation system (WPGS) is presented. Unlike the existed wind farms, the proposed structure has the merits of eliminated reactive power, low power loss, long transfer distance, and etc. With the purpose to overcome the effects of integrating large wind power plants into utility systems, a creative concept of direct integration of high energy consumption industry (HECI) with large scale WPGS where the fluctuant power or whole power is consumed by the HECI. A three-phase full-bridge high power step-up dc/dc converter is adopted to meet**

the implementation of the system. Compared to the traditional single-phase full-bridge dc/dc converter, the presented converter features strong power management ability, high efficiency and flexible transformer design. With proper control strategy, both of the voltage level before and after the dc transformer can be stabilized with a closed-loop converter located at the receiving-end of the transmission system. Finally, a 200MW wind farm is simulated with the proposed dc architecture. The results verify the feasibility of the presented WPCS and system control method.
Keywords-DC architecture, high energy consumptive industry, three-phase dc/dc converter, Rotor speed feedback control, Largescale non-grid-connected wind power

Hydraulic Turbines Vibration Fault Diagnosis by RBF Neural Network Based On Particle Swarm Optimization

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***Abstract*—For the system of vibration faults diagnosis of hydraulic turbines, the deficiency of generalization ability using single BP Network is analyzed and a Radial Basis Function (RBF) Neural Network algorithm based on Particle Swarm Optimization (PSO) is presented. It has advantage of being easy to realize, simple operation and profound intelligence background. The Parameters and Connection Weight are optimized by the algorithm. The diagnostic results of the instance show that it has better classifying results, higher precision, faster convergence and it provides a new way in the field of fault diagnosis of hydraulic turbines.**
Keywords- hydraulic turbines; vibration faults diagnosis; PSO; Neural Network

Classification of Database for Dam Safety Monitoring System

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***Abstract*—Aiming at the defects & deficiencies existed commonly in the database of dam safety monitoring system used currently such as large data redundancy, bad data consistent, having many difficulties in managing various monitoring data & supporting effectively dam safety monitoring system's successfully running and unsuitable for update & transform, various information, included in the database of dam**

safety monitoring system, are discussed further and classified in detail in this paper from the view of hydraulic structure knowledge. The structure of database designed using the method of information classification can improve the defects & deficiencies mentioned above effectively. Compared with the general design method of database, the design method of database classification is much more suitable for designing the database related with hydraulic structure engineering.
Keywords-dam safety; monitoring system; monitoring information; information classification; database classification

Fault Diagnosis Method of Hydropower units Based on Integrated Information Fusion Technology

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***Abstract*—A diagnosis method based on integrated information fusion which combining neural network and Dempster-Shafer evidential theory is presented in this paper. In the method, vibration-testing data of hydropower units is processed through several sub-neural networks and the output result of each subneural network is used as the corresponding BPA (Basic Probability Assignment) function that is hard extremely to be obtained. Whereafter, the more accurate and comprehensive diagnosis result can be obtained by fusion diagnosis. Diagnosis example shows that, using information fusion of multi-symptom domains, the belief function of fault target increases markedly, and uncertainty of diagnosis decreases obviously, as a result, the reliability of diagnosis can be greatly improved.**
Keywords-fault diagnosis; information fusion; neural network; D-S evidential theory; hydropower units.

Fuzzy Rule Set Based Engine Fault Diagnosis

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Abstract- **Based on a fuzzy match method of fuzzy rule sets which are a series of fuzzy neural networks, a system framework used for the engine fault diagnosis is proposed in this paper. This fault diagnosis system consists of five parts, including the extraction of fuzzy rules, fuzzy reference rule sets, a fuzzy rule set to be detected, the fuzzy match module of fuzzy rule sets and the diagnosis logic module. The extraction of fuzzy rules involves two steps: step 1 adaptively divides the whole space of the trained data into the subspaces in the form of hypersphere, which is expected efficiently to work out the recognition questions in the high dimension space; step 2 generates a fuzzy rule in each sample subspace and calculates the membership degree of each fuzzy rule. This paper specially makes extension of the conception of the fuzzy rule for resolving the contradictions among the generated fuzzy rules. The fuzzy rule is divided into the fuzzy reference rule set and the fuzzy rule set to be detected. Many fuzzy reference rule sets are obtained by the extraction module of fuzzy rules for the offline learning, and a fuzzy rule set to be detected is online formed while the monitoring process is going on. With the beliefs estimated from the fuzzy match process of fuzzy rule sets, which indicate the existence of working classes in the plant, the diagnosis logic module can export fault detection time, fault isolation time, fault type and fault degree. The simulation researches of the fault diagnosis in a 2000N space propulsion system demonstrate the superior qualities of the fault diagnosis method on the basis of the fuzzy match of the fuzzy rule sets.**
Keywords- fuzzy rule set; fault diagnosis; hypersphere; neural Network

A Concept Feedforward Control of Boiler Based on CFD Modeling

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***Abstract*—To optimally control utility boiler systems, a wellstructured database should be built to assist in the control of feedforward manner. This concept has been studied through computational fluid dynamics (CFD) modeling as an off-line tool. CFD has been widely used in simulation and prediction of fluid, combustion and the related transport phenomena, but without link to utility boiler control still. The generation of the CFD database and integration of the predictions to the actual utility boiler control situation are discussed in this paper.**
Keywords- Boiler; Feedforward control; Computational fluid dynamics (CFD); Database

Direct Nonlinear Controller Design Based on Virtual Reference and Support Vector Machine

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***Abstract*—This paper proposed a new direct nonlinear controller design method based on virtual reference(VR) and support vector machine(SVM), which allows to directly design nonlinear controller on the base of input/output data with no need of model of the plant. Firstly, the relation between virtual reference feedback tuning(VRFT) and internal model control(IMC) was analyzed. Then, the structure and design procedure of the proposed nonlinear controller was given. Simulation results demonstrate this method can effectively deal with the noise and nonlinearity and eliminate the steady-state error. Moreover, the amount of calculation decreases apparently compared to normal indirect model reference control method using neuralnetwork(NN).**
Keywords-virtual reference; support vector machine; nonlinear controller; direct method

Dynamic Simulation of Powerformer under Loss of Excitation

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Abstract: Powerformer is a kind of new high-voltage generator. The simulation method of dynamic simulation analysis of Powerformer under loss of excitation base on MATLAB/simulink is proposed. Simulation model of exciting windings open circuit based on simulink is built, and simulation result is analyzed. The changing regular pattern of exciting electric current, stator current, stator terminal voltage, active power and reactive power are obtained through simulation.. If Powerformer can be come into stabilized asynchronous running condition after loss of excitation, that offers time to clear fault. This reduces expense caused by its step-out and stoppage, and further improves operation reliability of generators and the electric power system.
Key words: Powerformer; loss of excitation fault; dynamic Simulation

Performance Simulation of Gas Turbine

Combined Cycle with Coke Oven Gas as Fuel

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***Abstract*—The resource of coke oven gas is very rich in China. Electric power generation from coke oven gas is helpful to save resource and protect environment. The model of key equipments of gas turbine combined cycle was approached in the thesis. The influence of air temperature on gas turbine combined cycle when firing no matter natural gas or coke oven gas was given. The part load performance of gas turbine combined cycle was also obtained. The results show that the net power and thermal efficiency of gas turbine combined cycle are decreased after firing coke oven gas. The economic performance of gas turbine combined cycle was also evaluated, and the results show that the project has great ability to make profit.**

Keywords-coke oven gas;gas turbine;performance; compressor

Distributed Generation Allocation for Loss Reduction and Voltage Improvement

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***Abstract*—The necessity for flexible electric systems, changing regulatory and economic scenarios, energy savings and environmental impact are providing impetus to the development of Distributed Generation (DG), which is predicted to play an increasing role in the electric power system of the near future. Distributed Generation is by definition that which is of limited size (roughly 10 MW or less) and interconnected at the substation, distribution feeder or customer load levels. The DG technologies are entering a period of rapid expansion and commercialization. The increasing load demand may violate the consumer's voltage permissible limits. While considering the tariff issues, the reduction in losses has a major role to play. With so many problems and so much new Distributed Generation being installed, it is critical that the power system impacts be assessed accurately so that DG can be applied in a manner that avoids causing desired. This paper presents an algorithm for proper Distributed Generation (DG) allocation in distribution systems, in order to minimize the electrical network losses and to guarantee acceptable voltage profile. The optimization process is a load flow base algorithm. The proposed algorithm is tested on a 33 bus test**

Exergy Analysis of a Steam Power Plant with Direct Air-cooling System in China

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***Abstract*—In this study, the exergy analysis is introduced to analyze a steam power plant in China. The main objectives of this paper are to analyze the system components separately and to identify and quantify their exergy losses and the site having the largest exergy loss. The performance of the plant will be estimated according to the results of the exergy analysis and the proposals of improving the performance of the plant will be presented. The exergy destruction mainly occurred in the boiler system where 189.95MW was lost, which is followed by the turbine where 12.82MW was lost. The percentage ratio of the exergy destruction to the total exergy destruction was found to be maximum in the boiler system (91.6%) followed by the turbine (6.18%). The results indicate that the boiler is the major source of irreversibilities in the power plant, and the key of improving the performance of the plant is to improve the exergy efficiency of the boiler system. Chemical reaction is the most significant source of the exergy destruction in a boiler system which can be reduced by preheating the combustion air and reducing the air-fuel ratio.**
Keywords—Exergy analysis; Exergy efficiency; Steam power plant; Direct air-cooling system

Study on the Optimal Back-pressure of Direct Air-cooled Condenser in Theory

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***Abstract*—In order to improve the system running economics of the direct air-cooled unit, based on the thermodynamic model of the air-cooled system, through considering the steam turbine power and the consumption power of fan, this article has researched the optimal back-pressure of the unit in theory under the running conditions, and given the basic law about the optimal back-pressure affected by the corresponding main factors. Thus, the results of studying will provide helpful**

guidance for the cold-end optimization and economical running
of the direct air-cooled thermal power plants.
***Keywords-direct air-cooling; turbine power; fan power
consumed; the optimal back-pressure***

Indirect Power Supply Planning Model Based on Total Quantity Control of SO_2

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***Abstract*—Modeling of indirect power supply planning was performed through the re-programming of the original coal-fired electric generating sets based on total quantity control and environmental cost. The established model could demonstrate when the desulfurizing units should be installed onto large coalfired electric generating sets, and when the small coal-fired electric generating sets should be closed-down in a generate electricity units with SO_2 emission as the most significant constraint. The resulted information in a case study indicated that the model could provide more detailed plan for the next maximum development of the generate electricity units in a new five years' plan, with limited target of SO_2 emission.**
Keywords- indirect power supply planning; optimaztion; energy conservation and emission reduction; total quantity control of SO_2

Optimizing Scheme of Power Delivery for Small Thermal Power Generating Units under Emergency

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***Abstract*—An optimization model was established based on the small thermal power generating units (STPGUs) as one of the effective emergency measures of power delivery in the natural disaster areas (such as the snow disaster on January 28, 2008, in China), which was subject to certain reliability and constraints including time and power capacity. The model was performed in a case study to minimum the total cost: the operating costs of small thermal power generating units (MC) and power customer interruption cost function (OC) using MATLAB, and the results showed that the optimization scheme of emergency power for STPGUs could meet the challenge of emergent power delivery caused by the natural disaster, although the STPGUs has been closing-down in China due to its "high-energy-consumption, high pollution".**
Keywords- *emergency; small thermal power generating units; optimization scheme; power delivery; environmental risk and pollution*

Study on Model of Interruptible Load to Participate in Reserve Market

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***Abstract*—The interruptible loads(ILs) which participates in the reserve market can ease the reserve shortage during emergency. In this paper a model which is based on the optimal power flow (OPF) for ILs to participate in the reserve spot market is introduced. the ISO could use this model to determine the real-time selection of the interruptible load bidders considering system operating reserve and impact of ILs's location. It is shown**

that the interruptible load market helps to reduce the system demand and raise the level of system reserve during the peak hours and in cases of contingencies. The IEEE 9-Bus system, considerably modified to represent different customer characteristics, has been used for the study.
Keywords-interruptible loads reserve market; optimal power flow; deregulated electricity markets

Pareto improvement of large customer direct power-purchase by use of multi-objective optimization

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***Abstract*—Large customer direct power-purchase(DPP) rises gradually in China with the development of power market which should bring risks to all participant as little as possible to avoid excessive and unnecessary market fluctuation. This paper proposes a multi-objective optimization model using Pareto improvement from the view of supervision institution which takes charge of design, supervision and management of power market. Direct power-purchase volume proportion, floating ratio of Time-Of-Use(TOU) transmission price and grid-supplied price are chosen as control variables to formulate the problem. The model presented in this paper has two objective of economy and environment consideration with some constraints including network loss, emission, price, market power, and so on and the model can optimize the control variables without benefit loss of any participant. The essential of the problem is to utilize price elasticity matrix of large customer to adjust profit distribution and to achieve the social integrated benefit optimization. Some power plants and large customers are supposed to form a**

scenario, which is used to validate the effect of method.
Keywords-power market; large customer; direct power-purchase; Pareto improvement; multi-objective optimization; price elasticity matrix; economy and environment constraint

A refined regulation model for incentive regulation of electric power transmission and distribution

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***Abstract*—After the reform of the electrical power industry, the vertical integration management control method has been accepted by the electric power transmission and distribution firms in China, where necessary supervision and control are needed. In this paper, the author firstly investigates the existing research studies and the current regulation methods of international electric power market and then proposes a refined regulation model by considering the particularity of the electric power transmission and distribution enterprises in China. The paper mainly introduces the establishment of the algorithm and formula, and identification of the quality factor for the proposed model.**
Keywords–Electric Power Transmission and Distribution; Price cap regulation

Utilizing Ratio Frequency Signal in Online Monitoring on High Voltage Vacuum

Cubicle Switchboard

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Abstract*—The vacuum degree of vacuum interrupter, the isolation contact and the surface insulation condition, when in bad status, are all possible causes of serious insulation or current carry failures to high voltage vacuum cubicle switchboard. A large series of experiments have been executed in this paper to verify the feasibility of using Ratio Frequency (RF) signal emitted by the partial discharge under those situations to online monitor the condition of high voltage vacuum cabinet. Firstly, A floating electrode gap was adopted and its discharge characteristic under different vacuum degree (6.7×10^{-3}~1×10^{5}Pa) has been studied. The experiment results indicated that when vacuum degree descend to some extent, partial discharge will occur in the gap. Furthermore, the start voltage and the characteristics of the discharge have direct relations to vacuum degree. The discharging or not of such a gap fixed in the vacuum interrupter can indicate whether the vacuum degree is in normal range. Secondly, a series of experiments on bad contact and surface insulation have been carried out, and it has been proved by the experiments that the intensity of the RF signal (above 10mV) can show the development and situation of the isolation contact and surface insulation failure. While high gain like 60dB was needed to the antenna. Since the intensity of the signal acquired was strongly affected by the position of the sensor and the case of shielding, locating the failure and identifying the disturbance from outside of the cubicle switchboard can be realized.

Keywords-Radio Frequency signal; vacuum degree; surface insulation; isolation contact; online monitoring

Voltage Stability Assessment Based on BP Neural□Network

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Abstract **An assessment approach on power system voltage stability is provided using Back Propagation (BP) Neural Network, which takes the Voltage Collapse Proximity Indicator (VCPI) as assessment index. The key feature of the method is to establish static and dynamic assessment models on voltage stability. The training results of the static models based on load flow calculation can reflect the nonlinear mapping relationship correctly between power flows and voltages on load bus with given load increasing mode; Based on integrated load model, the dynamic model uses two three-layer BP networks to make classification and prediction on system, respectively. With two instances of WSCC-9 and 3 generator-12 bus power system, it is verified that the method is effective to voltage stability assessment on power system.**
Index Terms—Voltage Stability assessment, BP neural network, Voltage Collapse Proximity Indicator

Control Strategies of Black-start

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***Abstract*— In recent years, the research on power system blackstart for the large-scaled break-off power fault is becoming an absorbing topic regarding the power system safety. The starting of induction motor machines that have large output power is a big threat to ensure the reliable running of a small system at the initial period of black-start. In this article, RTDS tool was utilized to simulate the black-start situation at the initial period that the small system was running at no load, and based on the obtained data, those issues, such as over-voltage and the capability of carrying power are studied. The factors that may induce system fault were analyzed, and in conclusion, the reactive power impact and trend of the real power changing should be the principal reason.**

Keywords-black-start; no-load; over-voltage; self-excitation; Stability

A New Particle Swarm Optimization Solution to Optimal Reactive Power Flow Problems

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***Abstract*—A new approach to ORPF (optimal reactive power Flow) based on NPSO-LRS (new particle swarm optimization, local random search) algorithm is proposed, and LRS subroutine is invoked using probability invoking strategy in this paper. The algorithm approaches and methods for solving ORPF problem are given. By applying the algorithm to dealing with IEEE 30-bus system, compared with the PSO algorithm and SGA(simple genetic algorithm),the experimental results show that the algorithm is indeed capable of obtaining higher quality solutions efficiently in ORPF and the convergence performance is better.**

Keywords- optimal reactive power flow; local random search; new particle swarm optimization

A Novel Optimal Power Flow Model and Algorithm Based on the Imputation of an Impedance-Branch Dissipation Power

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***Abstract*—This paper presents a new optimal power flow model based on the algorithm of Imputation of an Impedance-Branch Dissipation Power. The complex nonlinear constrained expression of line security and stability constraints in optimal power flow model is transformed into an approximate linear expression in which generator power output serves as a variable. This model is solved by successive or piecewise linear programming in light of the nonlinearity degree of the constraints, so the low efficiency controls are compressed. It considers line security and stability constraints directly, rather than examines them passively and modifies them in the case of Newton’s method, so the marked advantage of this method is its good convergence and solution efficiency. Simulation results show that the proposed model and algorithm is effective and feasible.**

Keywords- Line security constraints，Stability，Linearization, Optimal power flow, Electricity market

Short-term Load Forecasting based on RBFNN and QPSO

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***Abstract*—Coping with the questions of Radial Basis Function Neural Network (RBFNN) in short-term load forecasting, a new training method of the RBF neural network based on Quantum behaved Particle Swarm Optimization (QPSO) algorithm was**

introduced. In the algorithm, all network parameters were coded into individual particles which can search optimal-adaptive values at random in the overall space. So, the parameters can be quickly and accurately identified. The application in power load forecasting show that the method can accelerate convergence speed of the network and increase accuracy of predicting compared with traditional RBFNN.

Keywords: load forecast, quantum-behaved particle swarm optimization algorithm, radial base function

Identification of Lightning Stroke and Fault in the Transient Component Based Protection

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***Abstract*—To resolve the impact of transient traveling wave induced by lightning stroke on the transient component based protection of transmission line, a novel identification algorithm is proposed. Using the characteristics of symmetry of waveform induced by lightning stroke without causing fault and asymmetry of waveform generated by fault within a very short interval, the waveforms of transient current above and below time-axes are integrated respectively. First, through comparing the ratio of them with threshold value, the primary criterion identifying fault and lightning stroke is constructed; Secondly, to improve the reliability of discrimination between lightning stroke with and without causing fault, according to the difference of them, the secondary criterion is also defined. The simulation results from EMTDC demonstrate that the proposed integral criterions are valid and correct.**

Keywords-transmission line; transient component based protection; lightning stroke; characteristic of waveform; criterion

The research U_L-P of loss-of-excitation protection
for generator based on the artificial neural networks

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Abstract **Simulated model of loss-of-excitation protection for generator is established in Matlab, and then taking advantage of BP neural networks which are most advantageous in recognizing patterns, the operation zone of the active power rotor criterion for loss-of-excitation protecting of generator is recognized. Comparing with conventional microcomputer protection using linear approximation, the result shows that the method of BP neural networks is accurate and superior.**

Keywords ***simulationt*****;** ***artificial neural networks*****;** ***generator*****;** ***loss-of-excitation protection***

Special Problems in Current Differential Protection
Based on Bergeron Model

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***Abstract*—UHV long transmission line takes on distinct characteristics of distributed parameters, and it has great capacitive currents. Traditional phase segregated current differential protection is severely influenced by distributed capacitive current. In order to realize differential protection with high sensitivity and reliability for UHV transmission line, phase segregated current differential protection based on Bergeron model had been put forward. The time-domain Bergeron model is widely used for calculation during fault transient period. In theory, new principle can completely compensate capacitive current, but in practical application, consecutive sample values are necessary to realize calculation of Bergeron equation. Therefore, it's necessary to estimate the voltage or current values at non-sampling points. The paper proposes that the cubic spline interpolation algorithm can be used for calculation of Bergeron equation. Theoretical analysis and simulation tests show that the proposed method is valid and precise.**
Keywords-UHV transmission lines; current differential protection; Bergeron model; cubic spline interpolation

Boundary Protection Algorithm Based on Phase Information of Improved Recursive Wavelet Transform for EHV Transmission Lines

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Abstract — **According to the frequency characteristics of transmission line boundary, this paper proposes a new algorithm of boundary protection for Extra-High-Voltage (EHV) transmission lines based on improved recursive wavelet transform (IRWT). IRWT is used to directly extract desirable frequency components of fault-induced transient current signals. By comparing the average frequency of the extracted signals, which measured by the phase information of wavelet transformation, an internal or external fault can be distinguished definitely. Due to the IRWT update only using previous values and regardless of the sampling rate, the proposed algorithm reduces computational complexity, improves the real-time capability and is very desirable for ultra-high-speed protection. The EMTDC simulation results show that the new boundary protection algorithm is insensitive to fault location, fault resistance, fault type, and fault initial angle, and that the algorithm is feasible.**
Keywords - line boundary; transient based protection; phase information; improved recursive wavelet transform(IRWT);

Study of the Inrush Current Identification Using the Improved Half-Cycle Fourier Analysis

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***Abstract*—Among the traditional schemes of current differential protection for power transformer, the principles of second harmonic restraint and dead angle restraint to distinguish inrush current from fault current are influenced such many factors as the decrease of transformer core magnetic saturation and CT transient saturation. In fact, the inrush current is characterized of its peaky wave and its relatively big dead angle compared with**

internal fault current. So the paper proposes a novel method to identify the inrush current using the improved half-cycle Fourier analysis (HCFA). The improved HCFA can accurately extract the fundamental component and reflect the characteristic difference of the inrush current waveform. The proposed method is tested by a large amount of EMTDC simulation on various i

conditions, the dynamic analogous test data from different transformers. These test results indicate that the novel method to identify inrush current is basically correct and feasible.

Keywords - Transformer protection, Inrush current, Internal fault current, Fourier transform

Study of Single-ended Traveling-wave Protection for Transmission Line Unsymmetrical Grounded Faults

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Abstract — **The identification of reflection wave is the primary trouble of the existing single-ended traveling-wave protection schemes. The paper proposes a novel single-ended protection for EHV/UHV transmission line unsymmetrical grounded faults, which only needs initial traveling wave. The protection principle is based on the propagation time gap between aerial-mode and zero-mode traveling waves. The propagation time gap rises monotonously with the fault distance increasing. Under various fault situations, the performance of this novel traveling-wave protection scheme is investigated with a number of PSCAD/ EMTDC simulation data. Theoretical analysis and testing results show the proposed protection scheme is ultra-high-speed and feasible.**

Keywords – traveling-wave protection; aerial-mode; zero-mode; unsymmetrical grounded fault; transmission line

Function-Oriented Information Assets Identification on Substation Automation Systems

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***Abstract*—Information security risk assessment combined with power control process is an issue which has not properly solved yet. As substation automation system (SAS) functions as the key link of between implementation of control instructions and the collection of operation information, research on the application of information assets identification method in SAS under network environment, is an important part of improvinginformation security risk assessment system in power system. Consisting of the features of SAS, the paper presents a function- oriented information assets identification method with following procedures: Establishing function tree model to identify assets and defining key level as a parameter to measure the importance of assets, utilizing association factor to measure the association between assets and quantitatively analyzing the degree of association by building association matrix. The paper also presents assets quantification method on system level, according to the impact of different functions on the electric power primary system. At last, the paper constructs an evaluating example with IEC 61850 standard, and verifies the effectiveness of assets identification method.**

Keywords-SAS; assets identification; function tree;key level

Substation Locating and Sizing in Rural Power System Based on GIS and Modified

Differential Evolution Algorithm

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Abstract— A modified Differential Evolution (MDE) algorithm is introduced to solve the problems of substation location optimization based on GIS. Numerical study is carried out □□ using three test-functions to the MDE algorithm which introduces inertia scaling factor, and the result is compared with that of dynamic differential evolution .Analysis results show that the efficiency of modified differential evolution is significantly improved for adjusting the inertia scaling factor F scope purposefully to different function. The model of the problem involving the geographic information, the rural power network characteristic and its located complex geographical environment make the given solution more effective and feasible.

Keywords- substation locating; differential evolution algorithm; inertia scaling fact;GIS

Vulnerability Assessment of Power Grid Based on Complex Network Theory

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Abstract--**Frequent occurrences of blackouts have made the reliability of power grid much more concerned in the last few years. Recent work reveals that some important lines can have critical impact on the blackouts in power system. Based on the newest progress in the field of complex network theory, power grids are treated as small world networks. This paper calculates the topological characteristic parameters of the power grid, investigates the tolerance of power grid against random failures and targeted attacks, and proposes a methodology for the study of the relationship between small-world effects and the reliability of power grid. The failure simulation results of a practical large power grid show that the power grid is much robust facing random failures but becomes much vulnerable in front of attacks**

on selective nodes.

Keywords- Power grid; Vulnerability assessment; complex network.

A spot inspection information mangement system of units in thermal power plant based on the frame of Browser/Server

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Abstract—**The spot inspection management is a scientific means of equipment management. The spot inspection information management system provides a necessary platform for spot inspection. This paper introduces the construction of the information management system , and it summarizes the functions of the spot inspecting apparatus from four dimensions, then it focuses on the function design of every module in the software, finally it introduces the new functions of the system.**

Keywords- the information mangement system; the spot inspecting apparatus; basic functions

Multi-Agent Based Control Framework for

Microgrids

Chun-xia Dou, Shi-jiu Jin, Guo-tao Jiang, Zhi-qian Bo

***Abstract*-- This paper presents a control scheme implemented with multi-agent System for the operation of a microgrid, which can be connected to the main power network or operate autonomously, similar to physical island of power systems. The features of agent for microgrid control are discussed. An agentbased control framework for microgrids is then presented.**

***Index Terms*—Distributed Generation, Microgrids; Agent; MAS**

Three Phase Power Flow For Weakly Meshed Distribution Network With Distributed Generation

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***Abstract*—Traditional power flow algorithms are not applicable to the distribution network with distributed generation because of the unbalance of power source load and line. Based on the analysis of wind turbines photovoltaic system fuel cell storage battery high frequency micro turbines and power frequency CHP(combined heat and power), their models in power flow are presented. In view of three phase unbalance and weakly meshed characteristics of the distribution network, the back/forward sweep power flow is improved, which is widely used for the radical distribution network. A new three phase back/forward sweep power flow for the weakly meshed distribution network with the distributed generation is presented. The example has proved the efficiency and feasibility of the algorithm.**

Keywords-distributed generation; three-phase power flow; weakly meshed distribution network

Reliability Analysis of transformer Based on FTA And Mente Carlo Method

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***Abstract*—Considering the fact that transformer is void of reliability data, Fault Tree Analysis (FTA) and Mente Carlo algorithm are combined in this paper to analyze the reliability of transformer. Fault trees are built. By using the fault tree, Mente carlo is applied to quantitatively analysize the model. Then the reliability index and cell importance parameter help to find out the weak link of the system. Combination of the above two methods offers a practical method for the reliability analysis of transformer.**

Keywords-transformer; Mente carlo; Fault Tree Analysis(FTA) ; Reliability

Research on the energy-saving management system of power generation groups and key supporting technologies

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Abstract—**Taking the performance evaluation of power systems as core, a new energy-saving management mode was proposed based on the routine and special evaluation for economic operation and energy-saving management of related systems and equipment. The technical reconstruction, maintenance, S&T planning and projects were proposed by means of current energy-consuming standard, identification and prediction of energy-saving potential. This mode integrated the science & technology management with the production management, such as operation, technical retrofit and maintenance. The solutions for several key supporting technologies were analyzed to build the energy-saving index system, technical standard system and information system. The scientific, complete and operational management system and technical supporting system were researched for the energy saving and consumption reduction of power generation groups. It laid a solid foundation to build the system of energy saving and consumption reduction.**

Keywords-power generation company; energy saving; management system; supporting technology

Research on Comprehensive Evaluation System of Power Demand Side Management by AHP

Zhi-qiang Chen, Yang Xia, Bo Chen, Hong-shan Zhao, and Dong-xiao Niu

***Abstract*-- As the change of power energy structure, the electricity markets are shifting gradually from sellers markets to buyers ones. Demand side management, which is one of the most important methods for energy management, plays an important role in power operation. However, the implement of DSM is a**

complicated market process which should keep the market effective and fair. From the views of economics, it is necessary that the implement of DSM ensure the benefit of all the participation subjects fairly. And from the views of society, the implement had better dive harmoniously development ahead of economy and society. Therefore, it is necessary to make a comprehensive evaluation on the effect of DSM from the views of both economics and society. In this paper, we construct an evaluation system by employing an analytic hierarchy model. The model considers two factors: economic factors (which includes the fairness index), the social factors. In addition, we define an evaluation set for the quantification of the two factors. By the above work, we can make a more precise evaluation on effects of the implement of DSM.

***Index Terms*—Analytic Hierarchy Process; Demand Side Management; Fairness Index; Evaluation Set**

Analysis of the Circular Volt-Detecting Method of Individual Cells Involved in the Supercapacitor Bank

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***Abstract*—Th□ voltage of single supercapacitor is no more than 1.6V. So a lot of cells are combined to a bank in order to reach higher voltages which make it possible for a high efficient transformation from the supercapacitor bank. Sometimes hundreds of cells are connected whereas the voltages of the cells differ with others. So proper measure should be taken to detect the voltages of the individual cells.**

This paper represents a new method of detecting the voltages of cells quickly. A microprocessor is implied to control the multi channels. This method is much faster and more accurate than those done by relays or voltage distribution by resistors. It is implied in the capacitor bank which contents 20 cells and gains a good result. It costs 1ms to detect each capacitor

and the precision reaches 2mV. As the detecting board is powered directly by supercapacitors and CAN bus is applied to connect the boards, it is more suitable for detecting voltages of supercapacitors in vehicles.

Keywords-supercapacitors; circular volt-detecting; multiplexers;CAN bus

CIM Extension of Microgrid Energy Management System

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***Abstract*—EMS-API(Energy Management System- Application Program Interface) standard IEC61970 has realized seamless integration of EMS application software, but IEC61970 standard covers little about Microgrid CIM (Common Information Model). Therefore, CIM in IEC61970 should be extended for the design of Microgrid Energy Management System based on IEC61970 standard.This paper discusses principles and methods of CIM extension, focusing on CIM extension of Wind Plant and Battery Energy Storage System. It demonstrates a bidirectional energy dispatching model for Battery Energy Storage System and sets up the CIM for Photovoltaic Power Generation System and Fuel cell Generating System. Based on all this, the CIM for Microgrid EMS is forged and then applied to the practical designing of microgrid EMS.**

Key words-Microgrid; EMS; CIM; IEC61970

Research on Condition Information Model of Substation Equipment Based on CIM/XML

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***Abstract*—Power Equipment with healthy condition is vital to security and stability of power grid. It is helpful to ensure power network secure and stable to grasp equipment status data immediately and comprehensively and to evaluate equipment status accurately. Information that reflects healthy status of substation equipment is analyzed. The CIM model is extended by following the semantic and grammar of CIM , a unified model for substation equipment condition information is built. The rule for translating extended CIM model into XML document is proposed. By using the extended model and XML technology it is effective to integrate distributed substation equipment status information and to realize retrieving flexible so as to support the higher level unit to made decision of equipment maintenance.**

Keywords-substation equipment; condition information model; CIM; XML; information integration

Similarity Analysis in Condition Evolution Rule Of Transformer In Family Based On Clustering

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***Abstract*—In integrated condition assessment, family quality is an factor affecting a transformer's condition. If some devices in family have had default record, then the other transformer in family would have same default in future. And now, the affecting degree by family default factor is subjectively decided by expert's experience. This paper collected power transformer experimental data in same factory and with same type, analyzed condition evolution similarity of power transformer in family based on clustering technology to mine the potential evolution rule. To make the clustering result more accurate, this paper improved the similarity criterion in clustering algorithm, proposed line slope distance of condition evolution as line shape similarity**

criterion, used both data distance criterion and line slope distance criterion to cluster transformer experiment data with same factory and same type in reality. It then analyzed the condition evolution of a power transformer according to the family condition evolution rule. The result is the same with the reality.
Keywords-*power transformer; family quality; condition evolution rule; clustering; integrated condition assessment*

Power Grid Crises Management and Research on Load-Model of Power Grid

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Abstract—Power grid crises, which have taken place at home and abroad, alert the importance of power grid crises management. This paper studies different load-model, and then adopts concrete loadmodel to analyze stability of Jiangsu power grid. On the base of calculated results, the paper submits the constructive suggestion on Jiangsu power grid. In order to avoid power grid crises for inadequate research on load-character and load-model, it is important theoretically and practically to utilize load-model to analyze the voltage-stability of power system
Keywords-power grid; power grid crisis; crisis management; load model

Analysis and Control of Maximum Transfer Power at Cross-section of Transmission Line With

Transient
Stability Constraints

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***Abstract*—It is widely used to control the total active power under restriction for one set of tie lines in real operation electric power system. So it is very important for operators to grip the transmission capacity of one set of tie-lines. In order to facilitate the real-time monitoring of the operation of power system, a principle and method is proposed to define the cross-section of transmission line. Operation mode is divided into two parts: generation mode and load mode. A mode identification method is proposed to range the regions according to the oscillation angle of typical unit. The analysis and stability control method of maximum transfer power at cross-section based on operation mode is proposed considering transient stability constraints. Examples show that the method proposed is simple, reliable and can fulfil the need of the operation of power systems.**

Keywords-maximum transfer power; transient stability; operation mode style

Research on Non-inferior Nash Equilibrium in Power Spot Market

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***Abstract*—Nash equilibrium is an important decision-making**

result for all players in non-cooperation game. In existed Nash equilibrium model, the cooperation relationship between the generation groups is not taken into account. Thus, in this paper, the non-inferior Nash equilibrium model of power spot market considering the power network constraints is proposed, in order to effectively describe the characteristics that both cooperation within each generation group and competition between the groups coexist. This model is a bi-level optimization model, in which the upper layer is the profit optimization model of generation group, and the lower layer is the market clearing optimization model considering the power network constraints. By using the nonlinear complementarity function to reformulate the KKT system for the optimization problem, the non-inferior Nash equilibrium of power spot market is solved simply and fast. Corresponding to different operational conditions of power network, i.e., congestion and non-congestion, the non-inferior Nash equilibrium of power spot market is analyzed and compared with different market parameters. The results indicate that the generation groups' production strategies are favorable to the power plant locating at the important place of power network when congestion occurs.
Keywords-nonlinear complementarity function; non-inferior Nash equilibrium; power spot market; power network constraints.

A PWM Controller IC for LED Driver Used to Multiple DC-DC Topologies

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Abstract—**A Pulse Width Modulation (PWM) controller chip for LED driver was presented in this paper. The controller features**

two major operation modes, current feedback mode and constant current mode, so as to applicable to almost all DC-DC converter topologies such like Buck, Boost, Buck-Boost, Flyback and SEPIC. A special error amplifier, which is composed of two submodules and a mode selector, was introduced to this chip to different applications. The peak current mode control with slope compensation was proposed to its control strategy. The controller integrated circuit (IC) was designed, simulated and fabricated in 1.5 μm BCD process. And both the simulation and test results were consistent with expectations well.
Keywords- PWM controller; multiple DC-DC topologies; LED driver; error amplifier

Network Design of Reverse Logistics Intergrated with Forward Logictics

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Abstract—**In this paper, we design the reverse network integrated with forward logistics under the background of electric power system. Firstly we make it on the basis of the original forward logistics facilities; then under the emergency logistics, we establish the stochastic network-design model to solve the location problem, considering the demand for electric power materials and the quantity of returned vitiated power materials following the Poisson distribution. Lastly, in this paper, in order to solve this stochastic network-design model, we take use of random simulations algorithm, and verify the model with a hypothetic numerical example.**
Keywords-Forward Logistics; Reverse Logistics; Network design; Stochastic network-design model; Random simulations

Swarm Intelligence based Security Constrained Congestion

Management using SSSC

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***Abstract*— The power system is said to be in a state of Congestion** (iii) Operation of FACTS devices particularly series
whenever the physical or operational constraints in a devices.
transmission network become active. In a deregulated Non-cost-free means:
environment, Congestion in the transmission lines can be relieved (i) Re-dispatch of generation in a manner different
by one of the two congestion management methodologies viz. cost from the natural **free and non-cost free methods. In this paper, Congestion is** settling point of the market. **relieved by using Cost Free method and is reduced by employing** Some generators back down while others
Static Synchronous Series Compensator (SSSC). Genetic increase their output. The effect of this is that
Algorithm (GA) and Particle Swarm Optimization (PSO) generators no longer operate at equal incremental
techniques were used to obtain the global optimal solution as the costs.
objective function is nonlinear in Congestion Management and (ii) Curtailment of loads and the exercise of (not**these**
techniques were tested on IEEE 30-bus system. cost-free) load interruption options.

Keywords- Congestion Management, Static Synchronous Series Flexible AC Transmission System (FACTS) devices are ***Compensator (SSSC), Optimal Power Flow, Genetic Algorithm,*** commonly used devices to relive congestion and maintain ***Particle Swarm Optimization***

A New Method for Interharmonic Identification

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Abstract—**A new method based on improved multiple signal classification (MUSIC) algorithm and independent component analysis (ICA) method is applied in this paper. In contrast with the original MUSIC algorithm, the proposed version can give good performance at lower signal/noise ratio (SNR). After estimating the frequencies accurately, the amplitudes and phases of interharmonics are calculated with ICA method. Compared with some other algorithms, the improved MUSIC algorithm obtained higher resolution in frequency domain and ICA method separated fixed signal into several independent signals. The simulation indicates the validity of this method.**
Keywords-improved multiple signal classification, independent component analysis, interharmonics

Study on the Framework of Natural Disaster Early Warning System for Power System

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***Abstract*-- In this paper, the characteristics and harm of the impact that natural disasters could make on power system were analyzed. Furthermore, the natural disaster early warning system for power system is proposed, and details of the four parts of the system are introduced respectively. The authors focused on the information sources of early warning monitor, the three steps of risk assessment, the determination of warning grade and five facets of early warning response. This paper will provide theoretical support for the future construction of a natural disaster early warning system for power system.**
Keywords- Power System, Natural disaster, Early Warning, Emergency, Early Warning Response

A Multi-Mode Four-Switch Buck-Boost

DC/DC
Conv erter

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***Abstract*—Considering that the output voltage of battery will decline during its use, a four-switch buck-boost converter was proposed, which could provide stable output voltage over a wide voltage range of battery so as to extend the use time of battery and enhance its use efficiency. To improve the efficiency, the converter is designed to operate in multiple modes, which controlled by different strategies that depends upon the difference between output and input voltages as well as the different load conditions. As results, the proposed converter could provide a steady output voltage over the entire fluctuating range of battery voltage. The converter chip was designed in 1.5-µm BCD (Bipolar-CMOS-DMOS) technology and the expectations were well achieved.**

Keywords-four-switch; buck-boost dc-dc converter; multi-mode; PWM; Burst

Analysis on Fault Statistics in Wenzhou Electric
Power Distribution Network

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***Abstract*—The distribution network of Wenzhou Electric Power Corporation (WEPCO) has witness quite great progress during past decade. In order to give a comprehensive performance evaluation of the retrofit and construction of the distribution network from the view point of fault incidence, fault statistic over past three years are investigated and the major causes of the fault leads to interruption of service are identified firstly in the paper. Since power systems fault are temporally or spatially uneven**

distributed, the temporal and spatial distribution of fault are analyzed in detail using fault data from 2004 to 2006. Thereafter, some possible countermeasures are proposed to improve our service correspondingly. Since the countermeasures focus on most notable timing and location of the fault, they are expected to achieve most with least cost.

Keywords-*Distribution network, Power System, Extreme climate, Fault, Countermeasure***.**

Monitoring and Modeling Geomagnetically Induced Currents in Power Grids of China

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Abstract**—Geomagnetically induced currents (GIC) flowing in the power grids threaten the safe operation of the power system. The GIC disturbing events in Chinese power grids show the necessity of knowing the level of GIC. This paper introduces two aspects of work on the subject, which are monitoring and modeling of GIC, respectively. Firstly, the author introduces the detecting and monitoring technology of GIC in the power grids, and gives examples of GIC monitoring data which expose that the GIC amplitude can be quite large even if in low latitude areas. Secondly, the author introduces the model of calculating GIC and, based on the Plane Wave Method, presents a discrete algorithm according to which software has been developed to calculate the Earth surface electric field. The data of a strong magnetic storm at the Zhaoqing Geomagnetic Observatory are used to calculate the electric field and GIC at the Ling'ao nuclear power plant. The measured data and the calculated results agree well, and the method is thus applicable to assessing GIC in power grids.**

Keywords-geomagnetic storm; geomagnetically induced current; GIC ; power grid

Harmonic Resonance Circuit's Modeling and Simulation

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Abstract —Modeling and simulation is the important means for people to know and remake the world. Resonance is a special kind of working state of sinusoidal stable circuits. Parallel resonance and series resonance are the two more important parts of the harmonic resonance problem. Parallel resonance phenomenon is associated with the singularity of the node admittance matrix. The singularity is due to the fact that one of the eigenvalues of the matrix approaches zero. By analyzing the characteristics of the eigenvalue, one can find useful information on the nature and extent of the resonance. Similarly, due to the affinity between series resonance and loop, by analyzing loop impedance matrix instead of node impedance matrix can obtain series resonance frequency and corresponding branch information. Based on the results, Resonance Mode Analysis can be used to analyze parallel resonance and loop mode analysis is proposed to analyze series resonance. Analytical and case study results by Matlab have confirmed that the mode analysis method is a valuable tool for power system harmonic resonance analysis.
KEY WORDS: Modeling and simulation; Harmonic resonance; Series resonance; Parallel resonance; Modal analysis; Eigenvalue

Price Forecasting Based on PSO Train BP Neural Network

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Abstract: In this paper, the basic idea is to use percent of reserve capacity, the historical load and price to forecast short-term electricity price .The paper provides an example of bidding model to forecast market clear price using BP neural network trained by PSO. To compare with the result of traditional BP neural network, the proposed method has better forecasting precision and can convergence to global optimal solution at all times.
Key words: back propagation network; particle swarm optimization; electricity market; market clear price

A Comprehensive Method for Online Voltage Stability Assessment

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***Abstract*—This paper presents a comprehensive method combined with the techniques such as an improved predictor/corrector, second order index and dichotomy to predict the point of collapse (PoC) constrained by limit-induced bifurcation (LIB), saddle-node bifurcation (SNB) and security limit. Case studies with IEEE118-bus systems are carried out and accordingly final conclusions can be reached that the method introduced here balances in linearity, speed and accuracy. And it can present distinct advantages with reactive power information and is very suitable for online voltage stability assessment.**
Keywords-voltage stability margin; PoC;LIB; SNB;second order index; dichotomy

Power Quality Disturbances Detection

Based on
Hilbert Phase-Shifting

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Abstract: This paper analyses the principle of work of using phase-shifting method to detect power quality (PQ) disturbances based on Hilbert transform (HT). This method is proposed by using phase-shifting for real-time detection on various PQ disturbances, such as voltage swells, voltage sags, voltage fluctuation, harmonics and transient oscillation. Based on the detection platform of LabVIEW environment, the simulation results show that the method can satisfy various PQ disturbances signal detection, and also has a good real-time system characteristics and accuracy.

Keywords: Power quality; Disturbances detect; phase-shifting; Hilbert ; LabVIEW

Research on Frequency Characteristics of the
Overhead Line Parameters

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***Abstract*—Having been learned a lot from the previous work , this paper proposed a new medium-frequency current icemelting method employing skin effect and proximity effect phenomena to overcome the weaknesses of existing de-icing method of overhead line. By the interaction of the two phenomenon, the transmission line unit resistance is expected to increase, compared with the working frequency current, the intermediate frequency current with the same ice-melting power can be reduced effectively to protect the conductor. First, this paper set up a simplified ACSR model according to the Principle**

of Equivalence Area, and then the calculation of frequency characteristics of three types of transmission line's resistance and inductance is undertook based on the model mentioned above and Finite Element Technique (FET).The result indicates that the unit resistance is increasing significantly when injected 400+HZ current. Similarly, the other type of ASCR has the same performance; however, the resistance of conductor with more layers is changing rapidly than the other conductors. All types of the ASCR have their inductance decreasing at the initial stage, then increase at certain point. By defined theory analysis, this paper proposed an intermediate frequency (1600 HZ) ice-melting method, the increase of the unit resistance and the choice of frequency is within the ideal extent. The proposed ice-melting method appears promising, and it needs further experimental practice.

Keywords- Skin Effect ,Proximity Effect ,Finite Element Technique,De-icing of Overhead Line, The Principle of Equivalence Area, Frequency Characteristics of The Parameters

Identifying Power Quality Disturbances in Real time Using Incremental Wavelet Decomposition and Least Square Support Vector Machine

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***Abstract*—Power quality disturbances identification is the important procedure for improving power quality, and real time application has actual value. An efficient method for power quality disturbances identification is presented. Wavelet decomposition is used for extracting features of various disturbances, and least square support vector machine is used for classifying the disturbances. For real time application, sliding window and incremental algorithms for wavelet decompositions are used. This method can identify different disturbances in high accuracy and less time. Simulation experiment**

using several typical disturbances is finished, and the experimental results show effectiveness of proposed method.

Keywords-Power quality disturbances; feature extraction; classification; wavelet transforms; least square support vector machine (LS-SVM); real time systems

Research on Under-voltage load-shedding to prevent Voltage Collapse of Electric Power System

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***Abstract*—A voltage collapse is defined as the process by which voltage instability leads to a very low voltage profile in a significant part of the system. Under-voltage load-shedding is an efficient scheme to prevent voltage collapse. The paper analyses the mechanism of under-voltage load-shedding preventing voltage collapse, compares distributed load-shedding scheme with centralized scheme, introduces under-voltage load-shedding scheme employment at home and abroad, points out that how to work out a proper plan to efficiently prevent voltage collapse, select the time steps, site and amount of load-shedding lies on the conditions of the special power system itself.**

Keywords- under-voltage load-shedding; power system; voltage Collapse

Performance Improvement of Parallel Active Power Filters Using Droop Control Method

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***Abstract*-In this paper, a new method based on droop control scheme is proposed for controlling parallel operation of active filters. The harmonic components of the load current are extracted by an enhanced phase-locked loop (EPLL). In the parallel group, each filter operates as a conductance and the harmonic workload is shared among them. A droop relationship between the conductance and non-fundamental apparent power controls the operation of each unit. The non-fundamental apparent power has been calculated based on IEEE Std 1459. Principles of operation are explained in this paper and simulation results which are presented approve the effectiveness of this method. The results indicate a significant reduction in Total Harmonic Distortion (THD) in a rectifier application.**
Keywords-Power quality; Parallel active filters; Power system harmonics; Droop

Research on Dry Resistance Load Test of Diesel
Locomotive for Energy Saving

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***Abstract*—A method of dry resistance load test of diesel locomotive is introduced. The electric power generated by a dynamotor, which is driven by the diesel, is converted to DC and consumed on the dry resistances. AS the heat dissipation of the resistances is about several thousand kilowatts, DC motor fans are used for air cooling the resistances. In order to save energy,**

the energy for driven the motor fans is come from the electric power of the DC power. A constant current speed regulating system for the motor fans is presented, which bases on a kind of high-power switch component (IGBT). The experimental results are discussed.
Keywords-dry resistance load test; PWM; IGBT; diesel Locomotive

Lighting Control and Its Power Management in Railway Passenger Station

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***Abstract*—Lighting control in a large railway passenger station is one important topic to be addressed, considering that the energy expenses are substantial and solutions to optimize the use of energy are required. This paper presents an integrated solution for lighting control and its power management using distributed computer control system and configuration control software. The system adopts hierarchical distributed structure, in which the bottom unit is PLC which collects real-time data and turns lamps on or off, and industrial control computer is the central unit which acts human-computer interface to display important information and manage the whole control system. These two units are linked by RS485 bus which accomplishes two-way data transmission. Additionally, a software application is designed so all bottom units could be controlled and monitored remotely and the power status could be monitored and analyzed.**
Keywords- railway passenger station; lighting control; power Management

Faraday rotation and sensitivity of Bi-substituted iron garnet single crystal for optical current/magnetic field sensors

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Abstract—**This paper is concerned with the preparation and magneto-optic characterization of the Bi-substituted rare earth ferrite garnet bulk single crystal of $(BiYbY)_3(FeGa)_5O_{12}$. Here we focus our studies on improving the sensitivity constant and its temperature dependence of iron garnet for optical current/magnetic sensors through compositional modification. Due to the Bi^{3+} ions□substitution, the specific Faraday rotation of $Bi_{0.75}Yb_{1.02}Y_{1.23}Fe_{4.72}Ca_{0.28}O_{12}$ crystal under saturation magnetic field was enhanced greatly to be about -161.7 $_0$/mm and -144.1 $_0$/mm at =1310 nm and 1550 nm respectively. Magneto-optic figure of merit is 87.6 $_0$/dB at =1550 nm and room temperature. The smaller Faraday rotation temperature coefficient (FTC) of 3.99×10^{-5}/K at =1550 nm have been obtained owing to the compensation effect. The sensitivity have been enhanced by a factor of 24 with respect to pure YIG, given the same sensor length and demagnetization factor, by substituting Bi ions into Y sites and substituting diamagnetic Ca ions into Fe sites in YIG. These results suggest that the new garnet composition is a highperformance material suitable for current/magnetic-field sensors.**

Keywords-rare earth ferrite garnet; current/magnetic filed sensor; single crystal growth; Faraday rotation effect

An Image Recognition Method of the Electric

Equipment Operation States

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Abstract: **A method of the recognition of electricity equipments operation state(EEOS) is put up based on Support Vector Machine (SVM). First Chinese character or number operation state images of electricity equipments are segmented with C-mean clustering; Then, feature vector of operation state image of electricity equipments is extracted using K-L transform; At last, classification method of SVM for state recognition is used. Experimental results show that classification method of SVM has better classification ability for classification of electricity equipments operating state, and can get better recognition result than that of neural networks. Comparing with all the kernel functions, kernel function of sigmoid is the best way to recognition of electricity equipments operation state.**

Keywords-Support Vector Machine (SVM); electricity equipments operation state(EEOS); image recognition; C-mean clustering K-L transform

Transitory Harmonic Analysis Using Harmonic Distribution Map

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***Abstract*—Wavelet packet transform(WPT) is established on the basis of Discrete WT, it has good time-frequency localization character and can be used to divide the spectrum of signals into**

uniform sub bands. Therefore, it has good performance for transitory harmonic analysis. This paper analyzes the implementation of WPT, and presents a method of harmonic distribution map based on the improved implementation of WPT for transitory harmonic analysis. Theoretical deduction and simulation results validate that harmonic distribution map has good performance for harmonic analysis. Therefore, presenting a good tool for harmonic analysis in power system.
Keywords- Harmonic analysis, wavelet transforms, Fourier transform.

Support Vector Regression Machine with Enhanced
Feature Selection for Transient Stability Evaluation

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Abstract— **This paper presents a Support Vector Regression Machine (SVRM) to predict the Energy Margin (EM) of power systems subjected to severe disturbances. The nonlinear relationship between the pre-fault, during-fault and post-fault power systems parameters and the degree of stability of the system under post-fault state is captured by the SVRM trained offline. Significant generators are selected by feature selection based on the sensitivity of stability margin and the features other than generators are selected based on a step wise feature selection by three fold cross validation. The performance of the proposed SVRM predictor is demonstrated through the simulations carried out on 17 generator reduced Iowa system.**
Keywords- Transient Stability, Support Vector Regression Machine (SVRM), Dimensionality reduction, Feature Selection,

Energy Margin(EM).

Voltage Stability Margin Computation and Visualization for Tri-State South Colorado Area using EPRI Power System Voltage Stability Region (PSVSR) Program

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***Abstract*— A comprehensive study has been performed to compute the voltage stability margin for Tri-State South Colorado area using EPRI Power System Voltage Stability Region (PSVSR) program. We determined the critical cut-sets to separate the weak region from the rest of the transmission network, calculated the voltage stability boundaries in cut-set state space, and investigated remedial action schemes.**

Keywords-component; Power System Voltage Stability Region

The Study of Generalized S-transform

in Power
Quality Disturbances Analysis

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***Abstract*—A new method based on generalized S-transform(GST) is presented for detecting and identifying power quality disturbances (PQDs). The GST formula of discrete time series is deduced firstly, and then nine kinds of typical PQDs are formed for GST analysis. As a result of GST analysis, three voltage-based characteristics, one frequency-based characteristic as well as one phase-based characteristic are extracted. According to the comparison of identification validity between GST and Stransform(ST) made in this paper, GST shows its advantage that it can detect not only voltage instantaneous varies, but also PQDs phase variation. Furthermore, the approach is proved to be quite viable for inter-harmonics detection.**

Keywords-PQDs; GST; detect; identification

On-line Supervising System for Boiler Combustion of Power Station

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***Abstract*—To help operators of power station to monitor major operating parameters and accurately adjust air distribution, this system is developed independently on the base of □ie□dbus Technology and JBuilder software. And heat balance law is accepted as the principal for the measurement of pulverized coal's concentration. This system could monitor and save operating parameters at all time, such as velocity and temperature of primary and secondary air, temperature of pulverized coal and pulverized coal-air, pulverized coal concentration. At the same time, it could realize past records inquiry, trend curve analysis, failures detection and alarm. So that this system could significantly improve boiler air distribution and combustion, and prevent pulverized coal-air pipe jam, then increase safety, stability and economy of boiler's operation.**
Keywords- Fieldbus; on-line supervising; pulverized coal concentration; heat balance law; primary air

A Vibration Based Condition Monitoring System for Power Transformers

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***Abstract*—This paper is concerned with the design and development of an on-line condition monitoring system for large power transformers utilizing signals such as transformer vibration, voltages, currents, temperature and state of switches. The system consists of two parts which communicate each other via Ethernet**

or series port. The formal is a front-end computer subsystem used for data acquisition and processing, and the latter is a remote computer subsystem for analyzing and monitoring transformer's operating conditions. It provides a reliable real-time service to power industry by integrating the transformers' electrical properties with the mechanical properties for detecting potential problems in power transformers. The developed system has became useful platform for an on-going project on the condition monitoring and fault diagnosis for large power transformers.
***Keywords*—vibration method; condition monitoring; power Transformer**

Transformer Fault Diagnosis Utilizing Rough Set and Support Vector Machine

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Abstract—In this study, we are concerned with fault diagnosis of power transformer. The objective is to explore the use of some advanced techniques such as rough set (RS), support vector machine model (SVM) and quantify their effectiveness when dealing with dissolved gases extracted from power transformers.

In order to increase data quality and decrease scalability of input data, we utilize the strong ability of RS theory in processing large data and eliminating redundant information, SVM is performed to separate various fault types of power transformer.

As the simulation results to verify the effectiveness, the proposed method showed more improved classification results than artificial neural network (ANN).

Keywords- Support Vector Machine; Rough Set; Transformer fault diagnosis; dissolved gases analysis

Leakage Current Pattern for Diagnosing the Contaminated Degree of Ceramic Insulators under Different Humidity

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***Abstract*—In this paper, Leakage current flowing along contaminated ceramic insulators was separated into low frequency component and pulse component, which were detected respectively by Rogowski coil in artificial contamination tests. The effects of the operating voltage, the equivalent salt deposit density and humidity on the two characteristic components of leakage current were investigated. It is revealed that the peak of the pulse current component has a sudden rising during the increase of humidity, and the inflexion has been found to be closely related with the low frequency current. The diagnosing methods based on the combination of the two current components have been proposed eventually.**

Keywords-ceramic insulator, contamination, leakage current, Diagnosing

wavelet-based de-noising method to online measurement of partial discharge

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***Abstract*—The extraction of partial discharge (PD) signals from excessively noisy environment is crucial to on-line PD measurement. Recent research shows that the Wavelet transform (WT) has achieved good effect in noise rejection in PD on-line detection. This paper presents some vital issues of WT implementation in extracting PD signals, including optimal**

mother wavelet selection, decomposition level selection, threshold rule determination, and thresholding function selection. The antinoise effect of this de-noising method is proved by simulated and field detected data.
Keywords-partial discharge; on-line measurement; wavelet denoising

Digital System for Detection and Classification of Power quality disturbance

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Abstrac*t*—In recent years power quality (PQ) has become a major concern to both power utilities and power customers. How to extract features of disturbances from large number of power signals and how to recognize them automatically are important for further understanding and improving of power quality. The paper presents an identification scheme for online monitoring and identification of power quality and system disturbances caused by nonlinear loads. The wide proliferation distributed renewable energy and green power sources, and rapid changes in utility load types require affordable and robust on-line data acquisition and expert identification systems, especially for utilization grid power systems. In this work, we propose a digital system for detection and classification of Power quality disturbance using wavelet transform and multi-class support vector machines. The proposed technique allows creating such expert systems with the extensible knowledge base, which can be used for identification of power distortion events.
Keywords- Power Quality, expert identification system, wavelet transform, support vector machine.

Inter-harmonics Spectral Estimation Based on
Improved Burg Algorithm

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Abstract—**Burg algorithm suitable for the inter-harmonics estimation, however, in the presence of noise, the obtained spectral estimates will be biased or even be erroneous. In this paper, an improved Burg adaptive algorithm based on higher-order cumulant is proposed to estimate the inter-harmonics signals. Firstly, this paper introduces the principle of Burg algorithm, and uses cumulant-based prediction error power in place of correlation-based prediction error power, based on the fact that higher-order cumulant is insensitive to gaussian noise. Then, the steepest descent method is used to calculate the reflectance coefficient, so as to reduce the computational complexity brought by the higher-order cumulant. The simulating result shows that the proposed method improved spectral estimation performance obviously, and can get accurately inter-harmonics frequencies even in the noisy environment.**

Keywords- Adaptive; Burg Algorithm; Higher-order Cumulant; Inter-harmonics Estimation; Gaussian Noise

Improved Algorithm of Scaleless Band Identification
on Correlation Dimension of Vibration Signal

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***Abstract*—An improved algorithm by curve-line-curve fitting piecewise is proposed for fractal scaleless band automatic identification, which is based on the study of the correlation integral algorithm and the distribution rule of the correlation integral series for vibration signal. To get the correlation dimension of vibration signal, a curve-line-curve fitting piecewise on the double logarithmic point series of correlation integral is processed firstly, with a target of least fitting residual square sum, and the middle line section can be treated as scaleless band, thereby the correlation dimension of signal can be got by that line section's slope. The method was applied to some real vibration signals, which were tested in different operation conditions and different rotate speeds. Finally the region of fractal scaleless band and the correlation dimension of signal are made automatically, which showed the effectiveness of improved algorithm. Meanwhile the result was compared with the calculation results by conventional three-line fitting method, while the comparison shows that the method is more precise.**
Key Words-Scaleless band; fault diagnosis; vibration signal; fractal; correlation dimension

Power System Fault Diagnosis Based on Fault Information System and Forward and Backward Reasoning

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***Abstract*—In this paper, an approach of power system fault diagnosis based on the fault information system and forward and backward reasoning is presented. From the fault information system, we get the power network topology and the configuration information of protection; we get the set of suspicious faulted equipments according to the operation rules and the operational information of breaker, protective relaying. The method and rules of identifying the faulted equipments by forward and backward reasoning are described in detail. The relation grade between faulted equipments and their protection are described also. Test result shows that the method can reduce processing time and increase accuracy. The method is more able than previous method to adapt to the changing of network configurations and protection configurations. The method is suitable for online applications.**
Keywords- fault diagnosis ***;*** the forward and backward reasoning***;*** fault information system

Application of LS-SVM by GA for Dissolved Gas Concentration Forecasting in Power Transformer Oil

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***Abstract*-LS-SVM (least square support vector machines) is widely used in the regression analysis, but the predition accuracy greatly depends on the parameters selection, in this paper, genetic algorithm is applied to optimize the LS-SVM parameters, correspondingly, the prediction accuracy is improved. First, this paper introduced the principle of LS-SVM and genetic algorithm, and gave the optimization parameter flow chart with genetic algorithm. Then this algorithm is used to forecast dissolved gas concentration in power transformer oil. Through comparing the forecasting result with the other results, which are forecasted by traditional SVM and LS-SVM, it proved that the method had the higher forecasting precision. Field application showed that the method is effectiveness.**

Keyword-genetic algorithm (GA); least square support vector machines (LS-SVM); forecasting model; dissolved gas analysis (DGA); power transformer

Harmonic Source Location at the Point of Common Coupling Based on the Nonlinearity Index of Load

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***Abstract*—Harmonic source quantitative location can not simply be achieved by the severity of load harmonic distortion at the point of common coupling (PCC) because the tested harmonic at PCC contains the background harmonic and the harmonic of given customer emission. Harmonics in distribution system are caused mainly by nonlinear loads. In view of this, a harmonic location method based on the nonlinearity index (NLI) of loads is proposed. In this method, the real parameters of loads are calculated by using the time domain model, and the linear parameters of loads are obtained by removing residual error. The nonlinearity index is calculated to evaluate the harmonic emission level. The simulation and the practical engineering results indicate that the proposed method is valid and feasible.**

Keywords- Nonlinear load, Nonlinearity Index, Harmonic emission level, Harmonic source location

The Optimized Combination of Fault Location Technology Based on Traveling Wave Principle

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***Abstract*—The accuracy and the reliability of modern D-type double-ended and A-type single-ended traveling wave fault location principles used for transmission lines is comprehensively evaluated. Based on the evaluation, this paper presents the idea of optimized combination of location based on these two traveling wave principles, and successfully applies the idea in actual fault analysis of transient traveling waves. Compared with the traveling wave location schemes based on D-type or A-type principle alone, this scheme has the greatest advantages of utilizing the A-type traveling wave principle to verify and correct the location results obtained with the D-type traveling wave principle, so that both the location reliability and accuracy are enhanced. Practical applications showed that the optimized combination of traveling wave location schemes is feasible, and the location precision is improved significantly.**
Keywords-electromagnetic transient propagation; fault location; global positioning system; power transmission lines; surges

Fault Diagnosis based on PCA and D-S Evidence Theory

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***Abstract*—A fault diagnostic method combined with principal components analysis and D-S evidence theory is presented. Firstly a set of principal components models(PCM) are established by the type faults sample data, and high dimensions data could be characterized by the low dimensions data as new sample data under the condition of information lose least, and then the new data are to train the radial basis function neural network as recognition network to construct basic probability assignment function; Measurement data are analyzed with the PCM to get the low dimension characteristic vector, that are identified by recognition network; Finally the recognition result is fused by combining rule of D-S evidence theory as decisionmaking. The simulation study on boiler feed water control system shows that the fault of sensor can be isolated correctly and effectively by this method.**
Keywords- automatic control technique; power plant; fault diagnosi; D-S evidence theory; principal components analysis

Research of cloud neural network based on cloud transformation and its application on vibration fault diagnosis of hydro-turbine generating unit

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***Abstract*—**Existing vibration fault diagnosis methods' application was limited because the lack of randomness, fuzziness and the relevance between the two. So a new algorithm-cloud neural network(CNN) based on cloud transformation is presented in this paper. And the vibration fault diagnosis steps of CNN based on cloud

transformation are: First, extract the spectral feature vectors in the frequency domains of the generation sets as training samples, and the digital characteristic of clouds of training samples are obtained by cloud transformation; Then the feature vectors are used as training samples and the digital characteristic of clouds as initial weight to train the CNN to realize the mapping relationship between spectral feature vectors and fault types, thus achieving the purpose of diagnosing faults. The result shows that the application of CNN based on transformation on vibration fault diagnosis is feasible.
Keywords- Cloud neural network(CNN); Cloud transformation; Fault diagnosis; Vibration; Hydro-turbine generating unit

Development and Implementation of Intelligent System for Gas Insulated Switchgear

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***Abstract*—A set of online monitoring and control system for Gas Insulated Switchgear (GIS) has been developed and implemented in this paper. Most main mechanical and electrical parameters of GIS can be monitored and phase controlled operation can be realized by this system. Therefore, the intelligentization of GIS can be achieved. Optical Ethernet, embedded technologies and modular design method have been adopted in system design and development, which make the system meet the requirements of IEC61850 □ the new generation communication standard for substation automation. Furthermore, EMC technologies have been applied and the system has passed the fourth rigorous level EMC test, which is the most strictest one for substation automation device. The monitoring system has been practically applied in a 110kV substation.**
Keywords-Gas Insulated Switchgear; Online Monitoring; intelligentization; IEC61850; EMC

Research on Ultrasonic Locating of Partial Discharge in Power Transformer Based on Modified Multiple Signal Classification

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***Abstract*—The precise PD locating in power transformer can provide scientific information and guidance for its state maintenance. Due to the low resolution and estimation precision of MUSIC algorithm in PD locating used ultrasonic phased array, in this paper, a new locating method is proposed based on Modified Multiple Signal Classification (MMUSIC). Firstly, MMUSIC algorithm is used for direction of arrival estimating of PD source. Secondly, space locating of PD source is realized by crossover locating principle. Finally, the result of simulation based on 8×8 plane phased array model vertifies the correctness of the new method, with the error less than 6 centimeters.**

***Keywords* -- Power Transformer; Ultrasonic Phased Array; Modified MUSIC; PD Locating**

A New Power System Fault Diagnosis Method Based on Rough Set Theory and Quantum Neural Network

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***Abstract*—This paper proposed a novel fault diagnosis scheme for estimating the fault section of power system by using hybrid Rough Set and Quantum Neural Network (RSQNN). The RSQNN approach is developed basing the**

rough set attributes reduction and quantum neural network recognization. The efficiency and fault tolerance of RSQNN scheme used for fault diagnosis is evaluated in simulation studies, which show promising results that the faults section can be accurately diagnosed in complex power grid and imperfect/uncertain fault information condition.

Index Terms— **Rough set theory; Quantum neural network; Fault diagnosis; Fault section estimation**

Detection of Power Quality Disturbances Based on Generalized Morphological Filter and Information Theory

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***Abstract*—Detection of power quality (PQ) events is a significant task for the power system monitoring. This paper presents a new method for the detection of PQ disturbances using mathematical morphologic and information theory, which employs the generalized morphologic filter as pre-processing unit and difference entropy as a feature extracting unit. A simulation on six ideal signals, such as ideal sine wave, interruption, voltage sag, voltage swell, impulse and oscillation transient, is done and its results show that the proposed method has good adaptability on signals excepting disturbance occurs on cross-zero instant.**

Keywords- generalized morphologic filter; difference entropy; power quality; detection

Distribution System Fault Diagnosis

Scheme Based
on Multiple Information Sources

For Railway Passenger Dedicated Line

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Abstract—**For power distribution systems of passenger dedicated line demand high reliability of power supply, it is very important to detect fault, locate fault and restore power supply as quickly as possible. A novel fault diagnosis scheme based on multiple information sources is proposed in this paper. The scheme is wavelet based and realizes fault detection, fault inception identification, fault classification and single line to ground fault location. In order to actualize rapid fault detection, modal electric component resulting from a novel phase-modal transform is employed. Fault detection, fault inception identification and fault classification process all use local transient electric quantities, and in addition, fault classification also uses local protection information. The fault location process is artificial neural network based and uses the interested frequency band signal of voltage and current to locate fault. Through simulating in MATLAB/SIMULINK, the results show that the proposed fault diagnosis scheme is correct and reliable.**

Keywords-railway power distribution systems; passenger dedicated line; fault diagnosis; artificial neural networks; phasemodal transform

New Method of Live Line Measuring the Impedance

Parameters of Transmission Lines

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Abstract—**Based on GPS technology, a new Algebra Equation Method (AEM) of live line measuring the parameters of transmission lines with mutual inductance is proposed. The mathematical model of the new method is explained in detail. The hardware structure of the live line measuring system based on GPS is given. Digital simulation results are shown. Finally, an example of live line measuring six 500-kV transmission lines with mutual inductances in North-East China power grid is given. Comparison of results between AEM and an Increment Equation Method (IEM) is also shown. The field measurement results prove that the new method can meet the need of live line measurement of transmission lines' inductance parameters.**

Keywords- Global Positioning System; live line measurement, power system, transmission lines, zero sequence parameters

Assessment of Rotor Degradation in Steam Turbine Using Support Vector Machine

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***Abstract*—Steam turbines are the major equipments in power industries, which play an important role in national economic production. Rotors are the critical component of steam turbines, the assessment of rotor degradation is of great significance to ensure the safe and economic operation of the power plants. In this paper, support vector machine (SVM), a new machine learning technique, is applied to assess rotor life loss severity. Comparing to traditional mechanism methods for rotor residual life evaluation, the SVM model has no limits of the dimension of inputs and less time is spent on computation. Furthermore, the method provides a feasible tool for online rotor condition monitoring and even life prediction based on future operation schedules. The methodology presented in this paper was validated using the data including various starting parameters and corresponding life loss values from Harbin Turbine Company, the evaluation accuracy shows the effectiveness of the method.**
Keywords-component; formatting; style; styling; insert (key words)

Experimental Study and Data Processing of On-line Monitoring System for High Voltage Cables

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***Abstract*—A high-reliability, high-precision, small volume of insulation on-line monitoring system for high-voltage cables is developed. Without changing the connection of original power**

system, the aging state of cable insulation is evaluated by multiple parameters relevant to insulation to improve the reliability of monitoring. Constructed experiment is carried out to verify the performance of the monitoring system. The main modules and functions of the system were tested. Experimental results show that the system has better measuring accuracy and an effective means is provided to monitor the changes of cable insulation parameters. To void the influence of data disturbance and periodic change, exponential smoothing method is introduced to extract the trend of monitoring data and improve the reliability of diagnosis.
Keywords- high voltage cable; on-line monitoring; insulation parameters; experimental study; trend extraction

Crack detection in structural systems using electro-mechanical signatures

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Abstract- **A modified model combining EMI technique and RMM is proposed to quantitatively correlate crack parameters with piezoelectric signatures for structural health monitoring. The structural members are modeled as Timoshenko beams for flexural motion and as the classical longitudinal rods for axial motion as well as the cracks are treated as massless rotational springs. For a structural member with surface-bonded PZT wafer, a coupled system is considered. Then, an analytical expression of impedance involving information of cracks is derived. Based on this model, EMI signatures extracted from the PZT wafers can be used to identify cracks in a structural system.**
Keywords- EMI; RMM; structural health monitoring; coupled system.

Effective Method to Diagnose Abnormal Vibration

Of Dish Centrifugal Separator's Helical Gear

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***Abstract*□Dish centrifugal separator is a kind of high speed rotary machine, which is widely used in rubber, pharmacy and food industry. Any fault of rotary part could bring about separator's strong vibration and noise. Not only can the strong vibration debase machine's separating efficiency, but it can also affect operator's health. Condition monitoring by vibration is a proper way to reduce loss brought by separator's faults. For dish centrifugal separator, helical gear's condition is closely related to separator's working state. In this paper, main faults of dish centrifugal separator's helical gear are described. In order to analyze the dish centrifugal separator's vibration with different helical gear correctly, the vibration is tested with helical gear both under normal and abnormal condition. After comparing several general methods of gear's fault feature extraction, a new convenient and effective method is presented on the basis of analyzing vibration spectrum under different rotary velocity. Experimental result shows that method proposed in this paper is effective.**

***Keywords*□condition monitoring; vibration test ;dish centrifugal separator; helical gear; fault diagnosis**

Target Value Surface and Energy Loss Surface in the Steam Turbine Unit Performance

Monitoring System

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***Abstract*—In order to optimize the performance of the steam turbine unit performance monitoring system, improve the reliability, stability and accuracy of the system, a new idea to establish target value surface and coal consumption growth surface in different load is presented. Take an imported supercritical steam turbine unit, which capacity is 600MW, as an example to expound the design idea, the mathematic model and the construction process of these two types of surfaces.**
Keywords- coal consumption growth surface; target value surface; steam turbine unit; performance monitoring system

Fault Diagnosis Based on Cluster Analysis Theory in Wide Area Backup Protection System

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***Abstract*—In wide area backup protection of electric power systems, the prerequisite of protection device's accurate, fast and reliable performance is its corresponding fault type and fault location can be discriminated quickly and defined exactly. In our researches, global information has been introduced into the backup protection system. By analyzing and computing real-time**

PMU measurements, basing on cluster analysis theory, we are using mainly hierarchical cluster analysis technology to seek after for the statistical laws of electrical quantities' marked changes. Then we carry out fast and exact identification of faulty components and faulty sections, and finally accomplish fault isolation. Multivariate statistical analysis theory is an efficient theory that can resolve different kinds of complex problems. It has been applied successfully in many researches of various fields, such as geology, weather, hydrology, iatrology, industry, agriculture, and economy, etc. In the study of electric power systems, multivariate statistical analysis theory must also have a good prospect of application.

Keywords-Multivariate statistical analysis theory; wide area backup protection; phasor measurement unit, PMU; fault diagnosis; hierarchical cluster analysis

A Novel Real-Time Fault Diagnostic System by Using Strata Hierarchical Artificial Neural Network

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***Abstract*—The real-time fault diagnosis system is very great important for steam turbine generator set due to a serious fault results in a reduced amount of electricity supply in power plant. A novel real-time fault diagnosis system is proposed by using strata hierarchical fuzzy CMAC neural network. A framework of the fault diagnosis system is described. Hierarchical fault diagnostic structure is discussed in detail. The model of a novel fault diagnosis system by using fuzzy CMAC are built and analyzed. A case of the diagnosis is simulated. The results show that the real-time fault diagnostic system is of high accuracy, quick convergence, and high noise rejection. It is also found that this model is feasible in real-time fault diagnosis. This electronic document is a "live" template. The various components of your paper [title, text, heads, etc.] are already defined on the style**

sheet, as illustrated by the portions given in this document.

Keywords- real-time fault diagnosis strata hierarchical neural network fuzzy CMAC steam turbine generator set

On the use of traveling wave for fault location in coal mine distribution power systems

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***Abstract*—Coal mine distribution power system is a one-terminal power network which located at the end side of power network. When single phase to ground fault occurs, fault current is too weak to locate the fault position. In order to solve this problem, a new algorithm is presented, which uses the difference of wave velocity between ground mode component and aerial mode component of traveling wave that arrives at the point of detection, the occurring time of modulus maxima of the wavelet can be considered as the arriving time of the ground mode component and aerial mode component of current traveling pulse. Only the time of initial wave head arriving is detected, and it is not affected by other branch lines, the dependability of the fault location is improved. Further more, the on-line measurement of traveling wave velocity is implemented, and it is effective for the improvement of fault location accuracy based on traveling wave. The simulation of the ideal condition and the existence of transitional resistance in the 6kv mine power network proved that this method is more effective and feasible.**

Keywords-mine; power cable; fault location; modulus maxima; traveling wave velocity; aerial mode; ground mode

A Novel Commutation Strategy to Suppress the Common Mode Voltage for the Matrix Converter

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***Abstract*—The double line-to-line voltage synthesis of matrix converter is based on the instantaneous value of the input line-toline voltage. And the obvious advantage of this modulation strategy to automatically suppress the imbalance of the input voltage makes it excellent in the modulation strategy of the matrix converter. Considering the EMI issue in driver system based on matrix converter, common mode voltage is of great importance. Reducing the common voltage actively could be achieved by designing the proper modulation strategy a new modulation strategy with reduced common voltage in the context of double line-to-line voltage synthesis is proposed in this paper. It is based on the idea without employing zero vectors instead of the vectors which are opposite to the active vectors in space vector modulation. The modulation strategy is verified by the simulations finally.**

Keywords- Double line-to-line voltage synthesis, common mode voltage, commutation strategy, Matrix Converter

Upgrade of Fujian grid on-Line Stability Control System for the Transformer Operating of 500kV

Ningde Substation

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***Abstract*—To adapt the need of stability control of Fujian grid after the transformer operating of 500kV Ningde substation, Fujian grid on-line stability control system has been upgraded. After stability computing and analyzing, the upgrading scheme has been putted forward, and the upgraded system has been implemented successfully.**

Keywords-500kV Ningde Substation; on-Line Stability Control System

Hysteresis Space Vector Control for Parallel Active
Power Filter

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Abstract—**This paper analyzes the basic control principle of space vector PWM combined with hysteresis, and applies this method to control the Parallel Active Power Filter(APF). The simulation results through Matlab show that the output compensation current at any time can be real-time tracking the instruction current of the APF to reduce the current compensation error effectively, and eliminate the harmonic currents pollution on the grid caused by nonlinear loads.**

Keywords- *Parallel active filter; Hysteresis space vector; Simulation*

A New Control Strategy for Voltage-Type

PWM
Inverter to Realize Zero Steady-State Control Error

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***Abstract*—In this paper , a new simple control strategy for the output voltage of voltage-type pulse width modulation(PWM) inverter which can eliminate the steady-state control error completely is proposed. In the proposed control system, a resonant element implemented by a digital signal processor(DSP) is introduced as a feedback controller. The resonant element exhibits a function similar to an integrator for the fundamental frequency component. Thus, it can eliminate the steady-state control error completely. The principle of the proposed control method is discussed, and its effectiveness is shown theoretically. To confirm the effectiveness of the proposed control method, some simulation testing are shown.**

Keywords- resonant element,inverter,zero steady-state error.

Study on Low Frequency Oscillatory Active Power Increment Distribution Based On Transmission Network Structure-Preserving Model

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Abstract**Based on the structure-preserving power system model, the linearized state space with detailed generator model, excitation system model and dynamic load model has developed. The novel method for calculating low frequency oscillatory active power increment distribution by employing the eigenvalues and eigenvectors of the linearized state matrix is presented. The method not only can be applied to calculate oscillatory active power increment distribution over generators, transmission lines and loads, but also can be used to analyze the effects of load on power system low frequency oscillatory. Simulations carried on four-machines example system testify the validation of the proposed method.**

Key Words*power system; low frequency oscillation; structurepreserving model; oscillatory active power

Application of Nonlinear PID Controller in Main Steam Temperature Control

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***Abstract*—The fixed parameters in traditional PID controller lead to poor performance. In this paper, the ideal change relationship between the error of the control object and the control parameters is analyzed and nonlinear functions are presented to form a nonlinear PID controller. The parameters are tuned with the NCD Blockset in Simulink. The nonlinear PID controller is applied to one main steam temperature control**

system. The simulation results show that the nonlinear PID controller has better performance and robustness than traditional linear PID controller.

Keywords-nonlinear PID controller; NCD Blockset; main steam temperature control;

Power System Oscillation Mode Analysis and Parameter Determination of PSS Based on Stochastic Subspace Identification

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Abstract—**Advanced mathematical tools with the potential to identify and characterize these dynamics in near real time have been applied very successfully to power system.This paper introduces the stochastic subspace identification(SSI) to the analysis of power system low frequency oscillations,and the power system stabilizer can be designed to use the results of identification and residue .This method can overcome the incapability for the Prony and ARMA algorithm effected by signal noise and system orders.And at the same time,the complex process of identification and the long time of calculation in the HHT transformer can be dealt with. Using the SSI method,the oscillatary information can be obtained accurately from signal containing noise.And the parameters of PSS can be designed only by using the observation signal. This method can be used to power system low frequency oscillations on-line identification and control.The real test data and simulation results show that this metod is a highly effective tool for power system low frequency oscillations.**

Key Words—low frequency oscillations ***，dynamic characteristics，modal，residue，Stochastic subspace identification (SSI)***

Inversion Control Method of Components in Power Systems Based on Structural Models

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***Abstract*—The component structural models can fully describe the complex characteristics of components in real power systems, including nonlinearity, DAE (differential-algebraic equation), sub-system, etc. In this paper, inversion controllers of components are designed based on component structural models. Firstly, the inputs and outputs of component structural model are expanded, and then an expanded controlled object of component expressed by standard ODE (ordinary differential equation) model could be derived. Secondly, based on the Interactor Algorithm, the inversion controller is designed. The proposed inversion control method is theoretically strict and effective. Meanwhile, choosing SVC (Static VAR Compensator) as an example, the detailed procedure of designing controller is illustrated.**

Keywords-inversion control; component; power systems; interactor algorithm

Harmonic Signal Detection Algorithm in Parallel of UPQC Studies Based on PSO-FUZZY

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***Abstract*—The growing interest in power quality has led to a variety of devices of mitigating power quality problems.**

Integrating the character of parallel power quality compensator and series power quality compensator, unified power quality conditioner (UPQC) has generally been accepted as a new electric power quality conditioner which has a good development prospect. A new harmonic signal detection algorithm of UPQC which abandons original vector transformation and low pass filter aiming at measuring and compensating for reactive power and harmonic current is proposed in this paper. Fuzzy controller based on particle swarm optimization is discussed for its character of simple computation and high measurement accuracy. Simulation is used to verify the control concepts.
Keywords- unified power quality conditioner; harmonic compensation; particle swarm optimization; fuzzy control

Multi-Objective Synthesis Based on Extended State Observer and LMI Optimization for Excitation System of Synchronous Generator

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***Abstract*—This paper presents a method to design excitation controller. The main results rely on extended state observer (ESO) and linear matrix inequalities (LMI) optimization which can handle various closed-loop specifications, such as a given set of admissible initial states, asymptotic stability of the saturating closed-loop system, and *D*-stability, on different channels. The dynamic feedback linearization method using the nonlinear ESO is introduced, and anticipating dynamic characteristic design for**

the linearization system is also demonstrated. The validity and applicability of the proposed method are illustrated in a singlemachine infinite-bus (SMIB) system.
Keywords- extended state observer; linear matrix inequality; pole placement; saturation nonlinearity; excitation system

Nonlinear Predictive Control on the Load System of a Thermal Power Unit Based on AOSVR and SAPSO

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***Abstract*—Due to the strong coupling and nonlinear properties of large-scale boiler-turbine-generating unit load control systems, conventional linear control strategies don't yield satisfactory control performance. We hereby propose a novel nonlinear predictive control strategy based on online support vector regression model and simulated annealing particle swarm optimization algorithm. A support vector regression model derived from online auto-tuning identification, is used for the prediction of future plant behavior. The receding horizon optimization of nonlinear predictive controller is achieved online by simulated annealing particle swarm optimization algorithm, in order to obtain the corresponding optimal control actions at each sampling instant. The simulation study results show the proposed control method has excellent control performance and enhanced self-adaptability, and thus is suitable to the boilerturbine-generating unit load control systems.**
Keywords- predictive control; thermal power unit; load control system; accurate online support vector regression; simulated annealing particle swarm optimization algorithm

Transient Stability Analysis of Large-Scale Power Systems Based on Reduce Feature

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Abstract **- This paper presents an effective data analysis approach for character data compression from bi-direction. At the first step of the algorithm, basing on the theory of component analysis, the paper adopt a principal component analysis approach to reduce the dimension of data horizontally, then after comparison of existing clustering algorithms, put forward an immune clustering algorithm based on similarity measurement of principle component core for vertical reduction by using related mechanism of clone selection as well as immune network selfstabilization in organism natural immune system for reference. Finally, a pattern discrimination model based on a cerebellar model articulation controller neural network was developed. Simulation experiments on the data from the process control field proved the effectiveness of this algorithm.**

Index Terms **- feature compression, data mining, machine learning, fault diagnosis, principal component analysis (PCA).**

Small-Signal Stability Analysis of a Grid Connected Doubly-Fed Induction Generator under decoupled P-Q control

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***Abstract*—Small signal stability analysis is conducted considering grid connected doubly-fed induction generator (DFIG) type. The modeling of a grid connected DFIG system is first set up and the whole model is formulated by a set of differential algebraic equations (DAE). Then, the mathematical model of rotor-side converter is built with decoupled P-Q control techniques to implement stator active and reactive powers control. Based on the abovementioned researches, the small signal stability analysis is carried out to explore and compared the differences between the whole system with the decoupled P-Q controller or not by eigenvalues and participation factors. Finally, numerical results demonstrate the system are stable, especially some conclusions and comments of interest are made.**

DFIG model; decoupled P-Q control; DAE; small signal analysis;

Transfer Limit Enhancement Using Decentralized Robust STATCOM Control for Wind Farm

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***Abstract*—In this paper, we analyse the effects of the integration of various types of wind generators into power systems based on available (dynamic) transfer capability (ATC). The amount of static (shunt capacitor) and dynamic compensations (STATCOM) to restore[1] and enhance the transfer capability for fixed speed wind generators integration is determined. In addition, we compare the effects of both fixed and variable speed wind farms (WFs) penetration on transfer capability. A**

decentralized minimax linear quadratic Gaussian (LQG) based STATCOM (Static Synchronous Compensator) controller for fixed speed wind turbine is designed to enhance the ATC. The effectiveness of the suggested control strategy is confirmed by nonlinear dynamic simulations. The simulation result shows that the dynamic voltage stability can be improved by the use of the robust control and thereby power transfer limit increases.

Transient Stability Analysis of Power System Based on Bayesian Networks and Main Electrical Wiring

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***Abstract* - In order to deal with the uncertainties of power system better and overcome the shortcomings of other artificial intelligence methods, a new method based on Bayesian networks and main electrical wiring was proposed. Reliability analysis methods were adopted such as depth-first search (DFS) and matrix method. Multi-state components were introduced to represent the main electrical wiring. All contingency states were obtained by minimal cut sets. Markov Chain Monte Carlo (MCMC) program of approximate inference algorithm was then applied. Vulnerability was used as index to denote the weights of some vectors and was updated in real time. The example of 3/2 breakers scheme of power plant testified the feasibility of this model. It could effectively transform uncertainties into probabilities and achieve ideal results.**

***Index Terms* – Dynamic security assessment, transient stability, Bayesian networks, main electrical wiring**

Distributed Model Predictive Control Employing Trajectory Sensitivities for Cascading Failures

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***Abstract* – The paper introduces a new distributed model predictive control (DMPC) method employing trajectory sensitivities for the cascading failures of the complex power system. Firstly, it predictes the trajectories of the system by trajectory sensitivities. Secondly, it uses the MPC to find out the optimization control method, and activates it to eliminate the cascading failures of the large-scale power system. It simplifys the DMPC employing the trajectory sensitivities optimization control algorithms.**

Index Terms – Cascading failure, Trajectory sensitivities, DMPC.

Semi-acive Mode Fuzzy Control for Multi-Dof Floating raft Isolation System with Magnetic Suspension isolators

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***Abstract*—The magnetic suspension isolator is designed. Multi-**

DOF floating raft vibration isolation system supported by magnetic suspension isolators and ordinary vibration isolators is established. Taking the system as research subject, the dynamic mathematic expressions of ever parts of system are established. Base on the expressions, a semi-active output feedback mode fuzzy controller is designed for floating raft isolation system with magnetic suspension isolators. Then, optimal stiffness of magnetic suspension isolator and the appropriate current could be obtained. Input force and output force response of floating raft isolation system, under complex-frequency exciting signal and shock exciting signal are simulated. The simulation results indicate the isolation performance and resistance characteristic of magnetic suspension supporting floating raft isolation system with semi-active mode fuzzy control method are more effective in vibration isolation in comparison with the passive optimal system. *(Abstract)*
Keywords- Magnetic suspension isolator, Mode Fuzzy control, Floating raft isolation system, Semi-active

Comparison of 3 Kinds of Reactive Power Compensation Modes Based on Matlab/Simulink

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***Abstract*—The principles and technologies of var compensation implemented with Static capacitors, Static Var Compensator and Static Var Generator are concisely presents. The simulation and study for these methods are made. These methods' merits and faults are also compared through the wave analysis after simulation. It is shown the SVG is even more advantageous to dynamically improve voltage regulation, stability, and power factor.**
Keywords-reactive power compensation; Static Var

Compensator; Static Var Generator; Matlab/Simulink

Energy Saving and Optimal Control of Gas Boiler Group

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***Abstract*—In order to achieve energy-saving and improve the quality of heat output, the optimize energy-saving control system based on the original boiler group was designed. This article is aimed to discuss the feed-forward control technology based on the optimal air-NG(natural gas) ratio combustion and the control strategy of the boiler group based on feedback and feed-forward compensation, what's more, system structure and backup redundancy technology are introduced in this article.**

Keywords-energy-saving; boiler group control; optimal control; compound control; backup redundancy.

Study on Sine Waveform Inverter Based on S-Domain Repetitive Control

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***Abstract*—The key of the sine waveform inverter design is to assure the quality and stability of its output waveform, as well as the adjusting ability to different kinds of loads. The repetitive control technology is used in this paper to realize the periodic signal tracking control of the sine waveform inverter, and a new method of stability analysis and design of repetitive controlled**

sine waveform inverter is also proposed. Analog repetitive controller is realized by using analog delay chip MN3304, and repetitive control for the single phase sine waveform controller is researched. The experiment results show that this method is valid.
Keywords- sine waveform inverter; instantaneous current control; repetitive control; stability; non-linear load

Research on Closed-loop Control of Single-Phase Excited Permanent Magnet Synchronous Generator

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Abstract—**Aiming at the characteristic of excited single-phase brushless synchronous generator, it is analyzed that the single closed-loop excitation regulator has a defect that its output voltage is reducing with increasing load. Using double closed loop speed regulation system of DC motor for reference. Design a new type regulator which has a excitation current inner loop and voltage outer loop, and use PWM method to regulate excitation current. Based on mathematic model and design target of the diesel generator and voltage regulation of generator's steady and dynamic state, Current and voltage regulator are designed by typical link which is known by relation of target and parameter. The test result shows that the whole system has advantage that is regulating voltage precision and fast response. The voltage regulator is designed by engineering method, and it meets the requirements after correcting.**
Keywords- single generato;, double closed-loop; PWM

A New Combined Model for Simulation of

Mutual Effects between LFC and AVR Loops

***Abstract*— In this paper a new model is proposed to show the interaction between the LFC and the AVR loops. These coupling effects of the AVR and LFC loops are studied by extending the linearized AGC system to include the excitation system. A complete system model for low-frequency oscillation studies should be composed of mechanical and electrical loops. So one machine - infinite bus model of a power system is combined to load frequency control system. This proposed combined model is tested on one-area power system. The results are shown that by using this model more accuracy will be reachable in dynamic and steady state responses.**

Keywords-component; Automatic voltage regulation, Excitation system, Load frequency control, Low-frequency oscillation

The Research on H□ Control and Fuzzy Control in Shunt Active Power Filter

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***Abstract*—The traditional control strategy of active power filter(APF) has low accuracy and bad robustness. Firstly, a statespace model of shunt APF is established. Taking errors as unknown disturbance to the system, a robustness controller is designed based on the H□ control theory. Secondly, the fuzzy PI control with self-adjustable factor is applied in the DC-link voltage control of APF. The self-adjustable factor regulates in the whole region according to error absolute value and the outputs are the corrections of scale factor and integrating factor. Finally, the designed H□ controller and fuzzy controller are used in the simulation model of APF. From the simulation, it can be seen that the controller can improve the current compensation effect of APF meanwhile stabilize the DC-link voltage. Simulation**

results certify that the synthetical control method can improve the stability as well as the robustness of control system and the APF has better effects on the harmonic compensation.

Keywords-active power filter; H control; fuzzy control; selfadjustable Factor

Simultaneous coordinated tuning of PSS and FACTS damping controllers using improved particle swarm optimization

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***Abstract*—This paper deals with the simultaneous coordinated tuning of the power system stabilizer (PSS) controllers and the flexible ac transmission system (FACTS) power oscillation damping controllers in power system. A new particle swarm optimization approach is proposed for the design of optimal PSS and FACTS power oscillation damping (POD). Simulation results of multi-machine power system validate the efficiency of this approach.**

Keywords-low frequency oscillation; damping control; particle swarm optimization power system stabilizer; FACTS; static synchronous series compensator ; Prony

Research and Simulation on Dynamic Characteristics of Excitation Control System

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Abstract-Taking a practical Power System Stabilizer (PSS) as an example and Using the concept of comprehensive damping coefficient method to study supplementary excitation control systemic parametric, This paper analyzes parameter dynamic characteristic of accelerating power signal input in various working condition . A PSS's optimal parameter is designed. As a result, it presents the convenience for engineering design and parameter selection.
Keyword-comprehensive damping coefficient damping characteristic Power System Stabilizer

A Novel Way for Using Chopper Method to Stabilize Amplifier

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Abstract—**In this paper, historical background and fundamental concept of chopper stabilized amplifiers are introduced. Then effects of noise and residual offset are analyzed. Several techniques to reduce the residual offset are proposed. Also some of the disadvantages of chopper stabilization technique, as compared to correlated double sampling technique, are stated. Applications of chopper stabilized amplifiers, some latest research findings, and some new products utilizing chopper stabilization technique are given.**
Keywords-choppert; stabilize; system control

Analysis and Application of Synchronous Motor

Running at Adjusted Voltage

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***Abstract*—Two problems-power factor regulation and out of synchronism protection for synchronous motor need to be further investigated under inverter supply power. Due to the inherent relations among the stator voltage, current, power factor, and power angle, the adjustable stator voltage takes an effect on the variation of these parameters. This paper presents the relationship of the quantities using phase graph under steady state adjustable voltage. It also demonstrates the calculating model and their regular interactions of the aforementioned variables. Finally, the validity of analysis has been verified by the experiment. The results show that the power factor control in certain range and out-of synchronism protection can be effectively implemented by adjusting the stator voltage.**

Keywords- Synchronous Motor Power Factor Regulation Adjustable Voltage Running Out-of Synchronism Protection

A Novel Fast Searching Algorithm for Power System Self-adaptive Islanding

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***Abstract*—Self-adaptive system islanding refers to the separation of an interconnected power system into electrically isolated islands automatically based on the identification of unstable mode. A fast searching algorithm for self-adaptive power system islanding, which is called multilevel reduced graph partitioning (MLRGP) algorithm, is presented in this paper. The aim of this algorithm is that the generation load imbalance in each island is as small as possible. The algorithm computes a reasonable islanding strategy of power system $G=(V, E)$ in $O(|E|)$ time. A C++ program is developed based on the algorithm. The verification of the islanding program is proven with simulations on a practical 212-bus power system. It costs only about 20 ms to get a reasonable islanding strategy on an ordinary PC, which satisfies the speed demand of self-adaptive system islanding.**
Keywords-generation load imbalance; islanding strategy; power system; system islanding; unstable mode

Analysis of 3D Transient Temperature Field for Permanent Magnet Linear Synchronous Motor with High Thrust Density

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***Abstract*—Double-side tabular permanent magnet linear synchronous motor (PMLSM) with high thrust density, which is with high current density, produces large loss and quick temperature rise. In this paper the mathematic model of threedimensional (3D) transient temperature field for a permanent magnet linear motor with high thrust density is established, and the basic hypothetical conditions and relative boundary conditions of the solved region are presented. The temperature**

fields of motor in different working systems are calculated. Also the laws of motor transient temperature rise and distribution are analyzed. Calculation and practical measurement results are in satisfactory agreement, both of them provide guidance for the security application of these motors with high current density, and provide the basis for the reasonable design of the cooling system.
Keywords- PMLSM; working system; primary, 3D transient temperature field

A New Approach for Classification of Disturbed Trajectories

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***Abstract*—In this paper, a new approach is proposed for classifying machines into critical cluster and remaining cluster by trajectory sensitivities. Trajectory sensitivity functions of the post-fault system with respect to parameters are computed to classify the swing curves and identify the unstable mode. The method is independent of model complexity and parameters concerned. By the presented method, the trajectory sensitivities can be easily obtained by Taylor series formula using some intermediate results instead of the independent numerical integration computation method. Therefore, computing efficiency is greatly improved. Numerical simulation results for IEEE 10-machine system have shown that it can classify the critical cluster correctly and increase little extra computational burden only.**
Keywords -- coherent group recognition, transient stability, power systems, trajectory sensitivity.

A Hardware-in-the-loop Simulation System of Diesel

Engine Based on Linux RTAI

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***Abstract*—In this article, the rapid prototyping technology is used to develop a hardware-in-the-loop simulation system for the diesel engine electronic control unit development. The hardwarein-the-loop simulation is based on Linux RTAI system, an open source hard real-time extension of the Linux Operating System, at low costs and within industrial standards. It exploits standard x86-based computing platforms provided with real-time Linux software in combination with generic computer-aided design software (Matlab/Simulink). One of its main characteristics is that it can automatically generate the real-time simulation code for many target processors, which runs under Linux RTAI operating system.**

Keywords- Diesel Engine; Rapid Prototyping Simulation; Realtime Linux; Hardware-in-loop Simulation

The emulation research of a heat-exchanger based on segment linearization

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***Abstract*—To accurately obtain emulation model of a heatexchanger, segment linearization was applied to the lumped parameter model: the whole heat-exchanger was divided several segments equally and became their connection. Each small heatexchanger applied the lumped parameter model of segment linearization. At the same time, the whole heat-exchanger embodied distribution parameter's characteristics of several small heat-exchangers' connection. Then the relevant emulation model was made according to this method. The emulation results show that the emulation model can effectively simulate the real dynamic process of a heat exchanger's operation.**
Keywords -heat-exchanger;emulation;segment linearization

Analysis of Low Frequency Oscillation Mode Based on PMU and PRONY Method

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***Abstract*—Low-frequency power oscillation issues are both serious in Yunnan power grid and Southern China power grid, the two "west to east" complex and long chain configuration networks. Based on the significant data provided by the real-time monitoring system in Yunnan power grid, low-frequency issue is analyzed by Prony method, frequency, amplitude, angle and the damping ratio of system are obtained. Analysis results provide suggestions to establish restraining measures for low frequency oscillation and operation control strategy to restrain lowfrequency oscillation.**

***Keywords*-Low Frequency Oscillation; Southern China Power Grid; PMU; PRONY Method**

A Dynamic Model of PEM Fuel Cell Stack System for Real Time Simulation

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***Abstract*—In this paper, a mathematical model is developed to simulate the transient phenomena in a polymer electrolyte membrane fuel cell (PEMFC) system. Models currently available for a PEM fuel cell are based on either empirical or theoretic. Both models do not fully meet the need to represent static and dynamic behavior of a stack and are difficult to use in the design of PEMFC control system. Hence, a dynamic fuel cell system model is proposed in this paper which incorporates the dynamics of flow and pressure in the anode and cathode, mass/heat transfer transient features in the fuel cell body and in the auxiliary components. The model consists three distinctive models, namely, the PEM fuel cell stack model, the thermal model and the auxiliary system model. The simulation results demonstrated that this model could describe the steady state behavior and predict the transient response of cell voltage, temperature of the cell and pressures of cathode and anode channel under sudden changes in load current. The model will be very useful for the optimal design and real-time control of PEM fuel cell stack systems.**

Keywords- proton exchange membrane fuel cell; nonlinear system modeling; thermal model

The Research of Power System Operation Risk Assessment modeling Based on Cloud Models

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Abstract—**Because there are lots of random and fuzzy uncertainty factors in power system, the certainty model used to be adopted in reliability research were not reasonable. But cloud models theory is a powerful tool to convert numerical quantitative analysis to conceptual qualitative analysis. In this paper on the basis of introduction of cloud models, the parameter and load cloud models in actual operation of power system is proposed and established to solve the uncertainty of the value FOR and the changing of load. And base the model takes the risk assessment by used the RBTS reliability test system and come out the risk indexes represented by cloud model. The result show that system actual operation condition based cloud models suit the Scene actual.**

Keywords-power system; cloud models; risk assessment; Monte-Carlo

Electric Load Model Based on Aggregation Algorithm

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Abstract—**At present, in the simulation program of power system, there are various load models whose parameters are generally assumed by experience. Thus, the simulation precision**

is not guaranteed. In this paper, according to the data investigated, a new load model based on load aggregation algorithm, with the distribution network impedance considered, is proposed. In this load model, transformer substation is equivalent to constant impedance, current and power load shuntwound with an induced motor, series-wound with distribution impedance. Effectiveness of the proposed model is verified according to simulation.

Keywords-power system; distribution network impedance; load aggregation.

Load Model with Small Generators Considered

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Abstract- **In this paper, based on coherency equivalence algorithm, a new equivalent load model of distribution network which contains small generators is presented. Because in distribution network, the electric distance of any two small generators is short, all small generators can be divided into only one coherent group, which has been verified by substantial electric simulations. Aggregation of Electromagnetic circuit of , prime mover governor of, excitation of , power system stabilizer of small generators into only ones have been inferred explicitly too . In addition, effectiveness of this method has been verified by a simulation.**

Keywords- coherency equivalence algorithm, electric simulation, load model, small generators.

Research on Harmonics Suppression in High Power

Middle Frequency 400Hz Inverter

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***Abstract*—The low ratio of device switching frequency to output voltage fundamental frequency in high power middle frequency 400Hz/115V inverters results in new problems in harmonics suppression. A single-phase inverter based on the cascaded topology with two H-Bridge units which can reduce harmonics content in output voltage was presented. After the harmonics formula of multilevel PWM wave was derived, the output LC filter was designed to eliminate high-order modulation □armonics considering simultaneously the fundamental voltage drop across the filter inductor and the inductor current ripple. Proportionalresonant control was adopted which can eliminate steady-state error and compensate the 3_{rd}, 5_{th} and 7_{th} harmonics. Analysis and simulation on a single-phase 100kW middle frequency inverter model were presented. The simulation verified the effectiveness of the proposed scheme.**

Keywords-high power middle frequency inverter; LC filter; proportional-resonant controller; harmonic compensation

Moving Boundary Modeling Study on Supercritical Boiler Evaporator

By using enthalpy to track moving boundary location

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Abstract—**in moving boundary (MB) modeling, different models are usually adopted to describe the stream generator of supercritical once-through boilers and it is difficult to switching them between different situations smoothly. Taking into heat transfer coefficient influenced by enthalpy of working fluid，we proposes that the enthalpy should be used to track the moving boundary location at supercritical pressure and a nonlinear moving boundary mechanism model for supercritical oncethrough boiler steam generator is developed in this paper, which can be used for both supercritical pressures and below supercritical pressures without switching. Finally, two simulation examples are presented, and the results show that the model developed in this paper is reasonable.**
Keywords-moving boundary model; supercritical once-through boiler; enthalpy; steam generator; digital simulation

Small Signal Stability Analysis on Power System
Considering Load Characteristics

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Abstract—**Considering the widespread problem of small signal stability on power system, which seriously threatens the safe operating of power system, and the discrepancy between calculation results and facts in stability analysis by choosing inappropriate load models, therefore, the influence of load characteristics on small signal stability analysis on power system has come to be a research subject. In this paper, the concept and analysis method of small signal stability analysis are presented firstly, and due to the importance of load models on power system small signal stability analysis, two kinds of load models are introduced. Taking a simple power system as the subject investigated, the influences of different load characteristics and**

the variation of some certain induction-motor load parameters under different operating modes are studied.
Keywords-power system; load characteristics; induction motor; small signal stability analysis; static load model

Time Domain Aggregation of Generating Units for Shipboard Power Systems

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Abstract-**An improved time-domain online dynamic equivalent method is presented, which is suitable to shipboard power systems (SPS) and based on the coherency technique. It preserves the structure of the generator, excitation system and governor system, and the time-domain non-iterative algebraic operations process is used to calculate equivalent parameters. Sixth-order generator equation is used to reduce the grid considering the subtransient. Formulas and the aggregation steps are come out. The method is applied to reduce an eight generators and fourteen buses SPS in PSCAD/EMTDC environment, equivalent parameters and dynamic response curves are presented. Simulation curves show that the equivalent system retains the dynamic performance of the original system with good accuracy.**
Keywords*-dynamic equivalence****;*** *coherency; structure preservation; Sixth-orde model; PSCAD/EMTDC; SPS*

Numerical Study on the Flow Behavior of

Near Wall
Cluster in the Circulating Fluidized Bed

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***Abstract*—The flow behavior of near wall cluster has an important effect on the heat transfer and attrition of the circulating fluidized beds (CFBs). In this paper, the gas-solid two-phase flow in the riser of CFBs was simulated by means of Large Eddy Simulation (LES) and the direct simulation Monte Carlo (DSMC) method. A extended cluster identification method was used to investigate the cluster properties. The distributions of time-averaged solid concentration and velocity of cluster near the wall region were analyzed. Simulated results showed that the descent velocity of near wall clusters appears to keep constant. The solid concentration of near wall cluster decreases along the height of riser. The simulated results have a reasonable agreement with the previous experimental data.**

Keywords- CFBs; LES; DSMC method; Cluster; near wall Region

Modeling and Simulation of Short-circuit Loss of
Excitation in Powerformer

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***Abstract*—In order to analyze the performance of Powerformer under loss of excitation (LOE) condition more effectively, in this**

paper, firstly, based on MATLAB/Simulink, the simulation model is constructed, the direct short-circuit LOE and the excitation winding forms short–circuit LOE with de-excitation resistance are simulated by the model; Secondly, the waveforms of excitation current, rotor speed, active power, reactive power, stator current are given; Thirdly, the results are analyzed detailed. In addition, the model can also simulate other LOE faults.
Keywords-Powerformer; Loss of excitation fault; simulation.

The New Evaluation Model of Bidder's Competitiveness Based on RS-SVM

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***Abstract*—This paper put forward and experienced an effective evaluation method of bidder's competitiveness based on Rough set and Support vector machine algorithm. The model make Rough set to reduce the indexes in the comprehensive evaluation system, thus reducing the dimensions of the input space of SVM, when treating the reduced data as the input space of SVM, the convergence speed and the classify accuracy can be enhanced obviously. Evaluation model proposed in this paper is applied in real example. The result shows that it can evaluate the level of competitiveness accurately, with good evaluation efficiency.**
Keywords- RS-SVM ;bidding competitiveness ; Evaluation model

Theoretical Studies on Start-up Characteristics of a High-pressure Generator for LiBr

Absorption Chiller

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Abstract—Dynamic models and simulation of a gas-fired bouble-effect lithium bromide absorption chiller and heat transfer character of high pressure generator are presented. The dynamic mathematical models of each component, as well as the whole system of the absorption chiller, have been established. Researches are done to study on the startup characteristics of a 106kW chiller through utilizing the dynamic model of the whole system. It can be discovered that the initial mass of LiBr solution in the high pressure generator has an apparent effect on the performance of the high pressure generator and the whole unit in the startup. When the lithium bromide solution mass is reduced 15% than the designed value, the delay time of the high pressure generator is shortened as well as the first stable time in the startup and the crystallization will not occur, which surely will be beneficial to the performance of the unit. The researches can provide with important reference for the design of optimization as well as technical support for on-line control of absorption chiller.

Key: Lithium-bromide, high-pressure generator, absorption chiller, dynamic characteristics, delay time

Panel Cointegration Modeling of Electricity Consumption and Sales Price

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Abstract—**Electricity sales price is an important economic lever of power market. The accurate analysis of relationship between the electricity consumption and sales price has become a crucial role on the rational adjustment of sales price. Thus, the analysis method of relationship between the electricity consumption and sales price is proposed based on the panel co-integration in this paper. By using simultaneously the time series and cross-section of data, the co-integration relationship between the electricity consumption and sales price at different time and in different regions is accurately analyzed. With the panel data of electricity consumption and sales price from 1990 to 2005 in United States, the test results of panel unit root and panel co-integration indicate that the electricity consumption and sales price have obvious panel co-integration relationship. Then, the fixed effect model based on cross-section weightings is proposed in order to describe the long-term equilibrium relationship between the electricity consumption and sales price.**
Keywords-electricity consumption; electricity market; fixed effects model; panel co-integration; sales price.

Classification of 220KV Substation Based on Daily Load

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Abstract --**It has been well recognized that the load classification has great effects on the load model building when it applied the statistic synthesis method to construct the load model. However, it is also widely known that the load classification is a quite difficult problem due to the primal data limited and singleness, for example the daily load consumption data which obtained from SCADA are very simply. Different disposal ways for the primal data will get the different cluster results . Scarcity of**

checkout ways and means brings on the very difficulties of judging the cluster result which is ture and which is wrong . In this paper, two kinds of eigenvectors abstracted from daily-load-curve are proposed . Using fuzzy cluster analysis , 90 substations with 220KV that in the middle areas of China are classified into four classes . Through the checkout method suggested by this paper , the case studies showes the efficiency .
Keywords-- load classification, fuzzy cluster, daily load .

Influence of Steam-Side Oxide Scales on Heat
Transfer of T92 Tube in Power Plants

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***Abstract*—The affection of oxide scales formed during exposure of Cr steels in steam environments on the service of components is discussed. Numerical model of T92 tube with oxide scales inside is built in this paper. The influence of steam-side oxide scales on heat transfer of T92 tube is analyzed quantificationally. The results indicate that average temperature of the substrate increases approximately linearly with the thickness of oxide scales. Then, the critical thickness of oxide scales leading to overheating of T92 tube is given and discussed, which shows that increasing the inner surface temperature and exterior surface heat flux will decrease the critical thickness of oxide scales. Finally, the slopes of average metal temperature –oxide scale thickness lines are obtained through curve fitting. The linear relationship between average temperature increment of tube wall and oxide scale thickness is illustrated and analyzed.**
Keywords-oxide scales; T92; tube; heat transfer; creep rupture Life

Power Load Modeling Based on Wide-area Measurements and Support Vector Machine

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***Abstract*—At present, the load modeling is still one of the difficult problems in power system. In this paper, a new method is presented which uses wide-area measurements and support vector machine (SVM) for load modeling. Based on wide-area measurements, this method does non-linear regression analysis on model with SVM. By using radial basis function (RBF), model structure is optimized, and Bayesian Framework is used for identifying parameters, then a kind of non-mechanical model is founded. This method can easily solve the problems in choosing structure and identifying parameters. The founded model has good generalization ability, flexible structure, and rapid calculation speed. In the end, this method has been programmed; the simulation verifies the validity of this model.**

Keywords- support vector machine; load modeling; nonlinear systems identification; wide-area measurement system; radial basis function; Bayesian evidence framework

Shorting current analysis for solid oxide fuel cell

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***Abstract*—An improved equivalent circuit model was applied to investigate low temperature solid oxide fuel cell with samariadoped ceria electrolyte in this paper. The correlation of ionic transference number and internal shorting current over 450~600□ was addressed.**

Keywords-SOFC; equivalent circuit models; shorting current;

Analysis on the Impact of Cooperation between Independent Power Producer and the Grid Company in Day-ahead Electricity Market

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***Abstract*—The cooperation between independent power producer (IPP) and the grid company (GC) in day-ahead bidding market**

are analyzed to identify its impact on different market agents. The profit models of market agents both with and without the cooperation of IPP and GC are constructed. Necessary conditions for cooperation with the consideration of maximum capacity constraint are derived, and then the impacts of their cooperation are analyzed to conduct corresponding conclusions. A numerical example is also provided to prove these conclusions.
Keywords- Independent Power Producers; Market agents; Necessary condition; maximum capacity constraint

Analysis on the Impact of Cooperation between Independent Power Producer and the Grid Company in Day-ahead Electricity Market

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***Abstract*—The cooperation between independent power producer (IPP) and the grid company (GC) in day-ahead bidding market**
are analyzed to identify its impact on different market agents. The profit models of market agents both with and without the cooperation of IPP and GC are constructed. Necessary conditions for cooperation with the consideration of maximum capacity constraint are derived, and then the impacts of their cooperation are analyzed to conduct corresponding conclusions. A numerical example is also provided to prove these conclusions.

Keywords- Independent Power Producers; Market agents; Necessary condition; maximum capacity constraint

P2P Computing Mode and Its Application in Flow Computation

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ABSTRACT: The P2P computing mode which may effectively overcome some shortages of the present sequential and parallel computing mode is applied to the large-scale power flow computation in this paper. The advantages of the P2P mode are analyzed and presented. The mathematic model and computing method is put forward and analyzed based on current-influx model. Based on current-influx method, power network is easily partitioned, and the relation among subtasks becomes weak. The mutual dispatch management in P2P are researched for the flow computation. The static and dynamic dispatch methods are adopted, which may flexibly adjust the topological structure of computing network. The dispatch arithmetic of the load-balance is studied, which may transfer high load to near computing node according to the total present computing instance. And the computing efficiency is enhanced totally. The proposed computing model and methods are implemented in IEEE 118-buses system. The computing results have approved the validity of this computing model.
KEY WORDS: P2P computing, Network computing, Power flow, Dispatch arithmetic

Rapid Control Prototype Design of the DC/DC
Converter for Fuel Cell Electric Vehicles

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Abstract—In this paper, the DC/DC converter for fuel cell electric vehicles is taken as an example and its principle is given briefly. Then the control algorithms for the DC/DC converter are analyzed and its rapid controller prototype is given via Simulink/Stateflow toolboxes of MATLAB. This paper not only describes the function of rapid controller prototype with several illustrations, but also gives the embedded code suitable for DSP to implement the control algorithms of the DC/DC converter for the fuel cell electric vehicle. The methodology of developing the project via rapid controller

prototype using Simulink/Stateflow and via automatic embedded code generation is of some reference value to facilitate the project development and improve the stability of the embedded code.
Keywords ***Fuel Cell Electric Vehicle (FCEV); DC/DC converter; rapid controller prototype; DSP***

Numerical Simulation of Boiler Implosion

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Abstract: Mathematical model of a 300MW boiler was created including furnace, super-heater, economizer, air pre-heater, ESP,
and ID fan. Furnace implosion simulation was accomplished at 100% load during MFT and ID fan mal-operation. The pressure
changing process was summarized into three steps and flow character of each step was analyzed in detail. It is pointed out that
furnace implosion is caused by many factors, such as air flowing-into, gas flowing-out, ID fan pressure, resistance of the gas duct,
gas combustion, and so on. Such analysis is helpful for both theoretical and application purposes. Simulated values of steady
combustion agree well with designed ones.
Keywords: furnace implosion; numerical simulation; MFT; flow analysis

Simulation of a Microturbine Generation System for Grid Connected and Islanding Operations

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Abstract—This paper presents the modeling and simulation of a high-speed single-shift micro turbine generation system. This

unit has four parts: a compressor-turbine, a permanent magnet generator, a three phases bridge rectifier and inverter. The model is built from the dynamics of each part with their interconnections, and two different control strategies suitable respectively for isolated and grid-connected operation were developed. Finally, simulation studies have been carried out under a stepped load. The model is developed in the MATLAB/Simulink (Matlab 2007a) and implemented in Power system Toolboxes. This model is a useful tool for studying the various operational aspects of micro turbines.
Keywords-component; micro turbine; distributed generator; rectifier; inverter

The Study of Full-voltage Starting Method of Highpower Asynchronous Motors with Dynamic Reactive Power Compensation

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***Abstract*—For all sorts of problems in the procedure of highpower induction motor's starting, as well as the drawbacks of traditional starting method. This paper proposed the full-voltage starting method of high-power induction motor with dynamic reactive power compensation, introduced its principle, and studied the control strategy of full-voltage starting with dynamic var compensation emphatically, established the simulation model using the Matlab/Simulink simulation software and carries out the simulation to examples, simulation results had indicated that the method proposed in this paper can make the high-power induction motor start fast and smoothly with both high-torque and low starting current, it has a better starting performance than the traditional starting methods.**
Keywords-high-power asynchronous motors; dynamic reactive power compensation; full-voltage starting; soft Starting; Starting

Transient simulation

A New Index of Voltage Stability Considering
Distribution Network

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***Abstract*—This paper was to research on voltage stability considering distribution network. An equivalent system considering distribution network with high/medium voltage and an approach of online tracking of voltage stability margin of the equivalent system were proposed. By applying the theorem of voltage stability, it was derived that because of power loss caused by the distribution line in the equivalent system, voltage collapse occurred at the distribution bus before at the transmission bus. With little additional calculation, the online tracking voltage stability margin considering distribution network included the main effects taken by distribution network on voltage stability, and well matched the current actual voltage stability situation, so it was very helpful for operator to make decisions before voltage crisis in distribution network developing into transmission network. Simulation showed that the presented new voltage stability margin can effectively avoid voltage collapse in power grid resulted from voltage crisis in distribution network developing into transmission network.**

Keywords-power system; voltage stability; distribution network; Thevenin's equivalent; voltage stability margin

Research On Grey Relation Analysis Model Based

On Projection Pursuit Coupling Model

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***Abstract*—By using multi-criteria Projection Pursuit Coupling Model based on the principle of maximum entropy, multidimensional grey relation analysis values can be integrated into the projection value of single dimension which indicates the advantage of each scheme, so the schemes sample can be optimized according to the projection value of each scheme. the larger it is, the better the scheme is. In order to find out a new method for the application of the projection pursuit coupling technique in the grey relation analysis scheme optimization, real coded accelerating genetic algorithm can be used to optimize the projection pursuit coupling model, to simplify the implementation process of the projection pursuit coupling technique, and to overcome its calculation complexity and the difficulty of its programming implementation.**

Keywords-grey relation analysis model; projection pursuit; principle of maximum entropy; real coded accelerating genetic algorithm; identification coefficient; objective weight

A Novel Frequency Estimation Algorithm on Dynamic Condition in Power System

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Abstract— a novel dynamic instantaneous power-system

frequency estimation method for Phasor Measurement Units (PMUs) was proposed for generalized sinusoidal models, which was intending to simulate the dynamic condition via modulating phase and considering magnitude damping. Frequency estimation from traditional Discrete Fourier Transform (DFT) could be attained based on frequency and damping character of voltage signal and sampling frequency. Two slightly different were introduced to meet the different sampling system, which were for fixed sampling and frequency tracking system. Simulation results and laboratory experiments allowed us to conclude that proposed method's performance was much better in comparison with the widely used phasor-based frequency measurement one under dynamic condition such as power system oscillation.

Keywords- Phasor Measurement Units (PMUs); Discrete Fourier Transform (DFT); instantaneous Frequency measurement; power system parameter estimation

Feasibility Study on Active Power Security Protection of Transmission Section

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***Abstract*—Recent blackouts have fully presented the damage of the cascading overload trip. The basic reason for cascading overload trip is poor global superiority of the back-up protection and existing auto-mechanisms which only focus on action behavior of themselves to cut component, but don't consider the damage of power transferring and the change of network. This**

paper first illustrates the meaning of transmission and point that the objective of security protection of transmission is to maintain its integrality and transmission capacity to avoid cascading overload trip. Then, implement condition and key technology are discussed, which are online searching for transmission section, real-time prediction of cascading overload and real-time control to avoid cascading trip on transmission section. This paper has brought forward the primary scheme. Its validity is verified by calculation result of a certain real system.

Keywords-transmission section; cascading trip; real-time control; real-time prediction

Real Time Transient Stability Prediction of Multi-Machine System Based on Wide Area Measurement

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***Abstract*—An on-line transient stability prediction method based on the data measured by wide-area measurement system (WAMS) is presented. This method is composed of measurement, identification, reduction and prediction. When disturbances occur, based on the dynamic response, the order of the original system can be reduced by clustering method with the WAMS data observed. The admittance matrix parameters of the reduced system can be identified with the least square algorithm. Then future operating trajectories of angle and angular frequency of generators can be predicted by time-domain simulation. The method proposed is verified on epri-36 sample system and northeast power system with promising simulation results.**

Keywords-power system; wide-area measurement system; transient stability; trajectory prediction

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Keywords-power system; wide-area measurement system; transient stability; trajectory prediction

A Method for Voltage Stability Assessment Based on
Wide Area Measurement System

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***Abstract*—An algorithm about voltage stability assessment is proposed in the paper based on wide area measurement system(WAMS). Only local synchronized phasors are used in the method, which include the synchronized phasors of the target bus and the buses connected to it. The whole system is converted into an equivalent two bus system by multiple measured synchronized phasors. The relationship of the load impedance magnitude and the Thevenin's equivalent impedance magnitude is analyzed when voltage stability problem occurred. A voltage stability index based on the relationship was also given in the paper. The simulation results on the New England 39 bus system demonstrate the effectiveness of the proposed method.**
Keywords-voltage stability assessment; Thevenin's equivalent; wide area measurement system

Robust Control of Interconnected Power System Based on WAMS Considering Signals Transmission Delay

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***Abstract*—Wide-area Measurement System can retrieval the real time dynamic and static information of the large scale power system under the same time reference, helping to resolve the problems of the dynamic analysis and control for an interconnected power system, especially the low-frequency oscillation. However, communication delay is a non-ignorable factor for the stability of wide-area control. In this thesis, the dynamic model for interconnected power system considering the**

time delay was established; it also optimized the controller parameters based on particle swarm optimization. Simulation of large and small disturbance to a typical four-generator two-area testing system indicates that wide-area robust controller has a strong capability of damping area oscillation and good robustness even at the long wide-area signal time delay.

Keywords- Wide area robust controller;inter-area oscillations;time delay;particle swarm optimization;WAMS

Online Monitoring of the Electrical Power Transfer Stability and Voltage Profile Stability Margins in Electric Power Transmission Systems Using Phasor Measurement Units Data Sets

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***Abstract*— An innovative method to monitor the electric power transfer stability on power transmission paths and the voltage profile stability at the power systems nodes in real time modus is proposed. Based on the laws of electric circuit theory, the transfer operating mode of each relevant transmission line is formulated in an active powervoltage PV characteristic. The relevant transmission line parameters and the actual system state phasor measurements are used to calculate the exact point of the maximum secure transfer mode of the given transmission lines at each operating instant, based on the voltage stability criterion. A combination of the transfer characteristic with a flexible voltage stability band allows the simultaneous observation of the**

voltage profile stability at the system's buses in the prevalent direction of the lines active power flow. The defined stability margins are directly evaluated on a PV mode without need to specify any loading scenario. The method uses synchronized phasor measurement data as input. It can thus be employed for the wide area stability voltage monitoring of large transmission zones retaining several transmission lines with a reduced number of phasor measurements units. The exactitude and robustness of the method are tested on a two-bus system and on a large power system represented by the western Danish power grid.
Keywords- Wide area monitoring, Phasor measurement units, Voltage stability, PV-Characteristic

Research and Design of High-Voltage Electronic Power Equipment Monitor System Based on Wireless Communication Technology

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Steady Energy Function and Its Trajectory Simulation of Power Systems

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***Abstract*—The conception of steady energy function is proposed according to existing methods which applied to transient energy**

function. Using Taylor Expansion, energy trajectory simulation method is also proposed based on course-oriented idea. The method is applied in calculations of power losses. Through the comparison of the results and the actual power losses in standard, the method is proved to be effective and valid.
Keywords-steady energy function; time-oriented process; energy trajectory simulation;

Delayed Dynamic Model for Electric Power Bidding in Oligopoly Market

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***Abstract*- Based on the bounded rational dynamics and adaptive dynamics,this paper presents power producer bidding Cournot model, bidding dynamic model and delayed bidding dynamic model respectively, analyzes the stable region, bifurcation and chaos of bidding dynamic models by simulation method and compares stable regions of the two dynamic bidding models and the average revenue of power producer.The results indicate that delayed dynamic model is conductive to maintain system stability, but it does not bring power producer additional revenue except from bifurcation state.**
***Keywords**-Adaptive dynamics Bidding strategy, Bounded rational dynamics,Cournot model, Delayed dynamic,Power market*

The Research of Co-optimization Model of

AGC Service Market Considering Generation Efficiency Parameter

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***Abstracter*-With the organizational reform of electric power industry in our country day by day, and the market of generation side gradually maturing, the construction of Ancillary Services Market was brought into schedule. As one of the most important ancillary services, AGC possesses certain competitiveness so far as its own characteristics and supply trend of the electrical network, and marketization is relatively easy to realize. Therefore, while guaranteeing the electrical network is safe and reliable, should follow the principle of market economy, set up the market actively, encourage the generation companies to participate in the AGC Service Market competition voluntarily, and ensure obtaining the sufficient, high-quality and economic AGC service. The standard chosen that present AGC service market mostly only regard the price as the trade, can't reflect the differences of AGC service qualities. At first this text carried on research the AGC bidding mode, then analyzed the impact on AGC trade of generation efficiency parameter, proposed cooptimization model of AGC and energy with considering generation efficiency parameter, and has verified the validity of the model through calculating the example.**

Keywords- AGC; Regulation efficiency parameter; Competitive bidding model; Network Flow Programming Method

Forecasting Short-term Load of Southwestern Power Market in China by Chaotic BP Network

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***Abstract*—Power is important to modern society and national economy. To forecast short-term load more accurately, phase space of the complex nonlinear system was reestablished according to chaos theory and properties of short-term load were analyzed. It proves that forecasting short-term load is a classic decision-making process, full of chaos. Combining with chaos theory and traditional BP network, an improved BP network (chaotic BP network, CBP network) was presented in the chaotic phase space. Learning algorithm of traditional BP network was improved because of initial value sensitivity and good ergodicity of chaos operator. The forecasting system has been applied in the power market in southwestern China. The results show that the forecasting system based on CBP network is more accurate than traditional BP network and reliability and accuracy can be used as needed.**

Keywords-chaos; CBP network; short-term load forecastin

Reliability Analysis of Power Vehicle of Certain New Ground-to-air Missile

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***Abstract*—Detailed reliability analysis was made on the power equipment of certain new ground-to-air missile weapon system, including the main engine generating system and the external power supply system, in which there are the generator set, the control device, the junction box and the cable. Besides, the reliability model of this power equipment was established according to its instance in battle and training. A software developed by VC++.NET2003 was validated through being calculate and analyze on IEEE DRTS. The application of the software in this reliability model shows that it can changeably control the reliability of power system, and effectively instruct the use and maintain of the power equipment, also it can provide the suggestion according to the weakness of the reliability design of mobile power plant, and make the idea which is reliability-centered maintenance (RCM) be carried out.**
Keywords- Computer programming; Estimation; Failure analysis; Missiles; Modeling; Power distribution; Power plants; Reliability.

Simulation of Three-phase Four-wire Shunt Active Power Filter

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***Abstract*—With the proliferation of nonlinear loads as power electronics equipment, the disadvantage of harmonic is more and more, which influence quality of power grid. Active power filter (APF) is a new harmonic restraint method comparing**

with passive filter, which is a power electronics device. This paper inspects harmonic current based on three-phase circuit instantaneous reactive power theory and simulates a three-phase four-wire shunt active power filter. The simulation results validate parameter is reasonable. The outcome indicates that active power filter can suppress harmonic and neutral wire current and balance three-phase current effectively.
Keywords-harmonic; instantaneous reactive power; three-phase four-wire; active power filter; simulation

Harmonics Analyses of Ship Power System under Different Commutating Methods

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Abstract **The paper summarizes the configuration and working principle of ship electric propulsion simulated system, then introduces two kinds of commutating methods, and then does harmonics analyses of them respectively, finally proposes a simple and viable improved scheme by designing an appropriate filter in AC input side. Besides, the whole system with the filter is validated.**
Key words—converter; commutate; harmonic; ship power system; filter

Voltage Stability of Induction Generator with Resistive Load

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***Abstract*—Bifurcation theory is utilized to analyze the dynamic voltage stability of an induction generator, which is used widely in isolated power system. Based on the transient model of induction generator under the stationary reference frame, the state equations are derived. For various resistive loads, the eigenvalues of state equations are calculated to obtain the bifurcation point related to the critical load resistance, which is the critical stability point of the power system. With the bifurcation point determined, the voltage dynamic performance can be analyzed in stable domain. Experimental results for dynamic behavior of the generator terminal voltage validate the theoretical results analyzed by the proposed scheme.**
Keywords-voltage stability; induction generator; isolated power system; bifurcation point; eigenvalue

The Optimal Configuration of Reactive Compensating Capacity for Traction Substation

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***Abst ract*—The technical and economical index of traction substations are concerned with the reactive power and negative phase-sequence(nps) power. Set up of parallel reactive compensation(PRC) which have combined compensation effects for the reactive power and nps power is the key to the problem. PRC for the positive sequence reactive power of traction load is only related to the total compensating capacity, and not related to the connection mode of transformer and the distribution mode of compensating capacity in every port; however, RPC for the nps power is not only concerned with the power and power factor of traction load, but also with the distribution of compensating capacity in ports of transformers' secondary side and the features of PRC. According to the characteristic of PRC for traction load, two kinds of optimal configuration schemes for reactive power and negative sequence compensation are proposed, and the general expression for compensating capacity of each compensating port under the two compensation schemes is given. Taking the measured data of a certain traction substation for example, the feasibility of the two proposed compensation schemes is verified.**
Keywords-traction substation; negative phase-sequence current; synthetical compensation; optimal configuration

Evaluating Robustness of Power Systems Based on Their Topological Structure Using Maximum-Flow Algorithm

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***Abstract*—To characterize the topological structure of a power system, we first define a dual system for the original one to handle the case where a transmission line is inoperative. Then, we introduce four new indices for a transmission line: dual power supply capacity, capacity balance ratio, dual load limit, and dual overload ratio. We use the maximum-flow algorithm of graph theory along with the indices to analyze the robustness of a power system. Unlike existing methods, this one is very simple; and there is no need to calculate the state of the system repetitively. Finally, the validity of the method is demonstrated using a power system with 18 nodes and 20 branches.**

Analysis and Design of a Kind of Improved Parallel Resonant Converters

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***Abstract*—Traditional transformer in high-voltage power supplies has many disadvantages such as high turn's ratio, large volume and great design difficulties. Parallel resonant converters (PRCs) are widely used in high-voltage power supplies. A kind of high-voltage circuit topology can be formed by combining PRCs and voltage-doubler rectifier, which is called parallel resonant dual voltage converters (PRDVCs). In PRDVCs both voltagedoubler rectifier and transformer can boost voltage, which reduced turn's ratio and volume of the transformer, making it easier to produce. Thus it not only realizes the high-voltage output, but also realizes the miniaturization of high-voltage**

power supply. Three modes of the converters were researched . Converting conditions of three modes were given. At last, PRDVCs was used to design a 5000V/50mA high-voltage power supply. The waveforms and results of the experiment were given, which validated the feasibility of the converters and its conversion efficiency might be improved to 93%.

Keywords-Power converters; Parallel resonant; Voltage-doubler rectifier; High-voltage power supply

Research of a New Reactive Power Optimization Method Consider of the Voltage Optimization of the whole Electric Network

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Abstract-A different objective function (OF) and model of reactive power optimization is proposed in this paper. In the model, the values of compensator are regarded as the controllable variables to be evaluated and the objective is to minimize the voltage deviation. An efficient algorithm for approximation of initial problem is described. The proposed method overcomes the drawbacks of conventional reactive power optimization method. Compared with that obtained using a traditional optimization method, Simulation has been applied to practical IEEE 30-bus system. The test results show that this method is feasible and practical method.

Keywords*-Voltage; Reactive Power; Power Loss; Voltage Profiles; Quadratic Objective Function*

Strategy Bidding of Power Generation

Enteprises Based
on Energy-Saving Generation Dispatching Pattern

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***Abstract* - The bidding strategies based on energy-saving generation dispatching pattern are dynamic and complex problems. It is very difficult to analyze and compute with the traditional mathematical methods, which is particularly conspicuous in the middle- or long-term transactions. This paper proposes a model about the optimized middle or long-term bidding strategy in two-tiers electricity market, which is based on the optimal power flow (OPF). In this model, uncertainties in the outside world are regarded as the agent (Agent) of "external environment". Under the condition, the agent selects a viable strategy by environment evaluating and guides the purpose of the optimal production by learning from past experiences and competitors' behaviors. The adaptability and superiority of this model are tested on a standard IEEE-5 bus 6 notes test system.**

Keywords - electricity market, reinforcement learning, RL; Agent; Repast

An Approach of State Estimation Based on Process
Measurement Data

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Abstract—**Began with a brief introduction of the basic principle and structure of SCADA system, this paper analyses the 3 practical problems exist in traditional state estimation, which is based on an isolated time section. It also points out that the problems cannot be eliminated by directly revising the existing algorithm and hence a new method of state estimation should be found from the methodology. On this basis, an approach of state estimation using process measurement data is proposed in this paper. The fundamental idea of the method includes two steps; the first one is to construct a relatively precise operation section with the process measurement data of SCADA system by utilizing the longitudinal relations of each measurement. The second step is to carry out the WLS state estimation, by which the transverse relations between different measurement data of the constructed time section are used. Theoretical analysis and testing scenario show that the method has great advantages over the traditional one in bad data identification and result accuracy improving. At the same time, the process measurement data using method in this paper provides a reference for making full use of the data in SCADA system, even in future WAMS.**
Keywords- SCADA System; Process Measurement; State Estimation; Power System;

Optimal Dispatch Algorithm With Dynamic Constraints Based On Interior Point Method

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Abstract—**This paper presents a methodology of dynamic optimal dispatch applied with non-linear interior point method. In order to solve the dynamic optimal dispatch, the constraints in time field are treated as two kinds of restrictive terms and two optimal strategies are used in this paper. Compared with static optimal dispatch, the case study showes the efficiency and effective.**

Keyword—dynamic optimal dispatch, dynamic constraints,
non-linear interior point method

Simulation research on high harmonics amplified in parallel capacitor circuit

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***Abstract*—For the problem of high harmonics amplification existences in the reactive power compensation with capacitor at presently, a research on simulation of reactive power compensation is carried out with MATLAB simulation software, the diversification of harmonics and reactive current are detected, and a detailed FFT analysis of the simulation result is presented.**

Keyword: Reactive power compensation; Harmonic analysis; Simulink simulation

Power System State Estimation Containing Wind Generators

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***Abstract*—It is essential to investigate the effects which will produce on the power system when wind generators are introduced. The paper describes the steady model of wind turbines with an asynchronous generator. Based on the conventional RX model, power system state estimation containing wind generators is proposed. The slip of the asynchronous generator is utilized for the formation of expanded**

correction function in iterations. This method retains good convergence property as the traditional WLS method and also can be integrated to the conventional state estimation program with the consideration of wind generators. The simulation results demonstrate that the model is effective for practical use.
Keywords-- power system; state estimation; wind generators

The Capacity Assignment Research among Different Kinds of Power Generators for Long-term Energy Resource Planning

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***Abstract*—Based on the two principles that guaranteeing power system safe and reliable operation and minimizing the total cost of power generation, this paper established a capacity assignment model among the different kinds of power generators. According this model, arranging each kind of power generators has practical instruction significance for power generators constructing during the development of our country's power system.**
Keywords-long-term energy resource planning; power generator; capacity assignment; optimization

A Novel Ventilation and Cooling Scheme for the Underground Diesel Generating Plant:

CFD Analysis

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***Abstract*—It is the premise for the diesel generator set to maintain the proper indoor environment of underground diesel generator plant. Based on the analysis and summarization of the merits and drawbacks for the diesel generator set heat exchange modes and ventilation and cooling schemes of underground diesel generator plant, this paper proposes a novel ventilation and cooling scheme for water cooling and wind cooling diesel generator set, separately. Finite volume method software is adopted to do the numerical simulation. The results show that the novel scheme, which can carry out the heat and contaminants simultaneously and effectively, may overcome the disadvantage of the ventilation and cooling schemes before.**
Keywords- diesel generator set; underground diesel generator plant; ventilation and cooling scheme; CFD analysis

The Research on Transient Stability Assessment Methods Based on Bayesian Network Classifier

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***Abstract*—Transient stability can be rapidly assessed using the artificial intelligence technology. In this paper, a fast transient stability assessment method based on Bayesian network classifier was proposed from the perspective of data mining. First, select the characteristic quantities which reflect the power system transient process rapidly as the attribute variables of the Bayesian network classifier, then determine the stable event's posterior probability using of the prior information and sample data which is produced massively by numerical simulation algorithm. When the disturbances occur, we can judge the power system is stabile or not by reasoning according to the corresponding attribute variables. Because any classifier has the probability of misclassification, the boosting algorithm of Bayesian network classifier is applied. Finally, we conduct a numerical simulation on New England 39-bus system to verify the effectiveness of the classifier.**
Keywords-Transient stability; Bayesian network classifier; characteristic quantities; boosting algorithm.

Dynamic Financial Management Goal in Power Enterprise

From the View of Firm Life Cycle

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***Abstract*—The business environment has become very competitive and dynamic due to the increased global competition and efficient flow of information. Firm management must**

constantly change. So the financial management goal which is very important for the management of a power enterprise must be different in the development of the firm. The paper will analyze the characteristics of the different growth period for a power enterprise and point out the best goal in the each special period.
Keywords- Financial management goal; Life cycle; Dynamic

Design of A Synchronous Rectifier Controller for Limiting Reverse Current

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***Abstract*—In this paper, a novel reverse current limiting circuit and the relative mechanism are both designed for the controlling loops of a peak-current-mode synchronous buck converter. The formulation and simulation results show that reverse current threshold is adjustable by changing the emitter junction's area ratio. When applying it to a typical condition of distributed power system (DPS), the efficiency under light load and middle load is 2%4% up and the transient response from heavy load to light load is improved than that without reverse current limiting circuit.**
Keywords-synchronous rectifier; reverse current limiting; efficiency; transient response

A Combined Load Flow Method for Large

Shipboard Power Systems

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***Abstract*—A new load flow method for large shipboard power system with multiple generators which combined Gauss-Seidel method and forward-backward method is presented. In the proposed method, an shipboard power system is divided into a main power supply network and several radial distribution networks, which are deal with respectively. The forwardbackward sweep method is used to solve the power flow for each radial distribution networks, and the Gauss-Seidel method is used to solve the power flow for the main power-supply network in which the radial distribution subnetworks are modeled to equivalent current injections. The two methods utilize the solutions of each other, and the final result can be obtained by iteration. Tests are conducted on a typical shipboard power system. The results validated the proposed method and demonstrate that it has better convergence on large shipboard power system network than tradition method.**

Keywords- shipboard power systems, load flow, Gauss-Seidel method, forward-backward method

An Improved Network-equivalent Method of

Reliability Evaluation for Complex Medium-voltage Distribution System Based on Feeder Partition

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***Abstract*—A method of reliability evaluation for complex medium-voltage distribution system based on simplified network model and network-equivalent is proposed in this paper. According to the topology of distribution system and the function of the protection device and the switch, a distribution network is divided into different zones, the distribution network based on electrical components is changed into a simplified network based on zones. This simplified network is laminated, based on networkreliability equivalent, thus a simple radial network is equivalent to original simplified network by use of the consequence analysis of fault Pattern of the reliability index of the complex distribution system can be calculated. The application of the proposed algorithm to RBTS-Bus6 shows its effectiveness.**

Keywords-*distribution system; reliability evaluation; feeder partition; network-equivalent;*

Compensation Loop Design of A Photovoltaic System Based on Constant Voltage

MPPT

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Abstract—**This paper presents an approach to design a high performance compensation loop for a photovoltaic system based on Constant Voltage (CV) Maximum Power Point Tracking (MPPT) method, which is quite different from that of common DC/DC converter. The dynamic model of the power module, which is implemented by a Buck converter, is established using Switch Average Model. Based on the analysis of the dynamic model, a PID controller is designed to compensate the loop. Wide phase margin, amplitude margin and bandwidth are achieved by introducing the compensation stage. Finally, the performance of the photovoltaic system with and without compensation is simulated and compared using Cadence Spectre.**

Keywords-Photovoltaic; constant voltage MPPT; transfer function; switch average model; loop compensation

Power Flow Tracing with Consideration of the Electrical Distance

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Abstract—**The power flow tracing method is found that it may produce unreasonable loss allocation due to not reflecting the electrical distances between buses directly. This paper presents a new tracing method to consider the electrical distances through network partitioning. The method first takes the equivalent impedance of the pair of terminals to evaluate the electrical distance between buses. Then it uses a hierarchical clustering method to cluster the buses close in electrical distance together which partitions the network into several sub-networks. Finally the power flows are traced from two levels, the exterior and interior of sub-networks. The method keeps the property of nonnegative loss allocation of power flow tracing method, and reflects the electrical distances among buses better. Test results for Northeast China power system validate the effectiveness of the proposed method.**
Keywords-Loss allocation; Electrical distance; Network partitioning; Power flow tracing

Designment and Implementation of Power Meter Data Acquisition Server

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Abstract—the paper illustrates to use OPC technology for data acquisition server designment and data collection, and introduces how design the Data Acquisition Server, describes the merit of OPC designing system, shows the I/O DLL development. In this paper, the data acquisition server is for power meter.
Key words- middleware, OPC, servers, Power meter

A Practical Reliability Model of Transmission Line Based on Main Influential Factors Recognition

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***Abstract*—Reliability analysis of different transmission lines based on its construction and maintenance conditions is very helpful in power system operation and management. In this paper, a novel overhead-line reliability management and modeling scheme is proposed in consideration of the geographic and weather influential factors. The concept and designing of an integrated transmission-line reliability monitoring and management system are introduced. Fuzzy description and classification criterions of seven line fault influential factors (lightning, ice, wind, animal contact, human elements, contamination flashover and the others) are proposed. Reliability models for lines and their terminals are constructed. Application of the proposed model in a 14-node system validates the feasibility and effectiveness of the proposed scheme.**

Keywords- transmission line; reliability model; fuzzy processing; classification criterion

Weak Voltage Area Recovery Based On Improved Poly-Particle Swarm Optimization Algorithm

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***Abstract*—In this paper, using this sensitivity algorithm to analysis of the problem of weak voltage area. After that, using**

the improvement of the traditional swarm algorithm to recover the weak volatage area. In this article, the inertial factor, the convergent factor and are introduced into the swarm algorithm. The model of the weak voltage recovery which is object to the minimization of the sensitive analysis result and the power loss, and the constraint conditions are introduced. Then the improved swarm algorithm is used as the tool to solve this model and find an ideal solution.
***Index Terms*—Voltage stability, Principles of particle swarm optimization(PS0) ,Weak voltage area recovery,Sensitivity index**

Research On The Over-voltage of 220kV Power System Caused by Traction Transformer's Commissioning

***Abstract*—The over-voltage of 220kV power system appeared during the commissioning of several traction transformers in Jilin Province. Analysis showed that the electromagnetic oscillating of the system caused the over-voltage of the feeding phases. After setting up an accurate simulating model used in ATP-EMTP, the adverse influence on the electric power system and the character of the oscillation over-voltage had been studied. Results showed that under the environment of these substations the amplitude of the over-voltage couldn't exceed 2.0p.u and would have little influence on electric power system.**
Keywords-Oscillating over-voltage Transformer Simulating study

A Loop-Improved Capacitor-less Low-dropout Regulator for SoC Power Management

Application

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***Abstract*—Stability is the major obstacle for capacitor-less lowdropout regulator (LDO). By using Miller compensation, a low frequency dominant pole is internally generated, and two other non-dominant poles, which frequency are higher than unity gain frequency (UGF), can be configured by Damping-Factor-Control (DFC) block. With opposed zero cancellation, single pole system is formed before UGF and satisfied phase margin is achieved, hence both the system stability and optimized transient performance are ensured. Based on DFCFC, a 1.8V 100mA capacitor-less LDO was designed by using HHNEC 0.25□m standard CMOS process in this paper. Simulation results showed that the improved regulator could provide a full load transient response of 2□s settling time and both overshoots and undershoots less than 70mV. Furthermore, 50mV dropout voltage, 40□A quiescent current, and smaller compensation capacitors cater to low power and low cost SoC application.**

Keywords-LDO; Capacitor-less; frequency compensation; DFC

Evaluation of the Importance of Network Nodes Based on Weighted Network Model

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***Abstract*--Some important nodes in Power grid may have serious impacts on cascading faults. In this paper, using reactance of transmission line as the weight parameter, a new weighted power**

network model agglomeration is established with application of complex network theory. The important node evaluation indicator is proposed on the basis of the weighted power network model. Both distribution characteristics of network topology and electrical characteristics of the power grid are considered in this method. Simulation of EPRI-36 bus system shows the effectiveness of the method.
Keywords--complex network; cascading faults; weighted network model; weighted network agglomeration; important node

Coordination Control between PSS and SVC
Based on Fuzzy–satisfactory Degree and MOEA

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***Abstract*—Power system dynamic stability includes two problems: power angle stability and voltage stability. For the former, the best way is to install power system stabilizer (PSS) on the key generator groups, and for the latter, however, Flexible AC transmission systems (FACTS) devices such as static var compensator (SVC), static compensator (STATCOM) and so on are the popular methods. PSS can effectively enhances the damp of the system, so is helpful for improving the stability of power angle, but it has little affects on the voltage stability. SVC not only improves the voltage stability but also reinforces the damp of the system if additional control is suitable. A multi-aim optimal designing method which is based on fuzzy-satisfactory degree theory is presented to solve the**

problem of cooperation control of PSS and SVC. Simulation results show that, used the solution presented in the paper, the stability of power angle and voltage can be effectively enhanced.
Keywords-PSS;□□□;MOEA; fuzzy-satisfactory degree

Study on Bifurcation and Chaos in Boost Converter
Based on Energy Balance Model

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Abstract—**Based on boost converter operating in discontinuous mode, this paper proposes an energy balance model (EBM) for analyzing bifurcation and chaos phenomena of capacitor energy and output voltage when the converter parameter is varying. It is found that the capacitor energy and output voltage dynamic behaviors exhibit the typical perioddoubling route to chaos by increasing the feedback gain constant *K* of proportional controller. The accurate position of the first bifurcation point and the iterative diagram of the capacitor energy with every *K* can be derived from EBM. Finally, the underlying causes for bifurcations and chaos of a general class of nonlinear systems such as power converters are analyzed from the energy balance viewpoint. Comparing with the discrete iterative model, EBM is simple and high accuracy .This model can be easily developed on the nonlinear study of the other converters.**
Keywords- power converter; nonlinear; bifurcation; chaos; energy balance model

Study on Bifurcation and Chaos in Boost Converter

Based on Energy Balance Model

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Abstract—**Based on boost converter operating in discontinuous mode, this paper proposes an energy balance model (EBM) for analyzing bifurcation and chaos phenomena of capacitor energy and output voltage when the converter parameter is varying. It is found that the capacitor energy and output voltage dynamic behaviors exhibit the typical perioddoubling route to chaos by increasing the feedback gain constant *K* of proportional controller. The accurate position of the first bifurcation point and the iterative diagram of the capacitor energy with every *K* can be derived from EBM. Finally, the underlying causes for bifurcations and chaos of a general class of nonlinear systems such as power converters are analyzed from the energy balance viewpoint. Comparing with the discrete iterative model, EBM is simple and high accuracy .This model can be easily developed on the nonlinear study of the other converters.**

Keywords- power converter; nonlinear; bifurcation; chaos; energy balance model

Applied Research of a Cooperative Evolution Model in Operation Optimization of the Thermal Power Plant

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***Abstract*—The on-line optimal control of operation is difficult to**

achieve with routine optimization methods because of the nonlinear thermal system and the changing frequently conditions in start-up, stop and load change of the large-scale thermal power plant. Based on the research of three typical evolution optimization methods which are evolution strategies, genetic algorithm and evolution programming in evolution optimization theory, the author analyzed the feasibility to solve the parallelism of on-line optimal calculation for thermal system by using evolution optimization methods, the existed problems in on-line optimal application of thermal system by using evolution optimization methods in the world at present. By understanding the relationship between the sub-population scales, the evolutional efficiency of layered cooperative evolution genetic algorithm and the thermal system characteristic, the author proposed the sub-population evolution layer model and the population evolution layered cooperative model. Furthermore, the author addressed the adaptive adjusting algorithm of subpopulation scale, presented the adjusting standard and method of sub-population scale. The feasibility and efficiency of this model are verified by simulation experiments in 300MWXPDS simulator at Wuhan University.
Keywords-cooperative evolution genetic algorithm; thermal generating unit; dynamic optimization; simulated evolution theory

Analysis of Harmonic Environment for Assembling Capacitors and Validation on RTDS Simulator

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***Abstract*- Instead of ordinary shunt capacitor banks, assembling capacitor are more extensively used in power system for voltage**

support and power factor correction due to its larger reactive power compensation per bank as well as free-maintenance. However, just owing to large capacitance and special internal configuration, it may aggravate system issue of harmonic amplification and thus may contrarily further aggravate itself and trigger it failure. This paper presents the analysis for assembling capacitor operation environment via a typical substation model and the validation on real time digital simulator (RTDS). The maximum capacitance error limit between phase and phase and the various series inductances in capacitor are considered to discuss the harmonic level endured by the equipment. The regulation limits for total harmonic distortion (THD) and imbalance feeder voltage in substation are also taken into account. As a result, a method with math equations is given for estimating the severity of harmonic pollution and the possibility of equipment damage.
Keywords- harmonic amplification; assembling capacitor; total harmonic distortion; individual harmonic distortion; real time digital simulation

Reliability-based Transmission Planning in Deregulated Environment

Zhixin Gao, Hongkun Chen, Qingke Tan
***Abstract-* The optimal design of transmission system expansion planning is an important part of the overall planning task of electric power system under competitive electricity market environments. Taking the cost-benefit analysis theory in economics as a basis, this paper analyzes the economy and reliability of the power transmission network at the beginning. Then, a mathematical model Cost/Benefit is proposed, and it is calculated by genetic algorithms which is introduced in section □. Finally, it is tested and analyzed by Gaver-6-node system. Furthermore, the results indicate the feasibility and effectiveness of the method proposed in the paper.**
***Index terms-* Transmission expansion planning; cost-benefit analysis; reliability; genetic algorithms (GAs)[1]**

A Power Flow Algorithm with Three-order Convergence rate

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***Abstract*—A power flow algorithm with three-order convergence is proposed, which make full use of the second order derivative information of power flow equations, and it can decrease the iterations effectively. To reduce calculation burden of Hession matrix, A new power flow model is given in the paper. Both node voltages and injected currents are treated as variables. Traditional power flow equations are departed to linear network equations and nonlinear node equations. The Hession matrix of the nonlinear equations is const matrix with simple structure. Simulation results of IEEE test cases and several real systems show that the proposed method can converge after only 2~3 iterations with fast speed.**

Keywords: power flow calculation; current injected model; three-order convergence

An Improved Ant Colony System in Optimizing Power System PMU Placement Problem

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***Abstract*—GPS-based synchronous phasor measurement technology is a powerful tool for the security and reliable operation of the inter-connected electric power system. This paper presents an ACO-based approach to optimize the phasor measurement unit (PMU) placement problem. The pheromone trail persistence coefficient adaptive adjustment mechanism and stochastic perturbing progress are introduced into the Ant Colony System(ACS), in case the algorithm entering the**

stagnation behavior and getting stuck at local minima. The improved algorithm outperforms the ACS in obtaining global optimal solution and convergence speed, when applied to optimizing the PMU placement problem. A graph-theoretic procedure based on depth first search is adopted to analyze system observability. Simulation results in optimizing a provincial 46-bus system PMU placement problem show that the improved ACS algorithm is effective.
Keywords-ACS;ASPACS;PMU;placement;

An Improved ACO algorithm for service restoration in power distribution systems

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***Abstract*-Considering the radial network constraint of the distribution system, an improved Ant colony optimization (ACO) algorithm combined with stochastic spanning tree algorithm is proposed in this paper. The proposed method applied in handling the service restoration problem in power distribution systems. In order to improve the searching efficiency, the behaviors of the ants are controlled in the feasible set by the spanning tree algorithm, and the paper also introduces two improved aspects in ACO algorithm. The results on three IEEE test systems show the prominent efficiency and the global search ability of the algorithm.**
Index Terms-Stochastic spanning tree; Ant colony optimization; Distribution network service restoration

Harmonic Suppression of Grid-connected Distributed
Generation Using Multi-objective Genetic

Algorithm

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***Abstract*—Genetic algorithm (GA) is an important method of multi-objective optimization. The method is introduced that using GA optimizes PPF parameters in this thesis. Distributed generation (DG) is a hot spot nowadays, but the harmonic pollution isn't ignored when DG is connected with the power grid through power convertors. First discuss several harmonic suppression methods have been adopted in practice, such as increasing the pulse number of convertor, using pulse width modulation (PWM) convertor, passive power filter (PPF) equipment, active power filter (APF) equipment and so on, among these Hybrid type combining PPF and APF is the most economical and effective method, so Hybrid type equipment is applied to suppress harmonics that are brought by gridconnected DG. From three respects of the cost, the DG penetration power and the total harmonic distortion (THD), using GA optimizes the PPF parameters, namely R, L, C, optimization results make the PPF cost is the most economical, the DG penetration power is the largest and the THD is the smallest, simulation shows this method is effective.**

Keywords-distributed generation; genetic algorithm; multiobjective optimization; harmonic

Analysis of Short Circuit Axis-direction Stability for Windings of Electrical Power Transformer

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***Abstract*—The reasons and computation on windings axis dynamic short-circuit electrodynamics force and axial translation are presented by analyzing and computing short-circuit current of transformer windings and the reasons for transformer axial instability and measures to be adopted are discussed.**
Keywords-transformer short-circuit current electrodynamics force axial translation axial instability

South China Power Market Development and
Simulative Operation

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***Abstract*—Establishing regional power market and optimizing the assets allocation in regional areas are key tasks in China's power industry reformation. South China Power Market (SCPM) is one of the pilot regional power markets in China and started simulative operation on Nov. 21st, 2005. As the economic development and tariff level in west-east provinces is much uneven, the simulative operation result of SCPM is attracting much attention in China. This paper provides the special characteristics and simulative operation of SCPM. The result of the simulative operation of SCPM was deeply analyzed and the profound reason of the monthly bidding result was discussed tentatively. In the end, some suggestions and recommendations for further improvement and challenge of SCPM are provided.**
Keywords-power market; simulative operation; empirical Analysis

Research and Application on
Matchmaking Tradeoff

Competition Mechanism Design in South China Power Market

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***Abstract*—There are two difficult problems should be solved during designing practicable regional transaction model, one of them is to design a rational transaction mechanism to ensure the electricity prices of different provinces in the region are relatively stable, so the balanced economic development of these provinces can be coordinated to implement the harmonious development in both power industry reform and social market economy; and the another one is that some practical problems, such as the power transmission cost for cross-provincial transaction should be impartially and properly solved. On the basis of detailed research on above-mentioned problems, this paper presents a new matchmaking tradeoff competition mechanism design in electricity market which used to be in security and stock market. Based on theoretical analysis, trade procedure and example in South China Power Market are also introduced, which can supply a theoretical reference for the competition mechanism design in regional electricity market.**

Keywords-power market; matchmaking tradeoff competition mechanism; transaction costs; balanced economic development

Study on General Model of The Thermol Cost of The Extraction Steam in The Cogeneration Plant

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***Abstract*—With the cogeneration power plant serving as an object of studying, Using the basic theory of Engineering Thermodynamics, the thermodynamic system is divided into many the thermodynamic cycle which is also divided into many mass units. Based on the general matrix equation, the water intake coefficient calculating model is established, and then analyzed the relationship between the power and the heat. Through revealed the nature of the Heat-electricity in extraction cycle, the calculation model of heat-electricity cost allocation and heat price of the products was established by strict mathematic deduction. In the end, one 600MW extraction condensing turbine is select to be calculated by our theories and methods. The method of the calculation is very simple and practical. The calculation results are true and reliable.**
Key words-energy and power engineering; heat-electricity cost allocation; mass unit; thermal cost

Comparison With Three Projects of Auxiliary Power Wiring for 1000MW Unit Based on ETAP

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***Abstract*—With the development of economy and increase of electro-capacity in our country, large capacity 1000MW power units will become the main force of power system. As a result, the auxiliary power system wiring will be complex due to the increasing of capacity and types of auxiliary machines, at the same time, the problems of large short circuit current and difficulty of motor starting are appearing. The ETAP software is used to model three projects of auxiliary power system for 1000MW units, they are project one (10kV one voltage grade three sections wiring), project two (6kV one voltage grade four sections wiring), project three (6kV one voltage grade three sections wiring). The reliability, power flow and short circuit**

current of system are calculated and motor starting checkout is carried through. Meanwhile, the economic data and power consumption rate are given in this paper. The data of the three projects are integrated and analyzed to supply references for the future designing.
Keywords: ETAP software, 1000MW unit; auxiliary power wiring, voltage grade

Using Critical Machine Couple Equal Area Criterion To Assess Multi-machine System Stability

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***Abstract*—This paper extends consistency of single machine equal area criteria and transient energy function based direct method to multi-machine system. Based on these characteristics, an approach to transient stability assessment is proposed. In multimachine system, two generators of best forward angle and best lag angle named critical generator couple is selected, equal area criterion (EAC) is applied to them, and incorporating time domain simulation (TDS),transient stability assessment is obtained. The advantage of this approach is that it avoids generators equivalence and network reduction and needs less computation time, less information, it has the same accuracy as time domain simulation in assessing stability and system model is applicable widely. Validity carried out on a New England test system of 10 generators is reported.**
Keywords-power system; transient stability; equal area criterion

Random Spanning Tree Based Improved GA for

Distribution Network Reconfiguration

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***Abstract*—Using traditional Genetic Algorithm (GA) to solve distribution network reconfiguration, the required radial network structure can not be ensured and a large number of infeasible solutions are brought about. Although some improved methods were put forward, they either are of computational complexity or can not completely settle the problem. In this paper, the strategy of searching randomly spanning trees is introduced to form an improved GA. The method proposed in this paper is simple and convenient to solve distribution network reconfiguration. Combined with graph theory, this algorithm can ensure any reconfiguration scheme characterized with radial structure of network. Numerical tests on both 33-bus and 69-bus networks show effectiveness and advantage of the proposed algorithm.**

Keywords-Genetic algorithm*; *distribution network reconfiguration*; *spanning tree*; *mutation rate

Prioritization of Transmission Projects using EPRI Probabilistic Risk Assessment Program

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***Abstract*—EPRI has developed a Probabilistic Risk Assessment (PRA) method under Power Delivery Reliability Initiative. Unlike the traditional deterministic contingency analysis, PRA combines a probabilistic measure of the likelihood of undesirable events with a measure of the consequence of the events into a single index. EPRI internally developed the PRA program that uses contingency analysis results as well as the transmission facility outage information as inputs to compute the reliability indices. This paper presents an application of PRA program to prioritize transmission projects for Tri-State Generation and Transmission Association. This work has demonstrated that the PRA method can assist system planners in comparing transmission enhancement options and determining the correct construction sequence in order to maximize transmission system reliability and minimize the operational risk**
Keywords-Probabilistic Risk Assessment (PRA)

Based on Particle Swarm Optimization and Simulated Annealing Combined Algorithm for Reactive Power Optimization

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Abstract—**This paper presents a novel combined algorithm based on particle swarm optimization (PSO) and simulated annealing algorithm(SA) for power system reactive optimization. According to the characteristics of PSO and SA, the proposed method which combined PSO and SA efficiently makes good use of easily implementing performance and fast convergence performance of PSO and global convergence performance of SA, and makes them search in phase. This paper detailed explains coding of control variables, selecting of parameters and material steps of combined algorithm for optimizing reactive power. Taking the IEEE 14-bus system, IEEE 57-bus system and IEEE 118-bus system for example, the simulation results demonstrate that the proposed method is simple and easy to implement, and has high computing efficiency and comparing with conventional PSO it can obtain higher quality solutions.**
Keywords-reactive power optimization; particle swarm optimization; simulated annealing algorithm; combined algorithm

Probability Distribution for the Feeder Current of Traction Substation

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Abstract—**Probability density function for feeder current of traction substation is fitted by using β function through the**

theory of stochastic process and method of numerical analysis, and the distribution characteristic of feeder current is generalized and analyzed based on a great deal recorded feeder current data. The feeder current sample, which will supply more detailed information for the procedure analyse of the feeder current, is obtained by using Monte Carlo method. The satistical regularity of simulation results is basically same to the recorded data of traction substations by comparing, which verifies the effectiveness of the proposed method.
Keywords-traction substation; feeder current; Monte Carlo simulation; β ***function; probability density***

An Optimal Power Flow based Algorithm for
Coordinated Secondary Voltage Control

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***Abstract*—Misbalance between reactive power production and consumption in power system causes the variation of node voltage outside the proposed limit. It is a main task for system operators to maintain the voltage profile against any unexpected disturbance. In this paper a practical coordinated secondary voltage control (CSVC) scheme was present, which was based on the optimal power flow algorithm. Additional measurements were used in order to offset the effects of the loads variation among neighboring areas. By taking the changing tendency of reactive power into consideration, a discrete optimal control model was proposed. An optimal power flow calculation was used to get the control law in each control step with the consideration of reactive power changing tendency. The simulation results as examples on the large power system were presented to illustrate the validity of the control scheme for coordinated secondary voltage control.**

Keywords- ***Secondary voltage control, Optimal power flow, Loads prediction***

Allocation of Congestion Cost in a Pool Based Model Using Shapley Value

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***Abstract*—Transmission congestion involves in system security and market efficiency under a deregulated environment. How to eliminate congestion effectively and allocate congestion cost reasonably becomes one of the important contents. In this paper, a method for congestion cost allocation in a pool-based market is proposed. The congestion cost is firstly allocated to congested lines using Shapley-value; then the line costs are allocated to all market participants according to their utilization degree of congested lines. The proposed method decomposes the allocation into two steps and computation speed for Shapley-value is improved greatly for the number of congested lines is far less than that of transactions. The method provides fair, economic signals and makes the revenue collected from the transmission users be equal to the cost of relieving the congestion.**

Keywords-Electricity market; Congestion cost; Shapley-value; Pool based modal

Optimization of DC Power Flow by Transmission Loss Allocation Method

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***Abstract*—A transmission loss allocation (TLA) method for generator and load nodes is presented by considering mathematical formulation between node power and line power flow. The formulation is based on X-matrix in DC transmission network. By the TLA method, an optimization strategy of DC power dispatch is proposed compare with AC optimal power flow (OPF) and former DC-OPF method. The proposed TLA method is also one of useful way to assess network use cost for individual transaction participant in the deregulated power market. The effectiveness of the proposed methods is illustrated through numerical examples for IEEE-118 power system.**
Keywords- optimal power flow; transmission loss allocation; economic load dispatch; loss factors; deregulated power market

A New Advanced Genetic Algorithm for Optimal Unit Commitment of Power System

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***Abstract*— Genetic algorithm (GA) is applied to the calculation of optimal unit commitment (UC) in this paper. Based on the theory of GA and the characteristics of UC in power system, a new advanced genetic operation is developed. The test results demonstrate that not only does the advanced GA consider the constraints very well, but also has some advantages, such as good convergence, fast calculating speed and high precision. The results also prove the efficacy and correctness of the method.**
Keywords- genetic algorithm; power system; unit commitment

A Novel Single-ended Fault Location Principle Based on the Differential Operator Approach

***Abstract*—A novel single-ended fault location principle, which based on the differential operator approach, is proposed in this paper. Through the further study on distributed parameter telegraph equations, the energy of voltage difference, along the lines, shows the minimum value at the fault position during a finite time period. Hereby, a novel fault location function E(x) is established, which has the only minimum value at the fault point. Whilst, the E(x) obtained by real voltage value, and $E_I(x)$ calculated from ostensible voltage have similar distribution trend. Hence, combined with fault location function, the fault can be accurately located by the minimum point of the voltage value, utilizing the single-ended fault data. The new fault location principle is proposed with the proofs of EMTP simulation tests.**

Keywords-transmission lines; single-ended fault location; projection transform.

Selecting the Faulty Line through Correlation of Zero-Sequence Currents in Non-solid Earthed Network

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***Abstract*—When single phase fault occurs in a non-solid the waveforms of the zero sequence currents in the healthy lines are similar to each other, but the waveforms of the zero-sequence current in the faulty line is quite different to those in healthy lines. The cross correlation coefficient of two signals represents the correlation between them. The more the cross correlation coefficient is close to unity, the more the two signals are similar to**

each other. Comparing the cross correlation coefficients of the zero-sequence currents in every line may find out the faulty line. The RTDS (Real Time Digital Simulator) simulations indicate that the method can find the faulty line correctly.
Keywords-Cross Correlation coefficient; Non-solid earthed network; Single-phase faults; Waveform distortion

An Accurate Fault Location Algorithm for Two-Terminal Transmission Lines Combined with Parameter Estimation

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***Abstract*—The transmission line parameters may not remain constant all the time, they may vary with different environment conditions, and the variation has much influence on the accuracy of fault location. In this paper, the effect of parameter variation on fault location was first studied using simulated transient data generated using EMTP, then an algorithm combined with parameter estimation was presented, and finally the presented algorithm was tested by simulated transient data generated using EMTP and actual recorded data. Test results show that the proposed algorithm can improve the accuracy of fault location, especially when the line parameters provided are not accurate.**
Keywords- Fault Location; Parameter Estimation; Two-Terminal Transmission Line; Distributed Parameter Model.

Hybrid Model of Computer Protection Operation

Logic Based on PNPT and Development of Dynamic Logic Diagnosis Software

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Abstract—This paper proposes the concept of 'quasi-hybrid model' and presents a new kind of dynamic relaying logic hybrid model based on Programmable time Petri Net (PTPN) and visualize software which could meet the need of dynamic display and analysis for the relaying logical relation, playback of fault and relaying program debugging expediently. Logic unit library is created in type of integrated prototype and figure. Figure platform could be supplied by drawing logic diagram with this software. Also, dynamic and visual analytical function of the protective relaying action is put into effect.

Keywords-quasi-hybrid model; computer protection operation logic; dynamical analysis; PTPN

Simulation and Analysis of System Oscillation and Characteristic of Starting Relay Based on Fault Component During System Oscillation

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Abstract—A parameters controllable oscillation model is constituted with ATP based on analysis of the changing pattern of oscillation current and voltage. The model covers deficiency of power system simulation tools that have no models to be used for analysis of oscillation. Protection relays which would be influenced by oscillation are classed. As a major test, detailed theoretic analysis as well as simulation of operation characteristic of starting relay based on fault component characteristic during system oscillation is carried out. The important meaning of the floating threshold used in starting relay is emphasized. The conclusion could be used as technical reference.
Keywords-fault component; starting relay; system oscillation; protective relaying; simulation

Novel Connection Scheme of Backup Power Supply Adaptive to Distribution Line Non-Communication Protection and New Criterion for High Voltage and Large Capacity Induction Motor

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***Abstract*—This paper presents a new practical backup power supply connection scheme for Distribution Line Non-Communication Protection (DNCP). Simulation tests have been conducted using the Alternate Transient Program (ATP) with respect to a typical single circuit breaker multi-section system. The results prove that the new scheme is able to not only recover the power supply of loads on healthy lines automatically, but also create disturbances in favor of Accelerated Over Current (AOC) criterion. Aiming at the failure of Directional Under Voltage (DUV) criterion derived from high voltage and large capacity induction motor load, a novel criterion using the increment of reactive power is proposed.**
Keywords-backup power supply; DNCP; AOC; DUV; ATP; high voltage and large capacity induction motor

THE STUDY OF CONTROL TACTICS OF RELAYING PROTECTION OF THE CERTAIN STEELWORKS IN BLACK START

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Abstract:
In this paper, the study of control tactics of relaying protection of certain steelworks is presented. According to the main issues that need to be considered in restoration process, such as the influence of set-up transformer and exciting rush current, the re-closing way of bus, current protection of line, and generator protection, the control tactics of relaying protection has been adjusted to match the restoration condition.
Keywords:
black start; relaying protection; control tactics; steelwork

Fault Line Detection of Non-effectively Earthed
Neutral System Based on Modulus Maximum
Determining Polarity

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***Abstract*—The traditional signal analysis method couldn't supply the part time-frequency characteristics of saltation signal. This paper analyzes the theory of fault line detection of non-effectively earthed neutral system based on modulus maximum determining polarity. A simulation of the non-effectively earthed neutral system is built here. It verifies the correctness and practicability of the method which is used in fault line detection, and shows a way of how to choose the wavelet function and the character scale. All of the results in this paper present a plausible way to transient protection and fault line detection.**

Keywords- Modulus Maximum; Fault Line Detection; Wavelet Function; Non-effectively grounding network

Research on Principle and Countermeasures of the

Transformer Sympathetic Inrush

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***Abstract*—Based on the analysis of sympathetic inrush in no-load parallel transformer, the principle and characteristics of sympathetic inrush are studied according to flux variation. Time differential method is analyzed to identify sympathetic inrush .The influencing factors of sympathetic inrush are studied. The points are verified by MATLAB simulation. The harm of sympathetic inrush to transformer differential protection and back-up protection are discussed, and several countermeasures to sympathetic inrush are presented.**

Keywords- transformer; sympathetic inrush; flux linkage; time differential method; differential protection

An active anti-islanding algorithm for inverter based multi-source DER systems

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***Abstract*— Islanding detection is an essential function for safety and reliability in grid connected distributed generation (DG) systems. Several methods for islanding detection are proposed, but most of them are not efficient for multi-source configurations, or they may produce important power quality degradation getting worst with DG penetration increasing. This paper presents an active islanding detection algorithm for Voltage Source Inverter (VSI) based multi-source DG systems. The proposed method is based on voltage positive feedback theory. Simulations by MATLAB/Simulink/SimPowerSystems**

were used to evaluate its performance and its advantages concerning time response and power quality effects under critical conditions as load's unity power factor and high quality factor.

***Index Terms*-- Distributed generation (DG), interconnected power systems, islanding detection, Power generation, Power generation control, Power systems.**

Combined Positional and Boundary Protection for Transmission Lines

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***Abstract*— This paper presents a novel relay for power transmission line systems, which is based on a combination of positional and boundary protection principle. The relay installed at a substation is responsible for the protection of the transmission lines associated with the substation. The relay is able to offer fast trip for any fault on its protected line sections without the need for communication link. The paper presents a detailed description to the basic principle, algorithm and design of the combined positional and boundary protection relay.**

Index Terms—*Transient based protection; Positional protection; Boundary protection.*

Power Grid Crises Management and Empirical

Research on Small Disturbance character of Power Grid

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Abstract**—***Power grid crises, which have frequently taken place at home and abroad, alert the importance of power grid crises management. With the development of interconnection of big power grid, a small-disturbance stability of a power system should not be ignored. This article introduce the basic concept of power grid crises management and the basic principle of small-disturbance theory to analyze the damping character of Jiangsu power grid, adopts Prony theory to prove the above calculated result, then researches the effect of PSS device to raise the damping property of power system. This study has theoretical and practical significance to guarantee the security and stability of power grid.*

Keywords-power grid; crisis management; small disturbance; Prony; PSS

Research on Measuring Equipment of Single-phase Electricity-Stealing with Long-distance Monitoring Function

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Abstract— The power distribution monitor is an important research in electric power system, and electricity-stealing defense is one of the chief steps in distribution network reconstruction. Due to the kind of electricity-stealing and actual demand of defending stealing electricity, based on a digital single-phase electric energy meter, the metering equipment of electricity-stealing with long-distance monitoring function is designed, which adopts a low power consumption MSP430 singlechip as the control core, uses the standard electricity measure module as the basis of accurate measure of the electricity-stealing quantity, takes use of the output impulse of standard electricity measure module and user electric energy meter to calculate and judge whether happen electricity-stealing, transmits the current time and the number of electricity-stealing to the remote terminal facility through GSM network. The system also realizes the user's measuring pocket monitoring, the image acquisition about the illegal on-off state of the user's measuring pocket by using the CMOS image sensor, provides positive proof to handle lawbreakers with the behavior of electricity-stealing. Results of the user application show that the system not only realizes monitoring the behavior of electricity-stealing, accurately recording the time of electricity-stealing occur and finish, the quantity of electricity-stealing and image information of on-spot electricity-stealing, but also realizes long-distance monitor the behavior of electricity-stealing, which is convenient for centralized management .In addition, the system offers a solving method to the data of meter reading.
Keywords-electricity-stealing; long-distance monitoring; single -phase; digital electric energy meter

Fault Location for Interline Fault of Parallel Transmission Lines Using One-terminal Data

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***Abstract*—To solve the problem of Interline fault of parallel transmission lines, by means of considering the influence of zero sequence mutual inductance of parallel transmission lines a fault location algorithm based on one-terminal electrical data is proposed. Based on the analysis of the relationship of two parallel transmission lines' fault components, the fault location equation for interline fault without ground is derived by the boundary condition of interline fault mode. It is shown that the new method is independent of fault resistance, load condition and source impedance. Extensive simulation studies using PSCAD/EMTDC have verified that this approach can obtain a highly accurate fault distance, it is also proved that the proposed algorithm is independent of transition resistance, system impedance and load situation.**

Keywords-Fault currents, fault location, interline fault, load currents, parallel transmission lines, power system faults, sixcomponent algorithm, source impedance, transition resistance, zero-sequence mutual.

Analysis on Cascading Outages of Yunnan-Guangdong Ultra-high Voltage

Transmission System

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Abstract--**Many severe cases of black outs have taken place recently among different countries, which has been the significant factor on power system's safe and stable operation. Taking 2010 Yunnan-Guangdong ultra-high voltage transmission system as example, power flow diversion is analyzed when faults occur on the sending Yunnan power system. Action of resistance three segment protection is obtained by comparing calculating resistance and protection setting, which provides the suggestion that how to prevent the cascading outage of Yunnan power grid. The research is constructive, and the conclusion has been applied on the manufacture of Yunnan power grid.**

***Keywords*-ultra-high voltage transmission system; cascading outage; resistance three segment protection**

Authentication Scheme for Substation Information

Security Based on Chaotic Theory

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***Abstract*—Information security is crucial to electric power system which requires high reliability, security and stability. According to the data and communication security standard IEC 62351 in power systems, authentication is one of the most important security measures. In remote control environment of substation, it is required that the authentication scheme can not only satisfy**

the authentication demand for substation communication security, but also ensure minimum calculation workload and transport expenses. Using the sensitivity of initial condition of chaotic theory, a new password authentication method based on Chebychev chaotic mapping is presented in this paper. The chaotic sequence is taken as identity mark sequence. Unlike the general OTP authentication, the chaotic authentication system needn't to maintain the entire sequence in its storage. The authentication between IEDs in substation automation is taken as an example, and the concrete authentication process between IEDs is designed.
Keywords-Authentication; Chebychev chaotic mapping; one time password; IEDs

Numerical Simulation of Cooling Water of Yangluo Power Plant

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***Abstract*—The thermal pollution due to the cooling water project of the Phase IV expansion project of Yangluo Power Plant is studied using a 2-D horizontal mathematical model, to predict the flow and temperature fields of the warm water outflow from the power plant. Based on the calculated area of thermal pollution of this cooling water project, proposals to reduce the influences of the thermal pollution of cooling water are thus put forward, providing a basis for the decision makings on the concerned environmental evaluation and design.**
Keywords-cooling water; thermal pollution; numerical Simulation

THE APPLICATION OF WAVELET TRANSFORM AND NEURAL NETWORK USED IN

SHORTTERM LOAD FORECASTING

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***Abstract*—A novel method of short-term load forecasting based on wavelet coefficients and BP neural network is proposed in this paper. The method of forecasting of load sequences has been replaced by the method of forecasting of wavelet coefficients. The wavelet coefficients on different scales are forecasted by BP neural networks respectively after wavelet detail coefficients have been dealt with by layer soft threshold. The new method combining wavelet coefficients with BP neural network is introduced in detail in this paper and the example about the method is given as well.**

Keywords-wavelets coefficients; BP neural network; softthreshold; short term load forecasting

Lessons Learned from the Ice Storm in 2008 in Jiangxi China

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***Abstract*—The most severe ice storm took place in Jiangxi China in the beginning of the year 2008 and struck more than 80% area of the Jiangxi power grid. Serious icing on transmission lines destroyed 116 towers of 500kV and 142 towers of 220kV in Jiangxi Power Grid. It is estimated that the power supply of about 7.5 million customers were affected. This paper provides a technical review of the procedure of the ice storm, the strike to the power gird and the power restoration process. The main characteristics of this ice storm are discussed. Finally, emergency strategy and the lesson from this natural disaster and power failure are summarized for power grid companies.**
Keywords- power grid; ice storm; planning; emergency Management

Lessons Learned from the Ice Storm in 2008 in Jiangxi China

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***Abstract*—The most severe ice storm took place in Jiangxi China in the beginning of the year 2008 and struck more than 80% area of the Jiangxi power grid. Serious icing on transmission lines destroyed 116 towers of 500kV and 142 towers of 220kV in Jiangxi Power Grid. It is estimated that the power supply of about 7.5 million customers were affected. This paper provides a technical review of the procedure of the ice storm, the strike to the power gird and the power restoration process. The main**

characteristics of this ice storm are discussed. Finally, emergency strategy and the lesson from this natural disaster and power failure are summarized for power grid companies.
Keywords- power grid; ice storm; planning; emergency Management

Research of Effect of Wind-blown Rain on Power Frequency Flashover Characteristic of Conductor-tower Air Gap

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***Abstract*—At 1:1 ratio scale simulated tower, the effect of rainfall 、wind and wind-blown rain on power frequency flashover characteristic of conductor-tower air gap was initial systematically researched at inner and outdoor. The result is that, rainfall、wind speed、wind direction、wind-blown rain can effect the power frequency flashover characteristic of air gap. The rain reduce the flashover voltage obviously, especially the air gap is small. When the air gap is 1.2m, and the rainfall intensity is 14.4mm/min, the flashover voltage reduced 13.3%, when the air gap is 0.6m, the flashover voltage reduced 16.2% with the same rainfall intensity. The resistivity of rainwater also has influence on the power frequency flashover characteristic of air gap, but its influence is less than that of rainfall intensity. When the resistivity of rainwater is greater than $4\times10^{3}\Omega\bullet$cm, as the resistivity increase further, the increasing of flashover voltage has the tendency of saturation; when the resistivity of rainwater is less than $2\times10^{3}\Omega\bullet$cm, the flashover voltage decreases rapidly as the decreasing of the resistivity, and when the resistivity decreases further, the decreasing speed of flashover voltage has the tendency of increasing. The influence of rainfall path is not obviously to the flashover. The wind direction and speed also influence the flashover voltage, when the wind direction is parallel to the discharging path, the strong wind decreases the flashover voltage of conductor-tower air gap,**

when the wind direction is vertical to the discharging path, the strong wind increases the flashover voltage of conductor-tower air gap. When there is wind-blown rain, and the wind path is parallel to the discharging path, the flashover voltage is less than that when there is only rainfall. And in the test, the influence of wind-blown rain to the power frequency flashover of air gap is about the lineal superposition of the influence on only rainfall and only wind. Through the test, the following result is putted forward, in the extremely atrocious weather, the air gap of which the power frequency withstand voltage is more than the maximum operating phase voltage of 500kV transmission line is 1.25m when there is no step bolt (The data is not corrected to the high altitude localities.).The research could supply technical base for the design of minimum air gap space of electric transmission line in adverse weather, reduce the windage yaw discharge fault and accident rate, and improve safety operation level and economic benefit of transmission line construction.
Keywords-Rain intensity; Rainwater resistivity; Wind speed; Wind direction ; Wind-blown rain; Air gap electric strength

Optimal Planning of Substation Locating and Sizing Based on Improved QPSO Algorithm

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***Abstract*—A hybrid model for substation locating and sizing is presented in this paper to work out the number of newly-built substations and capacity-expansion, load assignment and optimal size of substation. Geographic information system is used as a platform to manage a great deal of data in this method, in which the optimum assembly model of the substation capacity and the number of substations be the first layer model, then the second layer model of load assignment is constructed by load constructing vector, and then improves traditional single location model as the third layer model of substation locating and sizing. Based on economy and reliability constraints, threelayer**

model is nested to each other, finally the Improved Quantum-behaved Particle Swarm Optimization (IQPSO) algorithm is used as a new algorithm to solve hybrid model. The IQPSO algorithm is tested by a realistic planning project to verify the effectiveness and feasibility.
***Keywords*—Substation locating and sizing, Geographic Information System (GIS), Integer planning, Quantum-behaved particle swarm optimization**

The Study and Application of Power Plant Planning based on Evolutionary Programming

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***Abstract*—An improved multi-group evolutionary programming is proposed and applied to power plant planning. The minimum total cost capacity expansion scheme is established to meet the nonlinear constraints of planning and operating. In this paper the planning objective costs take into account unnerved energy costs besides investment, operation and environment pollution costs. A novel Bi-group Evolutionary Programming based on Communication (BCEP) algorithm is proposed. In this algorithm, evolution of Cauchy operator and Gauss operator are parallel performed with different mutation strategies, and then the group can explore the solution space separately and search the local part in detail synchronously. Information is exchanged when sub-groups are reorganized. The result of experiment shows that the algorithm is effective. Then it is applied to program 10-year power plant planning in a certain province.**
Keywords-Evolutionary Programming; Multi-group; Power Plant Planning

Improvement of probabilistic load flow to consider network configuration uncertainties

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***Abstract*—An improved probabilistic load flow method considering network configuration uncertainties is proposed in this paper. The linear relationship between power injections and line flows is deduced, which enables applying cumulants and Gram-Charlier expansion to compute the probabilistic distributions of the transmission line flows, instead of complex convolution calculations. Then compensation method and total probability theorem are combined to model the random variations of network configuration. In this way, the probabilistic distributions of state variables can be easily obtained, considering the random factors of loads, generators and network configuration. The case study of WSCC 179-node test system shows that the uncertainties of network configuration remarkably affect the probabilistic distributions of state variables. Thus the proposed method could provide planners with more accurate and comprehensive information. Furthermore, the comparison with Monte Carlo simulation verifies its higher speed, high degree of accuracy and the prospects for practical application.**

Keywords-Network configuration uncertainties Probabilistic load flow; Cumulant; Gram-Charlier series expansion; Compensation method; Total probability theorem

Multi-objective Transmission Planning

***Abstract*— This paper describes a transmission expansion planning method based on multi-objective optimization (MOOP).**

The method starts with constructing a candidate pool of feasible expansion plans, followed by selection of the best candidates through MOOP, of which multiple objectives are tackled simultaneously, aiming at integrating the market operation and planning as one unified process in the market environment. Subsequently, reliability assessment is performed to evaluate and reinforce the resultant expansion plan from MOOP. The proposed method has been tested with the *IEEE* 14-bus system and analyses and discussions have been presented.

Keywords- Transmission planning, Multi-objective optimization, Electricity market.

A New Load-Flow Calculation Method Based on the Theory of Adjoint Systems

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***Abstract*—In this paper, a load flow calculation method based on the theory adjoint systems is developed for both well-condition and ill-condition power systems. Solving the Nonlinear Least Squares Problem by means of a first order ordinary differential equation is considered. Then it is revealed the method based on the theory of adjoint systems to compute the controlling unstable equilibrium point. It is solving Nonlinear Least Squares Minimization by gradient flow method. A new method based on gradient flow to solve nonlinear equations is presented. The method is applied to compute power flow, especially to compute ill-conditioned power flow. The method can compute both wellconditioned power flow and ill-conditioned power flow efficiently, which is verified on IEEE 9-bus system.**

Keywords-component; power system adjoint system;

equilibrium point; gradient flow; power flow computations; illconditioned power flow

Distribution Network Optimal Planning Based on Clouding Adaptive Ant Colony Algorithm

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***Abstract*—An improved ant algorithm based on cloud model is proposed, and it's applied to the power distribution planning. In view of the main disadvantage of being inclined to local convergence and being slow of the convergence rapidity of traditional ant algorithm, the pheromone decay coefficient and the pheromone intensity are qualitatively controlled and dynamic**

selected in this paper by making use of the uncertain qualitative association rule inference based on cloud model, in view of the advantage of uncertain converting qualitative concept to quantitative expression of cloud model. The algorithm overcomes the shortcoming of being inclined to local convergence and being slow of the convergence rapidity of traditional ant algorithm. Numerical simulation results of power distribution planning demonstrate the efficiency of the algorithm.

Keyword-distribution network planning; cloud model; ant colony algorithm; qualitative association rule

A Comprehensive Evaluation Method for Distribution System based on Connection Modes

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***Abstract*—A comprehensive evaluation method is introduced in this paper. Security, reliability, economic profit and other indices are included in this method. Functions of fuzzy membership grade are constructed for the evaluation indices. The final evaluation is determined by the weighted average of each index. The 10kV distribution network planning of a district in Shanghai is selected as an actual example, in which several planning alternatives are evaluated based on this method. The results of the example show that the method proposed in this paper can not only evaluate the connection modes quantitatively in an effective way, but also reflect the key elements influencing the characteristics of network planning.**

Keywords- distribution system; connection mode; fuzzy membership grade; index; comprehensive evaluation

Equivalent Admittance Small-World Model for Power System

– I. Basic Concepts and Implementation

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***Abstract*—Small-world model based on equivalent admittance for power system is presented. Instead of shortest path used in the existed models, it is reasoned that the Thevenin's equivalent impedance can be used as measurement of the distance between different buses in power grid because the power flow is dividable which is quite different from the message flow in information network. Thus, global and local equivalent admittance are used to identify the small-world feature of power grid with more comprehensible physical view and polynomial time complexity. Numeric examples show that the presented model has the same effect as but more reasonable than the existed ones in power system, while it also works well in some situations in which the existed models are improper.**

Keywords-Power system reliability; Small-world model; Thevenin's Equivalent Circuit; Equivalent admittance

Equivalent Admittance Small-World Model for Power System

–II. Electric Betweenness and Vulnerable Line Identification

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***Abstract*—Electric betweenness is presented for vulnerable line identification in power system based on equivalent admittance small-world model by considering all possible transmission paths between any “plant-load” pairs together with different generation capabilities and operating modes. Whereafter，the maximal transition capability is also proposed to represent the changing of power system in cascading failures. Numeric examples of IEEE-39 system and Northwest China Power Grid show that lines with higher electric betweenness always belong to long-distance connections or vulnerable lines in power grid, while the power grid itself is more vulnerable under the attack based on high electric betweenness. Moreover, simulation of cascading failures in IEEE-39 system shows that the maximal transition capability is also valid when cooperated with the existed index, connectivity level.**
Keywords-Power system reliability； Electric betweenness； Maximal transition capability；Vulnerable line identification； Cascading failures；

Power Flow Calculation Method for Islanded Power Network

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***Abstract*—In the practical power system operation, sometimes, some reasons will lead to local power network splitting, generate islanded power network operating. In order to ensure islanded**

power network operation safety and stability, it is urgently need to know power flow distribution for islanded power network. However, conventional power flow model can't reflect the important features for islanded power network operating, power flow distribution calculated by using conventional power flow model also don't agree with practice. So, based on practical power system operation, a new mathematic model of power flow calculation is established for islanded power network in this paper. The new model not only has obvious physical significance, and conforms to the closed-loop regulation laws of practical power system operating, but also it doesn't need setting slack bus, all generator units with speed governing system and excitation control system undertake changing load together according to setting self-generator parameters at open-loop time, and gets rid of the drawbacks which caused by conventional power flow model when calculates islanded power network's power flow by using it. The new model has important application value for solving engineering problem for islanded power network. Simulating the power flow distribution of normal operation state, cutting generator unit, cutting load and secondary regulation by using IEEE 30-bus system, the results show that the new model is effective and practical.
Keywords-power flow calculation; islanded power network; speed governor; excitation control system; cutting generator unit; cutting load; secondary regulation

multi-objective power network planning based on improved pareto ant colony algorithm

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Abstract—**As the present power system planning can hardly take economy and reliability into account, an improved pareto ant colony algorithm(IPACA) is proposed in this paper. An improved quick sort method is applied to construct pareto optimal solution set, thereby the slowchain is shorten and the time complexity is reduced. Clustering analysis has been used to improve the diversity and distributivity of the pareto optimal solution set. Global convergence rate of the algorithm is expedited, as the control parameter in the local and global pheromone update is vary with the iteration. The global search ability is enhanced by dynamic self-adapting adjust mechanism of the evaporation coefficient. The proposed algorithm is tested with 18-bus system and results show that the find pareto optimal solution of it is more than the basic PACA, and distribution of the pareto front is well-proportioned.**
Keywords- power network planning; multi-objective optimal; Pareto ant colony algorithm; clustering analysis

A New Hybrid Approach for Unit Commitment Using Lagrangian Relaxation Combined with Evolutionary and Quadratic Programming

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Abstract- **This paper proposes an approach which combines Lagrangian relaxation principle with evolutionary programming and quadratic programming (LREQP) for short-term thermal unit commitment. Unit commitment is a complex combinatorial optimization problem which is difficult to be solved for**

largescale power systems. This paper presents a hybrid method for **ramp rate constrained unit commitment (RUC)** problem. Hybrid LREQP minimizes the total supply cost subject to the power balance, generation ramp limit constraints, on/off line minimum level constraints, minimum up and new down time constraints and generator operating constraints. The proposed solution method solves unit commitment problem with two coordination procedures. In the first procedure, an evolutionary programming algorithm is used to improve a solution obtained by the Lagrangian relaxation method: Lagrangian relaxation gives the starting point for a evolutionary programming procedure. In the second procedure, economic dispatch (ED) by quadratic programming (QP) is performed 24 hours to simultaneously dispatch output subject to all constraints and unit decommitment is carried out.
Hybrid LREQP is tested on the 26 unit IEEE reliability test system. The proposed algorithm takes the advantages of both methods and therefore it can search a better solution within short computation time.
Keywords-unit commitment, Lagrangian relaxation, Ant Colony search algorithm (ACSA), quadratic programming, evolutionary programming.

Transmission System Reliability Evaluation in the Central-1 and Northern Regions of the Lao PDR in Corresponding to Transmission System Development Plan

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***Abstract*— This paper investigates the 115kV transmission system development plan of Electricite du Laos (EDL), specifically for the transmission line projects in the Central-1 and Northern regions of the Lao PDR for the years 2010-2020. The steady-state power flow analysis at peak demand conditions is based on N-1 contingency criterion. The adjustment in transmission system development plan of EDL is to improve the reliability of such regional networks for the given years based on the economic justification (economic internal rate of return, EIRR and benefit cost ratio, B/C Ratio). The economic justification will be**

accomplished to indicate the internal rate of return and benefit cost ratio of each transmission system expansion project. This paper is used DIgSILENT program to calculate the steady-state power flow analysis and Transmission System Reliability Assessments. The results of the studies have shown that, power losses, energy not supplied (ENS), system average interruption frequency index (SAIFI), system average interruption duration index (SAIDI), are also reduced. In addition, the economic internal rate of return (EIRR) and benefit cost ratio, (B/C Ratio) of each project can assist planers to make a reasonable discussion or determination to reinforcement and expansion planning.
Keywords- Reliability evaluation by using N-1 Contingency criterion, Transmission system expansion, Transmission system reliability assessment, and Economic justification.

Effect of Votage Variation From Distributed Generation on Very Long Distribution Line with Multiple Voltage Regulators

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Abstract—This paper presents the effect voltage variation from distributed generator (DG) on long distribution line with multiple voltage regulator. The mini hydro power plant is used as distributed generator. This paper considers the operation of DG and automatic voltage regulator (AVR) effected voltage along distribution on varying load. From this study, the operation of DG and AVR has effected to voltage along the long distribution line depended on load varying and location. Therefore, the size of distributed generation has to be considered when it dispatches to the very long distribution system.
Keywords- Distributed generation, Voltage regulator, Very long distribution line, Distribution system, Mini hydro power.

Reliability Evaluation of Distribution

System Considering Composite Uncertainty Factors

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***Abstract*—Uncertainty factors such as unavoidable weather conditions and aging of components with time-varying process are compositely considered in the paper in reliability evaluation of distribution system. A method of distribution system reliability evaluation is introduced by considering uncertainty factors combined with sequential Monte-Carlo simulation method Reliability and economic indices of load points and system can be calculated. Reliability of IEEE-RBTS-bus5 system is evaluated in the paper, which can illustrate different effects on reliability indices for weather environments and component aging factors. The results of reliability evaluation considering uncertainty factors may be in line with practical situation, which supports references of decision analysis for operating planners.**

Keywords-distribution system; reliability; sequential simulation method; uncertainty factors

A Bi-level Programming Model for Multistage Transmission Network Expansion Planning in Competitive Electricity Market

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***Abstract*—A new bi-level programming model of multistage transmission network expansion planning (TNEP) based on double-bidding based pool electricity market is presented in the paper. Open access transmission brings new challenges to transmission planning. From the transmission company's view, the goal of optimal transmission planning scheme should not only bring the optimal transmission profit in the market, but also ensure high operation security and reliability. In this paper, the upper level program considers transmission profit maximization in long-term planning, the lower level program considers the social welfare maximization in short-term operation. Furthermore *N*-1 security constraints are also considered in the model. A hybrid algorithm integrated with niche genetic algorithm and prime-dual interior method is used to solve the bilevel programming model of the transmission network expansion planning. Test results of the 18-bus system and real world 77-bus system show feasibility and right of the method.**
Keywords-transmission network expansion planning; bi-level programming; hybrid algorithm

The Dynamic Planning of Urban Substation Based on Weighted Voronoi Diagram

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Abstract—Based on dynamic programming method, the unified planning mathematical model of multi-voltage substation is established. The model takes the voltage levels as phases, the location and sizing of new stations as decision-making, the power supply scope as state, and the annual cost of multi-voltage levels overall investment as objective function. In the paper, for locating and sizing of 110 substations, dynamic and weighted Voronoi (V) diagram planning method is presented, and an algorithm based on Cellular Automata for creating V diagram is designed; for locating and sizing of 220 substations, differential coefficient evolutional algorithm based on GIS is adopted. Due to

considering the effect of unusable plots, ensures the practicability of new substation locations. Practical examples show that: the proposed method can satisfy the requirements of substation planning well, and obtained the good efficiency.
Keywords- Cellular Automata; dynamic programming; weighted Voronoi diagram; substation locating and sizing

On Underground Power Planning Based Virtual Reality

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Abstract- With the development of city, the planning of underground power pipelines becomes more and more important. The layout is difficult because pipelines situate underground. They are invisible and related with many factors such as roads, buildings, transformer substations, other pipelines and so on. In order to improve planning efficiencies, a new technique based on virtual reality is presented. Firstly, a virtual scene is constructed according to the existing pipeline and related environment. And the area partition method is introduced to increase rendering speed. So the designer can browse the virtual underground space at their choice. It makes the planning work simple. Then, a planning drawing and a three-dimensional demonstration will be automatically produced on the basis of the planning message. When the technique was applied to power planning of Pudong District in Shanghai, China, it saved planning and lay out time about 20%. Keywords- Power planning; Virtual Reality; pipeline; visualization

New Method for Calculating Optimal Switching Time of Bang-Bang Controlled Series Capacitor Based On Direct Method

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Abstract—-Controllable series capacitors have been utilized to damp swings resulted from large transient disturbances in power systems, and the switching time of the capacitors has distinct influence on the swings of the machines. The reason that different switching time of the series capacitor brings out different stability of the system is analyzed in this paper, a method for calculating the optimal switching time is also proposed. The optimal switching time satisfies the following condition: the transient energy of the system is minimum after the capacitor is switched. Simulation results with a 9-machines power system show the effectiveness of the method.

Three-phrase active power filter based on DSP for power distribution systems

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Abstract—With the use of nonlinear loads increasing rapidly, which inject undesired harmonic currents into power distribution systems, Shunt Active power filters (SAF) are being considered as a potential candidate for solving harmonic problems in order to meet harmonic standards and guidelines. This paper presents a new digital signal processor (DSP)-based control method for a three-phase Shunt Active Power Filter. Compared to conventional analog-based methods, the DSP-based solution provides a flexible and cheaper method to control the SAF. The proposed control method for determining the reference compensating currents of the three-phase shunt active power filters based on artificial neural network (ANN) is presented. Finally, the simulation and experimental result also shows that both controller techniques can reduce harmonics in three-phase electric systems drawn by nonlinear loads and reduce hardware components.

Analysis of Linearity and Time-Varying Characteristic of Adaptive

Detecting Distorted Current System Based on LMS Algorithm

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Abstract—The conventional detecting methods for distorted currents have various limitations and we have introduced adaptive detecting system in power distribution. This paper proved that the detecting system based on least mean square LMS) algorithm is linear and time-varying adaptive system. Based on the adaptive noise canceling technology in the signal processing, this paper presented an improved LMS algorithm for distorted current detection, which can overtake the drawback of normal LMS algorithm effectively. Moreover, the presented algorithm is easy to implement and solve the contravention between the steady-state accuracy and transient response speed. Simulation results showed that detecting capabilities of the improved LMS algorithm is superior to those of the normal, the proposed approach gives better transient performance and better accuracy than the normal method. Keywords- distorted current detection, adaptive LMS algorithm, linearity and time-varying characteristic of detecting system based on LMS algorithm

Analyze Linearity and Time-Varying Characteristic of Continuous

Detecting Distorted Current System Based on LMS Algorithm

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Abstract—The discrete adaptive system have been used in detecting distorted currunt widely. This paper presented an analogy continuous system based on least mean square (LMS) algorithm, and proved that the analogy system has characteristics of linearity and time-varying system. Based on the adaptive noise canceling technology in the signal processing, this paper presented an improved algorithm of LMS for distorted current detection, which can overtake effectively the drawback of normal LMS algorithm. Moreover, the algorithm presented is easy to implement and solve the contravention between the detecting precision and speediness. The simulation results showed that the algorithm's capability is superior to those of the normal LMS, the proposed approach gives faster dynamic performance and better precision than the normal method.

Study on PAN-based activated carbon fiber prepared

by different activation methods

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Abstract—Activated carbon fibers (ACF) were prepared from polyacrylonitrile (PAN) precursor fibers by two methods: KOH activation at 400-1000 and H_3PO_4 activation at 600-1400 . H_3PO_4 activation yielded relatively poorly developed porosity regardless of the activation temperature maintaining a low surface area(around 1000m^2 1) at very high burn-off, while KOH activation provided high porosities above 650 . The microstructures of samples were studied by means of nitrogen adsorption. The nitrogen isotherms were analyzed in detail using the routine BET method, characterize the pore size distribution by DFT (theory of density function).

Study on PAN-based Activated Carbon Fiber Prepared by KOH activation method

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Abstract—In the paper,we studied the KOH activation method of PAN-based activated carbon fiber (ACF) systematically,tested the adsorption property of ACF by iodine valve and benzene valve and produced ACF with excellent adsorption property.The surface area of PAN-ACF manufactured by better technology was 1689.58(m^2/g),the volume of pore was 0.55ml/g,the average inside diameters was 0.65nm.

Adaptive PI Algorithm of SSSC Controller

for Power

Flow of Power Systems Based on Neural

Networks

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Abstract—Power system installed with SSSC is a large-scale nonlinear, indeterminist, multivariable system [1], and the traditional PI controller has a limited application in some cases because of its non-adaptive parameters. In this paper, a new control strategy of a SSSC based on self-adaptive PI algorithm with neural network is proposed for power flow control of power systems. In the proposed controller, an identification network is modeled to analyze the dynamics of power systems, and P self-tuning parameters network is employed to obtain the optimal control parameters using training algorithm presented in this paper. With perfectly dynamic characteristics of controller, the real power and reactive power of power systems is flexibly controlled using PI regulating parameters with neural networks. A studying example is carried out to estimate good robustness and adaptability of the proposed controller in the MATLAB dynamic simulation platform. The results verified the adaptability and feasibility of the proposed control strategy in power flow control of power systems.

A New Strategy for Tie-Line Power Regulation of Hydro-Thermal Interconnected Power System Based on Benefit Analysis

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Abstract—Considering different character between hydroelectric which decomposes the large problem into a few

smaller and power and thermal power contributed to tie-line, as well as the easy-solving sub-problems and reaches the optimal solution. cost function of the whole interconnected system under electric Dos Santos [2] used Newton-Rap son method for the power market environments, this paper presents a new calculation of area interchange control (AIC) of an optimization strategy based on benefit analysis to solve the interconnected power system in which the effect of AIC is power regulation on tie-line in hydro-thermal interconnected represented internally into a Jacobian matrix. The ANN power system. The units relating to tie-line can be procured by technique is applied to AGC for multi-area power systems in an electrical dissection algorithm in the sending and receiving [3].Meanwhile, other investigators have proposed to solve the network and matched with different correlative coefficient, while problem using LP methods, evolutionary the other units are also due to be coordinated with diverse simulated annealing [5], genetic algorithm sp r[o6g]r, atmabmui nsge a[r4c]h, regulating power capacity at the same time. The effectiveness of algorithm and particle swarm optimization [7]. However, a the proposed method is demonstrated on IEEE 57-bus system comprising of hydro and thermal units and compared with some common problem pertinent to the above mentioned conventional approaches. The experimental results show that the approaches is the negligence of different effect between proposed new strategy approaches is able to obtain higher hydroelectric power and thermal power contributed to tie-line, quality solutions efficiently than the conventional approaches.

A Design of the Series Compensator for the Distribution Network Integrated with Distributed Energy Resource

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Abstract — A novel power quality improvement scheme based on distributed energy resource (DER) and series compensator (SC) is proposed in this paper. The proposed DER-SC scheme can help the sensitive loads ride through the upstream voltage sags by regulating power flow in the distribution network flexibly. An analytical relationship between voltage sag magnitude, phase angle jump and the capacity of the SC is established. Simulation results verify the efficacy of the proposed scheme.

Time-domain Simulation Investigates Short-term

Voltage Stability with Dynamic Loads

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Abstract—Appropriate modeling of dynamic loads is of primary importance in voltage stability studies, especially increasing use of induction machines in both consumption and generation. This paper is mainly related to short-term voltage instability depending on time domain simulation. The actuality of voltage instability research is summarized, and the mechanisms of shortterm voltage stability are explained. A simple power system will simulate the load dynamics showing how a short-term voltage collapse occurs. Based on simulations, this paper analyzes frequency decay and voltage decay of power system with large generating unit out of service depending on the load model and system condition. It is useful to realize the impact of load characteristics on voltage stability and low frequency of power system, and properly design the under-frequency load shedding and under-voltage load shedding schemes to improve the power system stability.

Dual Heuristic Programming Based Control of SSSC in Power Systems

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Abstract—Power system installed with SSSC is a large-scale nonlinear, indeterminist, multivariable system, and the traditional PI controller has a limited application in some cases because of its non-adaptive parameters. This paper presents the design of a neuron-controller for a SSSC that augments the conventional PI controller. The neuron controller uses Adaptive Critic Design (ACD) with emphasis on Dual Heuristic Programming (DHP). A studying example is carried out to estimate good robustness and adaptability of the proposed controller in the MATLAB dynamic simulation platform. Results are presented to show that the DHP based neuron controller performs is better than the conventional PI controller, especially when the system conditions and configuration change. The numerical simulation results of using this method in one SSSC connected to power system verified the adaptability and feasibility

of the proposed control strategy in power flow control of power systems.

Research on Method to Get Corona Inception Electric-Field Intensity Based on Small Corona Cage

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Abstract—Corona is an important aspect which influences the design of transmission lines and electric equipments. With the increase of altitude and voltage grade, the corona performance of equipments becomes more complex. First, this paper explains electric field distribution around the overhead multiple conductors is consistent to one of multiple conductors in the corona cage; then according to the test data of four different altitude points, we bring up the method to get corona inception Electric-Field Intensity : in AC dry condition, using the tangent method ; in AC rain condition, using the threshold method. And afford the engineering basis to construct EHV and UHV AC project in the west high altitude area. Key words-transmission lines; corona inception voltage; high altitude; tangent method; threshold method; altitude correct

Self-tuning PI Control of SSSC Based on Neural Networks

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Abstract—Power system with SSSC is a large-scale nonlinear, indeterminist, multivariable system, and the traditional PI controller has a limited application in some cases because of its non-adaptive parameters. In this paper, a new control strategy of SSSC based on self-adaptive PI algorithm with neural network is proposed for power flow control of power systems. In the proposed controller, an identification network is modeled to analyze the dynamic power systems, and PI self-tuning parameters network is employed to obtain the optimal control parameters using training algorithm presented in this paper. With perfect dynamic characteristics of controller, the and reactive power of power systems is flexibly controlled using PI regulating parameters with neural networks. A studying example is carried out to estimate good robustness and adaptability of the proposed controller in the MATLAB dynamic simulation platform. The results verified the adaptability and feasibility of the proposed control strategy in power flow control of power systems.

A Novel Reactive Power Compensation Scheme of UHV AC Transmission Line

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Abstract— Reactive power compensation scheme directly affects the overvoltage and safety operation of UHV AC transmission line. To maintain the voltage along the line in a reasonable range, reactive power compensation should change with the power flow dynamically. In the paper, a novel reactive power compensation scheme of UHV AC transmission line is proposed, which is based on the independent local power network. Compared to other plans, this method requires less reactive power compensation capacity of sending and receiving ends, and the transmission capability of UHV AC line can be increased through dynamic reactive power compensation adjustment with the change of power flow. Finally, the feasibility of this scheme is discussed through an demonstration UHV transmission line in China.

Study on Grid-Connection of Powerformer

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Abstract-： Grid-connection is the first link of electric energy transport, which will impact generator on safety and electric power grid steady. Powerformer can generate high voltage of the grid level and be connected to the infinite bus directly. In term of the Powerformer prototype design feature, the relationship between the grid-connection conditions of generator and slippage voltage in different cases are analyzed in this paper. The effects of phase angle difference on

surge current and surge torque during fault-synchronizing process are studied, the varying waveforms are given. And the comparative analysis with conventional machine is also discussed.

A New Single Ended Fault Location Technique Using Travelling Wave Natural Frequencies

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Abstract—The relationship between the spectra of traveling waves, the fault distance and the terminal conditions of transmission lines is discussed. Especially the effects of the system equivalent impedance to the traveling wave spectra are studied. A novel frequency domain approach to the single-ended travelling wave fault location is presented. Firstly the dominant component of the traveling wave natural frequency is extracted. Then the propagating velocity, the reflection angles at the line end and fault point at this particular frequency are determined. Finally the fault distance can be derived. The accuracy of the algorithm is verified by simulation cases of various fault distances and fault types.

Dynamic Characteristics of ±800kV DC Transmission System under Single Phase Breaker Failure Action

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Abstract--Severe impact will be brought to hybrid AC/DC system when three-phase faults occur and single-phase breaker refuse to act, especially when disturbances are near DC converter. To perform the dynamic Characteristics study under such condition, electromagnetism transient model of Yun-Guang ±800kV DC transmission system is

established, and dynamic Characteristics of DC system such as DC power, voltage of converter bus and commutation failure condition are calculated and analyzed, when faults respectively occur on head and end terminal of transmission line near inverter. DC dynamic Characteristics under different control mode are also compared. DC power is higher when constant power control mode is used comparing with constant current control mode, while reactive power consumed by converters are higher after disturbance under constant power control. And it will provide reference to the operation of ±800kV DC transmission system.

Design of a novel optical voltage sensor for ultra-high voltage application

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Abstract - A novel optical voltage sensor for ultra-high voltage measurement is proposed in this paper. The sensor is based on the converse piezoelectric effect of quartz. The piezoelectric deformation of the quartz crystal induced by an applied alternating voltage is sensed by an electrophotonic detector. To measure the small piezoelectric deformation, an optical-beam-deflection method is presented and the corresponding optical path parameters are analyzed. Also, a multi-loop optical arm embedded in two parallel plates is presented. The optical path is dependent only on the height of the parallel plates and the laser incident angle and is independent of the width of the parallel plates, which facilitates the structural design of the sensor. Furthermore, a precision photoelectric conversion circuit is designed to convert the optical signal to electric voltage. According to the designed signal processing circuit, the ultra-high voltage sensor (500KV) is able to achieve an accuracy class of 0.1.

Research on Minimum Approach Distance for Live Working on 1000kV Ultra High Voltage AC Transmission Line

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Abstract—The switching impulse discharge performances of live working electric structure on outer phase, middle phase and tension string in 1000kV AC transmission line were studied. And based on the results, by calculation and analysis of the risk of live working, the minimum approach distance for live working was determined.

Characteristic Analysis of UHV Secondary Arc Current under Different Power Transmission

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Abstract—Along with the enhancement of voltage level, harmful affect of the secondary arc current to the system becomes more and more serious. The transmission power of the lines is one of factors that influence the secondary arc current obviously. The voltage distribution along the transmission line will changes according to the different transmission power, which will lead to the variation of the induction component from the sound phases when the fault occurs. In this paper, the quadric-mode transformation is adopted to establish the mathematic model of secondary arc current in the double-circuit transmission line. According to the variation of power transmission, the secondararc current of different fault point is calculated. The results indicate that secondary arc current is influenced much by the line transmission power, and the variation trend changes along with the fault point. When the fault occurs in head or terminal of the line, the secondary arc current may becomes larger along with the increasing of the transmission power, thus effective suppress measurements must be taken

Research on Secondary Arc for UHV Transmission Lines

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Abstract—A dynamic mathematical model—Johns arc model which could be used to simulate the dynamic secondary arc in the process of single-phase auto-reclosure after transient single-phasefaults is presented and actualized in PSCAD/EMTDC. This model is used in the digital faults simulations of the first Ultra high voltage (UHV) transmission line of 1000kv class in China—the Jindongnan-Jingmen UHV single circuit transmission project under construction, the outcomes and influences of several known important factors, such as wind, manner of shunt compensation and other meteorological and geographical factors including temperature, humility, altitude and so on are discussed. According to the discussion, the preconcert reclosure interval of 1s is proved to be proper.
Keywords-UHV transmission line; single-phase auto-reclosure; dynamic arc model; secondary arc; secondary arc current (SAC); arc extinction duration.

Study on the Insulating Oil Purification System of Ultra-High Voltage(UHV) Transformer

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Abstract—UHV network is known as the "highway of power". Today the study on technology research and technology stocks for UHV has become a top priority. In this paper, according to the special requirements of UHV power network to the insulating oil and the oil filtration and purification theory of transformer system, the overall structure and the main parts of the insulating oil filtration purification system are designed ancalculated by experimental research. Now the prototype has been completed and is under test which displays a high capability of oil purification.

The Research on Voltage Regulation Methods to Suit Large-power Transmitted through UHV Project

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Abstract Voltage and reactive power regulation capability of Central China Power Grid is researched in this paper when large-power is transmitted through UHV project which will be built in near future. At first, the basic condition of UHV and situation of voltage and reactive power when large-power is transmitted through UHV project are introduced. Then, several traditional and advanced voltage regulation methods are analyzed to solve low voltage problem of Nanyang UHV station which caused by large-power transmission. Nanyang transformer in plan is also analyzed to verify its necessity. Finally, several advices are brought forward to guarantee stability and reliability of system when UHV project is put into operation.

Analysis for electric loads of residential

buildings

during summer in Wuhan

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Abstract— Air conditioner electric load was the most significant factor for residential electrical peak load. Outdoor environmental parameters such as outdoor air temperature and humidity might have effect on air conditioner electric load. A field testing was carried out in Wuhan to study the relationship among residential electric load, outdoor air temperature and humidity. The result showed that the changing of air conditioner electric load was closed to outdoor air temperature and there were linear relationship in some temperature zone. However, it had a little effect on daily basic electric load. There was no evident indicate that humidity had directly effect on air conditioner electric load and basic electric load with the testing data.

Analysis on Harmonic Transfer along

Ultra-High

Voltage Transmission Lines

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Abstract—The transmission characteristics of Ultra-High Voltage (UHV) transmission line are analyzed. The influence of harmonic order for harmonic transfer coefficient as well as the length of the line are summarized. With the results researched, we know that the harmonic transfer coefficient is not linear changed with the increase of harmonic order and line length. As different harmonic orders, it is with cyclical changes to be amplified or attenuated along with changes in transmission length because of stand wave effect.

Simulation Research On The Multiple

Objective

Voltage Quality Regulator

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Abstracts—Due to the complexity of power systems combined with other factors such as increasing susceptibility of equipment, power quality (PQ) is apt to waver. With electricity in growing demand, low PQ is on the rise. the method of resolve those problem about power quality must be considered. In accordance with the familiar PQ problem, such as voltage sag, voltage swell, short interruption of supply voltage, harmonic suppression and short circuit fault. Basing on the H bridge cascade connection method, this paper design a new type regulator for the multiple objective control. Through the simulation software of PSCAD/EMTDC, the device can resume the voltage and restrain the harmonic dynamically and effectively, when there are voltage disturbances in the power system side. This device also could confine the short circuit current to a supportable level, when there is short circuit fault in the load side.

Analysis of the Influence on Power losses

by

Converter Control Mode

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Abstract—Converter needs to absorb large amount of reactive power from AC power system when it transmits active power. The control mode of converters and the setting of each control mode will affect the quantity of reactive power directly. Thus, the control modes of converters are one of the important objectivesfor establishing the converter operation modes. The most familiar control mode of DC system is the constant power control in rectifier with constant extinction angle or constant direct voltage in inverter. In this paper, the power loss of the composing AC/DC power system is firstly analyzed. Then, the thyristor control modes are discussed in detail. Based on mathematic calculation and numeric simulation, this paper draws a conclusion that the system power losses would vary with the variety of control modes and their parameters.

A Novel Method for the control of Multiple FACTS in the Enhancement of Power System Stability

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Abstract—This paper proposes the enhancement of power system stability by means of flexible ac transmission systems (FACTS) technology. Consequently, a different network configuration can be obtained immediately. In addition, justification analysis will be executed multiple FACTS devices embedded in a multimachine power system. Control strategies would also be developed for these conditions in this paper. Finally, comprehensive computer simulations will be given to testify the proposed proposal.

Study of Non-Unit Transient-Based Protection for HVDC Transmission Lines

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Abstract—It is difficult for existing HVDC line protections to distinguish internal fault from external fault rapidly and accurately, and the protective setting work encounters problems and difficulties. As a result, these protections have a low correct action rate. According to the feature of HVDC transmission system, this paper studies the characteristics of the natural boundary composed of the smoothing reactor and the DC filters. It is proved that this boundary has obvious differences in attenuation characteristics of different frequency components of fault transient signals. Consequently, a non-unit transient-based protection (NUTBP) is proposed. Wavelet multi-resolution signal decomposition technique is used to analyze the transient current caused by the faults. Extensive simulation results indicate that non-unit transient protection can clear all faults on the whole line quickly and credibly.

Feasibility Study on Replacement of SHELL Diala Oil by Kelamayi EHV Transformer Oil

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Abstract—According to ASTM and DIN international standard and other equivalent GB standards, we finished a lot of experiments on physical chemical properties and electric performance of EHV transformer oil. Based on the experiments data, Kelamayi EHV Transformer Oils are compared with SHELL Diala oil. Domestic Kelamayi oils, which typed KI50AX and KI50GX are blended with SHELL Diala oil in different ratios to carry out mixed oils experiments. Research results show that Kelamayi EHV Transformer Oils which named KI50AX and KI50GX are superior to SHELL Diala oil in general properties. Key words-extra high voltage, transformer oil, performance index, feasibility study

Configuration of A Novel Hybrid Active Power Filter and its control method

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Abstract—In order to meet the requirements of harmonic elimination and reactive power compensation in substation, a novel configuration of hybrid active power filter was proposed in this paper. Passive filter of this system can be used for reactive power compensation as well as for harmonic mitigation caused by

nonlinear load. A small-rated active power filter, which is shunted to fundamental resonance circuit, is connected in series with a matching transformer, thus the injection type of hybrid active power filter is formed. Basic principle of this configuration is introduced particularly. Then the steady compensation characteristic and the resonance-damping characteristic of this system are analyzed in detail. Based on the analysis of bode diagram, a frequency dividing control method is proposed, which consists of generalized integrator control unit and fuzzy adjustor unit. Generalized integrator is used for frequency dividing integral control while fuzzy arithmetic is for adjusting PI coefficients timely. Compared with other control methods, the shorter response time and higher control precision are the advantages of the proposed one. Simulation and operation results with this new filter installed in a copper plant prove the feasibility and validity of the novel configuration and the control scheme.

Voltage Stability Analysis at Converter Buses in Combined AC/DC Systems

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Abstract: This paper presented a method of estimating voltage stability for an AC/DC system based on nonlinear programming analysis of voltage stability for an AC system, and built the AC /DC model. This method converts the calculation of point of collapse (PoC) of AC/DC systems to a problem of optimizing load, which is solved by Sequential Quadratic Programming method (SQP). The method can handle various inequality constraints with strong robustness and good convergence and consider the effects of different High Voltage Direct Current (HVDC) transmission control modes on voltage stability. Finally numerical examples proved the validity of the proposed model and algorithm.

Coordinated Control Strategies of China-Russia BTBHVDC and SVC

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Abstract—This paper discuses the performance of the SVC (Static Var Compensator) linked to the inverter side of China- Russia Heihe BTB (Back-to-Back) HVDC project. Detailed Heihe BTB-HVDC primary system, China side AC 500/220kV electromagnetic loop network, the control system of BTB-HVDC and SVC are modeled using the electromagnetic transient simulation software PSCAD/EMTDC. Based on the detailed models, the interaction between SVC and BTB-HVDC is analyzed, and the effectiveness of the coordinated control strategies is verified.

A Nonlinear Decentralized Controller for SVC Considering Supplementary Control Object

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Abstract- Considering the practical decentralized control requests in the application of Static Var Compensator (SVC) to power system, this paper presents a design method of single-object nonlinear decentralized controller based on inverse system theorem, which only uses local measurable variables. In order to overcome the drawback of single-object control to improve stability of system, the signal of line current as a supplementary control object is introduced into the control system with the single-object nonlinear controller to compose a novel multi-object nonlinear composite controller, which still fulfills the decentralized control requirements. The simulation of the two-area four-machine power system with SVC verifies that the control strategy proposed is superior to the single-object nonlinear controller, which can realize multi-object control to enhance damping of power system low frequency oscillation and improve system stability.

Fault Diagnosis of Commutation Failures in the HVDC System Based on Wavelet Singular

Value and

Support Vector Machine

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Abstract—The paper based on the singular value decomposition and support vector machines, a new fault diagnosis of commutation failures method in HVDC system was proposed. The coefficient matrix acquired from wavelet package transform is first decomposed on singular value, by which fault current are mapped to different time-frequency sub-space. Then the singular value is put into support vector machines to carry out the SVM training and fault type identification. The new method in this paper has high recognition rate, identification speed and stability. It can solve the fault type classification well.

Study on High Voltage Capacitor Unbalance Protection in HVDC Projects

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Abstract—To detect internal faults of capacitors, the HV capacitors in the filters of HVDC projects are H-connected or branch-connected, with capacitor unbalance protection as their primary protection. However, there are still some hidden problems in the criterions of the existent unbalance protections. In the paper, the ratio of the unbalance current to the filter current and the over voltage are calculated during the evolution of the inner fault both in a single capacitor branch and in multiple capacitor branches. Based on the study, effective criterions and setting calculation methods are proposed for the HV capacitor unbalance protection.

Practical Issues of Recursive DFT in Active Power

Filter Based on CPC Power Theory

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Abstract—In this paper, a practical implementation method using the Recursive Discrete Fourier Transform (RDFT) for the reference signal generator of Active Power Filter (APF) based on Current Physical Components (CPC) power theory is proposed. Errors and convergence issues caused by computation or frequency deviation are addressed in details and related solutions with high computational efficiency for their elimination are given. Keywords-RDFT; APF; Compensator; CPC

A Novel Hybrid Dynamic Reactive Power Compensator

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Abstracts—A novel dynamic reactive power compensation circuit topology suitable for low voltage distribution system was proposed. The efficient compensation of unbalanced load could be realized by the structure of three-phase four-leg inverter circuit. The sinusoidal pulse width modulation (SPWM) control of inverter could ensure the low distortion of voltage and current. Besides, by the regulation of the inverter’s output voltage, the compensation reactive power could be dynamically regulated and the aim of system’s zero reactive power compensation could be realized. Combined with fixed capacitor compensator, small capacity of inverter is required to compensate dynamic reactive power. The novel dynamic static var compensator (SVC) could improve the system’s power factor and voltage stability. Finally, simulations are carried on the platform of PSCAD/EMTDC. The results show that the proposed control strategy is feasible and efficient

A Method to Compensate Unbalanced Load based on Instant Reactive Power Theory

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Abstract-- On the base of generalizing previously research findings, the authors of the paper apply theory of instant reactive power and theory of unbalanced compensation in the controlling of static reactive-power compensation equipments which can increase power factor and compensate three unbalance, thus simplify the algorithm of the instant reactive power. The formulary of compensating reactance is deduced in the condition of unbalanced load. The model of SVC which may compensate unbalanced load is established with PSCAD. The simulation proves availability and feasibility of the method. In view of the aberrance of bus current in the simulation, the paper analysis harmonic content of three-phase. It is also approved feasible of the algorithm in the condition of seriously disturbing by harmonic.

Realization of Self-defined Control System for Constant Extinction Angle Control Using PSCAD/EMTDC

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Abstract—In order to model real complex systems and provide designers with the possibility to study and improve strategy in PSCAD/EMTDC., the paper presents a new γ measurement method and models a self-defined control system for constant extinction angle control on the basis of the requirement of the operation in HVDC system and the control principle of constant extinction angle. According to the comparison of two HVDC systems using different control system, the self-defined control system and the control system of CIGRE, it is proved that the self-defined control system has good control performance. The system parameters of self-defined control system can be defined, and the structure of system can be optimized according to faults, as will make the system have fault protecting function. This system provides more powerful and efficient methods for designers to model real complex systems in PSCAD/EMTDC.

Energy Shaping Repetitive Control (ESRC) for Three-phase three-wire Shunt Active Power

Filter

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Abstract—Active Power Filter (APF) is usually used to the P parameter to expand the bandwidth. Furthermore, it is compensate the harmonic and reactive currents which are essential to consider a new control method to improve the generated by the nonlinear load, and its compensation steady precision of the system, according to the instabilities of performance mainly depends on the design of controller. When the system caused by the expansion of the P parameter. Hence, the parameters of the line and load are uncertain or unknown, for the APF control system, the design of current controller is the system may be unstable. In order to solve this problem, this most important. Energy is a basic concept in both science and paper adopts the Energy Shaping Repetitive Control (ESRC) to engineering. One complex dynamic system could be divided improve the output current waveform of th e-phase three-wire into many simple subsystems. The total energy of the shunt active power filter. In this control strategy, the Energy subsystems decides the dynamics of the whole system. The Shaping control is used to guarantee system dynamic passivity approach is a method using the idea of energy to performance and the repetitive control is to correct current design the control strategy. It includes two steps: energy waveform quality. The new controller design procedure is shaping and damping injection. analyzed in detail. Theoretical analysis and experimental results the desired energy of the total sy sEtenmer,g dya smhpaipnign gi nijse cttoio dne issi gtno demonstrate the validity of the proposed method and the filtering performance is improved obviously.

LFO Model Analysis in AC and HVDC Hybrid Transmission Power System

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Abstract—As the power system is interconnected with HVDC transmission, the power oscillation with low frequency appears in the AC transmission lines with weak damping. Due to the existence of the low frequency oscillation (LFO), the transmission power of AC lines is limited and the system angle stability is affected. In this paper, the low frequency oscillation (LFO) phenomena are introduced. By using the eigenvalue analysis method of small signal stability, the frequency and oscillation model of LFO in a two-area, four-machine model with AC and HVDC in parallel are analyzed. In the system model, the generator is identified as a three-order reduced-model, and HVDC is described as a two-order model, then the mathematical model of the whole system is expressed as linearized state equations. By calculating the eigenvalue of the linearized matrix, the system oscillation modes with damping ratio are analyzed in this paper. By using the phase signals of PMU' s output, the corresponding supplementary controllers for HVDC hybrid transmission are discussed simply for the future work. Index Terms—Low frequency oscillation (LFO); HVDC; PMU; Power System

Thyristor valve for the 12-pulse converter for Sino-Russia BtB scheme

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Abstract—This paper presents the design of the thyristor valve for the 750MW Sino-Russia Back-to-Back HVDC scheme. The thyristor valves are based on AREVA' s H400 series valve design and make use of Eupec 8.5kV 5" electrically-triggered thyristor technology. Details of the valve configuration, the cooling circuit, as well as the protective strategy are presented. Detailed electrical ratings such as the steady-state and temporary overload capabilities, the fault current capability, the valve losses, as well as the valve capabilities to cope with the fault scenarios such as the loss of ac voltage are described. The thyristor valve design satisfies the requirements of the scheme.

The Analysis of HVDC Over-modulation Technique

of Three-phase CSR

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Abstract—This paper introduces an over-modulation technique, a continuous extension of space vector PWM (SVPWM) linear control scheme for the HVDC three-phase current source rectifier (CSR). By judging the magnitude of active current vectors durations, this technique can select the current vectors in sectors and modify their active durations. It is neither necessary to store a lot of data in advance nor needs complex calculation strategy, which is very suitable to a digital implementation based on Field Programmable Gate Array (FPGA). The overmodulation scheme can extend the dc output voltage range of three-phase CSR, useful in improving the dynamic response and fulfilling the specific load demands. The simulations and experiments prove that the produced scheme not only has good dynamic and static performances, but also can keep the power factor at unity in a wide range of output dc voltage and the input current harmonic THD is very low.

The Calculation of Corona Inception Electric Field of HVDC Conductors

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Abstract—This paper calculates the single conductor corona inception voltage and corona inception electric field based on a corona inception voltage criterion. The calculated results agree with the results of Peek formula well. At the same time this paper analyzes the effect of air pressure, temperature and height above sea level on the corona inception voltage and corona inception electric field. It is found that the single conductor corona inception voltage and corona inception electric field become lower when the air pressure decreases, which is not good for electrical environment.

A Novel Nonlinear Decoupled Controller

For

VSC-HVDC System

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Abstract—The development of renewable energy resources generation technologies requires the support of VSC-HVDC systems. VSC-HVDC systems using PWM controlled Voltage Source Converters (VSCs) have the attractive features such as fault propagation prevention, increasing low frequency stability and voltage stability. This paper established the dynamic mathematical model for the VSC-HVDC system. Based on the obtained model and the theory of Exact Linearization Via Feedback, a MIMO nonlinear controller for the system is proposed. Independent control for the active power and reactive power are realized by this controller. By means of electromagnetic simulation software PSCAD/EMTDC, the feasibility and effectiveness of the proposed model and controller

Model Development of HVDC Control System

for Real Time Digital Simulation

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Abstract- The planning, design and operation of HVDC transmission systems require the detailed studies of various options and predictions of the system performance. Real time digital simulation (RTDS) could provide most vivid approach for the studies. Consequently, a tractable HVDC control model is required in the RTDS simulation platform. To implement the similar controls on the RTDS as on practical system, the configuration of control model must comprises major sections of practical controls. These sections are first made from functional blocks of RTDS control component library, and then integrated into a set of control model like the physical duplicate set. This paper presents our modeling effort including main section designs such as Converter Firing Control (CFC) and Pole Power Control (PPC).

Genetic Algorithm Based Multi-agent

System

Applied in Health State Estimation in HVDC

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1Abstract—A health state estimation scheme for HVDC(high voltage direct current transmission) system is proposed based on the genetic algorithm multi-agent . In order to apply the algorithm to HVDC state detection, the special technical problems are studied. The measured data in HVDC system can not be used to filter for the effect of the random noise. In the system, the calculation of HVDC state are induced from the consensus filter by which the signal affected by the noise can be dealt with. The system was applied to the HVDC benchmark model on account of the real data. According to the simulation results, the design has high reliability and accuracy, and the health state estimation problem may be have a new method to solve

Study on DC-side Harmonics Interference Criteria for UHVDC Transmission Lines

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Abstract—The performance and interference criteria for dc harmonics from high voltage direct current (HVDC) transmission lines are quite different from each other to each HVDC project up to now. With the developments of telecommunication circuits with giant anti-interference ability, such as light fiber and digital communication equipments and ultra-high voltage direct current (UHVDC) project in China, it is essential to map out practical and reasonable dc harmonics interference criteria for HVDC and UHVDC transmission lines based on the current conditions of telephone communication circuits. Taking into account the rigorous 4.5mV as the eventual telephone interference criteria for the dc transmission lines and a number of factors, for example, physical separation, shielding of telephone wires, circuit balance and ground resistivity, etc., the limitation of equivalent disturbing current as universal dc harmonics performance is calculated based on Xiangjiaba − Shanghai UHVDC (±800kV 6400MW). According to the calculation results the reasonable dc harmonics interference criteria expressed by equivalent disturbing current for UHVDC transmission lines are presented and some effects from above factors on the interference criteria are discussed.

A Simple Three-phase Model for Distributed Static Series Compensator (DSSC) in Newton Power Flow

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Abstract—Load flow problems have always been an important issue in power system analysis and require proper modeling of system components. In this regard Flexible AC Transmission System (FACTS) controllers are modern devices that their modeling specially the series type is a challenging topic. This paper describes a three-phase model for Distributed Static Series Compensator (DSSC) based on extending the Static Synchronous Series Compensator (SSSC) model in Newton power flow. To extend the SSSC model the following two differences must be considered; three completely independent phases and the existence of several modules in a DSSC system. Simulation results on the IEEE 30-bus system and a five bus test system illustrates the feasibility and performance of the proposed model in Newton power flow algorithm.

Dynamic Model and Control of Voltage Source Converter Based HVDC

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Abstract—This paper proposes a dynamic model and control strategies of a Voltage Source Converter (VSC) based High Voltage Direct Current transmission system. Assuming there is no zero-sequence components exist and the AC network is balance, so there are no negative-sequence components and the voltage and current variables are all positive-sequence components expressed in the positive-sequence frame. In this paper, direct current control strategy and dual closed loop structure are proposed. Decoupled control structure consisting of current feed back and voltage feed forward is adopted in the inner current control loop which can track the reference current quickly. The outer loop controller is power regulators, which combines the inverse steady state model with PI regulator, and can control the active and reactive power separately. The simulation tests realized by PSCAD-EMTDC that VSC transmission system connect two active networks have been adopted. The simulation results verify the validity of the mathematical model and the feasibility of the proposed control strategies.

Flashover Characteristics along the Insulator in SF_6 Gas under DC Voltage

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Abstract—In order to promote the flexibility about the selection of transmission corridor, DC gas-insulated transmission line (GIL) can be utilized to substitute part of the overhead line. One of the key factors that greatly threaten insulation level of GIL is the accumulation of surface charges along the supporting insulators under DC voltage. In this paper, the sphere-plane electrode system has been established to simulate the field distribution of the coaxial cylinder configuration in GIL. The effect of the insulator' s material and geometry on the insulator' s flashover characteristics under DC voltage in SF_6 gas has been investigated. Results show that the insulator' s surface conductivity has great influence on the surface charge accumulation as well as the flashover along the insulator in DC GIL.

A Nonlinear Control Strategy for Shunt Active Power Filter

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Abstract—This paper presents a nonlinear control strategy for shunt active power filter with better stability and dynamic performance in comparison with classical control strategy. The analysis is based on the rotating reference frame, and the nonlinear property of shunt active power filter mode is dealt through the exact linearization via feedback. The operation of control circuit has been explained using MATLAB software and simulation. The validity of control strategy is studied through simulation and experimental results. Active power filter; nonlinear control; exact feedback linearization;

Electric Quantity Test System of Unified Power Flow Controller Model on LabWindows/CVI

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Abstract—Unified Power Flow Controller (UPFC) is regard as the most representational device in the field of Flexible AC Transmission System (FACTS). In order to further study operation mechanism and physical characteristics of UPFC, a set of electric quantity test system is developed based on a 10KVA UPFC model, and the acquisition, storage, display and analysis of all electric quantity data are realized. In this study, a virtual instrument concept is adopted for the test system with modularization designed system hardware, which is composted of sensors, signal processing circuits, data acquisition cards and Instruments (NI) CO. of U.S.. LabWindows/CVI, a software development system for measurement and control field is employed for the system application software development environment. A friendly and easy-operation user interface is in the electric quantity system with abroad general usages. Not only common functions such as collection and storage for real time data, but also quite powerful graphic display and data analysis functions can be achieved by the system. Two kinds are found to fit electronic signal analysis from some common used wavelet basis after comparison of analysis graphics which is presented at the end of this paper.

Experimental Study on Lighting Shielding Performance of 500 kV HVDC Transmission Lines

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Abstract—This paper is to investigate the lightning shielding performance of the HVDC transmission line when taking the dc operation voltage into account. Firstly, the equivalency of the scale experiment is discussed from the following aspects: (a) the determination of test scale factor; (b) the electric field simulation of downward leader; (c) nominal field simulation of the HVDC transmission line. Secondly, a test circuit is established taking into account of the isolation of the dc charge circuit and surge generator. The exposure space distribution of the HVDC transmission line is obtained from a large amount discharge experiments. The total number of recorded discharge is over 7500 times. The competition between upward streamers originating from the grounded wire and polar conductor is observed by using the high-speed digital camera. Finally, the effectiveness mechanism of the dc operation voltage on the lightning shielding performance of HVDC transmission line is analyzed according to the recorded phenomenon.

The Harmonic Characteristic Analyzing of Reactive Power Compensation Equipment

Based on PSCAD

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Abstract—In power system, simulation is an effective method to analyze complex circuits. This paper first analyzes the harmonic characteristic of the reactive power compensation equipment TCR (Thyristor Controlled Reactor) in theory, then validates analysis results and gives the way of improving its performance in simulation software PSCAD (Power System Computer Aided Design). Practice proves that the model system built in PSCAD has excellent application value and the software PSCAD is very competent in harmonic analyzing and processing. Keywords-TCR; harmonic analyzing; PSCAD simulation

Research about Measurement Performance of Optic-Electric DC Current Transformer in 500kV HVDC Power System

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Abstract—Direct current transformer is the key device in measuring high current value of HVDC power system. Its accuracy and reliability is an important basis guaranteeing the control and protection system of HVDC grid work normal. A mal-operation event of protection relay of ±500kV HVDC system of China Southern Power Grid Co., Ltd. is described. Measurement performance of optic-electric DC current transformer based on shunt measurement theory

is analyzed. With the consideration of skin effect and close effect, the electromagnetic simulation about shunt is carried out. A series of frequency-dependent impedance tests about shunt in converter station are done too. The results of electro-magnetic simulation and in converter station tests are match. The research results show that the impedance of shunt will increase as the signal frequency goes high. High frequency signal will influence the measurement performance directly. Some methods of antiinterference are put forward at the end of this paper.

A Review of FACTS' Practical Consideration and Economic Evaluation

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Abstract — Flexible AC Transmission Systems (FACTS) and their controllers are of great interest today. FACTS controllers can offer great opportunities in modern power system, allowing better and safer operation of the grid. Their technical benefits are very well acknowledged, but there are some factors limiting the widespread of this technology: a) lack of a comprehensive onsideration of FACTS for multiple operational problems and operational conditions, b) lack of economic assessment of FACTS projects for utilities and transmission entities [1] c) lack of a clear understanding of the options of devices and their configurations [1], and most importantly d) the high degree of uncertainty associated with the transmission system on the time scale that is needed to assess this kind of long-term projects. This

paper gives a brief introduction of various FACTS devices and their controllers, main research methods. We mainly provide a survey of FACTS' economic assessment method proposed so far. We conclude that there is a huge literature body of technical benefits associated with FACTS targeting on single operational problems, but limited work on addressing their practical application considerations, and economic evaluation, offering great research opportunities.

VSC-HVDC Control Based on Rectangular Coordinate Utilizing Negative Sequence Component

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Abstract—The paper models VSC-HVDC(voltage source converter based HVDC) on rectangular coordinate, on which presents control strategy and designs corresponding regulators. In addition, transformation of symmetric component is used to getting negative sequence components aiming at unsymmetrical instantaneous faults at AC side. On PSCAD/EMTDC, whole control system, including VSC-HVDC, AC system and control parts, is established and runs. The simulating results indicate that controlling goals are achieved and adopted control strategy and regulators take effect. Toward various instantaneous faults concerning symmetric and unsymmetrical, the AC-DC power system responds quickly and possess strong stability.

Comparison of Series FACTS Devices Via Optimal Location in a Power System for Congestion Management

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Abstract—In contemporary power system studies, the optimal location and utilization of FACTS devices are important issues primarily due to their cost-effective option for power delivery system enhancements. Amongst various power electronic devices, the thyristor controlled series capacitor (TCSC) and a static synchronous series compensator (SSSC) device has captured the interest of researchers for its capability of regulating the power flow and minimizing the power losses simultaneously. Since for a cost effective application of FACTS technology a proper selection and placement of these devices is required, the scope of this paper is to propose the device location. The proposed placement approach reduces the congestion under normal and contingency condition in the transmission lines and their comparison. The modified IEEE 14-bus test system is selected to illustrate the feasibility of TCSC and SSSC models using power world simulator software.

Analysis of Subsynchronous Oscillation (SSO) Damping Characteristic of the AC/HVDC Parallel

Transmission System Using TCSC

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Abstract—The complex torque coefficient approach realized by time domain simulation (the Test Signal Method) is adopted in this paper to study the SSO problem for an AC/HVDC parallel transmission system. In order to analyze the effects of the damping characteristic of the system oscillations with TCSC in this new grid structure, three cases have been adopted: the normal AC system with HVDC lines, the system with FSC and HVDC lines, the system with FSC+TCSC and HVDC lines. The results showed that TCSC not only can inhibit the SSO, but also can improve the damping characteristic performance of the transmission system with HVDC. The results also demonstrated that the impedance characteristic of TCSC is related with the value of conduction angle, which will affect the damping characteristic performance of system.

The Study on Detecting Method for Harmonic and Reactive Current in Single-Phase Circuit

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Abstract—The instantaneous reactive power theory is widely another transformation. In [7] the harmonic current detecting used in the detection of harmonic and reactive current, and can is brought forward but without the reactive current. There was also be used in single-phase circuit detection. A detailed not a clear explanation to get the reactive current in existing deduction to the method of constructing two-phase system based

documents about two-phase construction. In this article on the instantaneous reactive power theory is presented. Aiming researches and deductions have been performed in detail. The at the shortages in existing documents an improved algorithm to author also gives a complete description and some obtain the key circuit components is presented. By completing improvement of this method, makes it clear that how to gain theoretical analysis, many simulations have been achieved and the amount of important current components through this illustrate the effectiveness and performance of the proposed method. With theoretical analysis and simulation research, the method. effectiveness and performance of the proposed method has Key words-The single phase instantaneous reactive power been illustrated. theory; harmonic detection; reactive current detection.

Impact of TCSC on enhancing power system stability

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Abstract— this paper investigates the impact of Thyristor Controlled Series Compensator (TCSC) to enhance power system stability. The design problem of TCSC controller parameters is formulated as optimization problem, and then particle swarm optimization (PSO) technique was used to search for optimal parameters. The proposed controller and technique are employed on test system under different cases and location of TCSC. To validate the effectiveness of the TCSC on enhancing system stability, eigenvalues analysis and a nonlinear time-domain simulation implemented on SMIB equipped with TCSC. The simulation results show the effectiveness and robustness of proposed controller to enhance system stability by damping oscillations of different disturbances.

A New Method for Control of Sustained

Over-voltage

during the Early Stages of Power System

Restoration

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Abstract—The control strategy of sustained over-voltage during the early stages of power system restoration is studied and a new method is presented in the paper. According to the results of load flow calculation and sensitivity analysis, the method applies expert system technique and non linear programming in turn to solve the control scheme of sustained over-voltage for each target bus. Differences between the early stages of restoration and the normal condition of power system are taken into account. A test to the IEEE 39-bus New England system is included to show effectiveness of the method.

Distribution Desgin

Using Transmission Concepts

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Abstract— Distribution protection equipment have become so sophisticated and advanced in recent years that can accommodate numerous protection functions and capabilities which once were only in the realm of transmission network. As such, protective equipment in distribution network can now match the functionality of the same devices in transmission. Similarly test equipment designed for verification of protection systems have become very practicable in application to both transmission and distribution networks' equipment and assets. There is now a need to apply design principles in distribution network that are aligned to transmission concepts. This paper aims to put forward a case study in which transmission design and testing principles were applied to a distribution site and discuss the results obtained from this approach.

Correlation Study of Voltage Fluctuation

and Interharmonics

in Distribution Network

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Abstract—This paper presents an investigation into the relationship between voltage fluctuation and inter-harmonics in distribution network based on modulation theory. It is verified by Matlab/Simulink simulation and physical tests. The modulation theory, commonly used for analysis of harmonics, is used to analyze the inter-harmonics. A switching function of a rectangle waveform is used to describe a diode or thyristor's commutation status. The input current and output voltage of the rectifier can be described by the final waveforms of some sine function modulated by the switching function. And the interharmonics characteristics can be obtained by the Fourier analysis of these waveforms. It can be proved that if there are some fluctuations in the voltage source, there will be abundant interharmonics in the current. In order to investigate the validity of analysis and simulation, the physical experiments are finished with electric Interruption Generator (IG).

A Circuit Model in a Wide Frequency Range for Power Transformer and Analysis of Its characteristics

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Abstract—In order to predict VFTO(Very Fast Transient Overvoltage) distributions in the windings during transformer design stage, it is important to acquire the frequency range of the surge wave that could enter the transformer winding, and then model the windings in that frequency range. In GIS (Gas Insulated Station), transformer is connected to bus through bushing and lead wire. The bushing capacitance to ground will bypass the high frequency components, so there should be a upper limit of the frequency components of the surge wave at the entrance of the transformer. In this paper, the transformer windings are modeled using MTL (Multi-Transmission-Line) model firstly, then the lumped equivalent circuit is formulated with the π-type circuits, and finally the driving-point impedance and voltage transfer functions of the equivalent circuit are calculated using nodal analysis. The driving-point impedance of a model winding is calculated and compared with the measured result, and the validation of the equivalent circuit of transformer winding in the frequency range below 20 MHz is verified. Then the driving-point impedances of two real transformer windings are calculated with the equivalent circuit. Taking the lead impedance into consideration, the impedance of the winding is compared with the one of the bushing capacitance. The results show that most of the energy of the frequency components above 10 MHz in the surge wave will pass through the bushing capacitance and will not cause damage to transformer insulations.

Influence On Power Frequency Over-voltage By Employing Series Resonance Type Fault Current Limiter

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Abstract: The series resonance type fault current limiter (SRFCL) is the most prospective one that can be applied in power grid at present. The influence of SRFCL on power frequency over-voltage in 220 kV power grid was studied. Analysis and calculation results showed that the SRFCL has no distinct impact on the power frequency over-voltage caused by capacitive effect of no-load long transmission lines, but it could reduce the over-voltage caused by unbalanced short-circuits. However, the over-voltage caused by load sheding would increase if SRFCL was employed. When the SRFCL with a 15 limiting reactance was installed at the transmission line of 300 km, the power frequency over-voltage caused by load sheding would increase from 1.28 p.u. to 1.41 p.u., which exceeded 1.40, the allowable value of National Standard. This problem should be solved before the SRFCL was employed in power grid.

Application of Nonlinear Dynamic on Ferroresonance

in Power System

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Abstract—Ferroresonance is a complicated electrical phenomenon, and it is a great threat to the security of the power system. The basic ferroresonance circuit constructs a nonlinear dynamical system. In this paper, the elementary concepts of nonlinear dynamics such as the phase plane, the Poincaré section and the Lyapunov index are applied to analyze the ferroresonance in a typical 110kV substation. The fundamental resonance, the subharmonic resonance and the chaotic resonance of the system are discussed in the paper. On the base of the nonlinear dynamical theory, the characters of various resonance types can be directly exhibited. The proper control strategy for the ferroresonance prediction and suppression can be efficiently applied according to its types.

Analysis of the effects of ground resistivity on the lightning radiation fields based on FDTD method

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Abstract—In order to investigate effects of ground resistivity on the lightning radiation electromagnetic fields produced by lightning return-stroke, a three-dimensional finite-difference time-domain (FDTD) numerical model is

developed with lightning current's transmission line model. Lightning radiation electromagnetic fields at the flat ground are calculated and effects of different soil resistivities on lightning radiation electromagnetic fields are compared, which make a great contribution for predicting the lightning electromagnetic environment accurately in various geological conditions. The computed results indicate that the resistivity of the monolayer ground has greater effects on the lightning radiation electric field than the magnetic field. Effects made by the horizontal stratified ground mainly lie on the resistivity of the upper ground and the vertical stratified ground's resistivity affects radiation fields slightly. Numerical results have proved that the numerical solution is in good agreement with the analytical solution, which shows the reliability of the computed results in this paper.

Parameter Analysis and Research on Sheath Lightning Overvoltage of Single-core Cable

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Abstract—If lightning strikes on an overhead line connected with a cable, an over voltage will invade into this cable and induct an over voltage in its metal sheath. The sheath-lightning –overvoltage (SLOV) under one-terminal-grounding connection (OTGC) and cross-bonding connection (CBC) are simulated; and impulsive test was undertaken in real cable of Guangzhou power system. However it is hard to get the exact models and parameters. In this paper, based on the SLOV simulation, the effects of several factors, such as the cable structure and its length, stricken wave shape, magnitude and character of cable loads, the ground resistivity and impulsive grounding resistance are discussed. Simulation and discussion indicate that cable structure and its length, stricken wave shape, and magnitude and character of cable loads, have more influence to SLOV.

Research on Lightning Over-voltage Protection for 500kV GIS Substation

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Abstract—This paper combines incoming lines with 500kv GIS substation, considering the influence of the impulse voltage-second characteristics of insulator strings, the impulse corona of incoming lines, the impulse grounding resistance of tower and the position of lightning. ATP-EMTP simulation program is applied to analyze the lightning over-voltage of 500kv GIS substation. The result shows that impulse corona and the resistance of tower which is close to the substation have great influence on over-voltage, when lightning strike the tower which is close to terminal door-typed structure, the lightning over-voltage may be not the most serious, and when the over-voltage of the equipment is very serious, a group of arrester is installed which can decrease the over-voltage effectively. This research thinking takes safety and economy into account, which can provide new reference for the engineering.

Research on Protection Measure for Very Fast Transient Over-voltage of GIS

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Abstract Based on Tian huangping GIS Substation, very fast transient over-voltage caused by disconnecting switch operation of GIS is simulated and calculated in this paper with ATP-EMTP program. The effect of protection measures on equipments is compared and analyzed, such as adding opening and closing resistor, MOA, R-C absorber, and Ferrite Rings. Also the measures are analyzed with considering the actual situation, which can provide reference for the implementation of the practical project.

Simulation of Arc Grounding Over-voltage

Based on MODELS and TACS for Neutral Isolated Systems

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Abstract—The arc grounding over-voltage is one of the worst over-voltages in the neutral isolated system. It is an important factor to be considered when selecting neutral ground mode. At present, system simulation is the main method for the study of the arc grounding over-voltage. Arc extinguish and re-ignition is simulated by controlling the switch on or off. However, the switch opening or closing need to be controlled by the manually preset timer, according to the principle that arc re-ignites for every other power frequency cycle or half power frequency cycle. In fact, arc re-ignition may not occur at the maximum recovery voltage of the faulted phase because of the statistical property of arc occurring. For this reason, the simulation model based on the fixed timer controlled switch is not accurate. In addition, the timer for the switch opening or closing is needed to be reset every time when the system operating mode changes. This process is very complex so timer controlled model is difficult to apply in practice. In the light of the above, a new simulation model is proposed in this paper, which is based on a comprehensive study of the mechanism of the generation of arc grounding voltage. Transient analysis of control system using the TACS and MODELS modules of EMTP is employed to study and design the control section of the switch. The control program is compiled by the special language of MODELS module. There is no need to set the opening and closing time of the switch. This simulation model offers flexible operation and is more close to the actual situation. Desirable results are achieved when applied to study the arc grounding over-voltage in 10kV neutral isolated system. Simulation results from EMTP verify the correctness of this model, which also have a great potential for practical applications.

Effects of Impulse Voltage Waveforms on Lightning Shielding Simulation Test of Transmission Lines

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Abstract— In order to make a research on the effects of impulse voltage waveforms on lightning shielding property of transmission lines, this paper adopted the model of 500kV transmission lines in plain country at the ratio of 1:40. Large amount of impulsive discharge tests were done, including lightning surge voltage and switching impulse voltage. The scattergram of shielding failure probability of lightning stroke points in space is plotted, and the distribution rule is in close agreement with the results calculated by EGM model. The shielding failure probability is calculated by two methods according to the simulation test results, and the results are compared with the results calculated by order method and LPM method. Comparative result shows that test with switching impulse voltage is closer to the reality than test with lightning surge voltage when the length of the air gap is the same.

Performance of pipeline-tower combined grounding system under direct lightning strike

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Abstract—For sharing corridor, analysis of electrical of interference effects of the high voltage transmission towers and nearby buried natural gas pipelines or pipe laying becomes a topic of great interest in China. Because of the complexity of this problem, computer aided simulation is introduced. Applying traditional FFT method and general frequency grounding system model, this paper accurately solves the parameters of pipelinetower combined grounding system under direct lightning strike. Considering different factors, such as the parameters of soil and lightning current, the layout of the combined grounding system, this paper computes some specific cases, and presents some useful reference for practical engineering. At last, the software package is briefly introduced.

Computer modeling and simulation of impulsive grounding

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Abstract—Based on the mathematical and physical model of impulsive grounding, this paper constructed a computer model to solve this problem in an efficient and precise way. The solution of this problem was divided into 4 parts: the spectrum analysis of lightning current, the general frequency model for grounding device, fast calculation of impulsive response, visualization of the result. In the end, this paper gave a practical example to show the advanced use of this computer model, and some useful conclusion was obtained.

Rolling Sphere Method using 3D Graphics Approach

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Abstract—Modern computer 3D graphic technologies are applied to the solution of lightning protection analysis and design problems using the Rolling Sphere Method. It is shown that the use of such techniques can greatly accelerate the computer solution of lightning protection problems. Keywords- Lightning Protection, Rolling Sphere, Collection Surface Method

Numeral Analysis on Lightning Shielding Performance of Overhead Lines based on Leader Progression Model

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Abstract—With the increase of voltage level of transmission line, the proportion of outages because of shielding failure increases. In this paper, a numeral analysis method based on leader progression model was proposed to analyze the lightning shielding performances. Keywords- numeral analysis method; leader progression model; shielding failure

Lightning Backflash Performance for ±

500kV Double

Circuit Transmission Lines

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Abstract: Adopting ±500kV HVDC double circuit transmission lines to transmit power can both economize line corridor and add unit corridor aera transmission capacity, so ±500kV HVDC double circuit transmission lines are more and more adopted. Because the length of double circuit transmission lines is high, it is more likely to be attacked by lightning stroke, so lightning performance for double circuit transmission lines is studied in this paper. Applying ATP can calculate backflashvoer withstand levle when the datas like tower height, polarity configuration modes, soil resistivity and grounding resistance are changed. In the calculation, the insulators' behavior is judged by comparing the insulators' volt-time curves to the overvoltage, the system voltage and the induced voltage's influence on lightning withstanding level is considered.

Influence of mountain on lightning radiation field

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Abstract— In order to investigate the effects of large mountain in the propagation path on the lightning radiation field, firstly the lightning radiation field is calculated by using MoM without consideration of the mountain. The calculated result is taken as the radiation source in the subsequent calculation of scattering field. The scattering field is determined with the mountain supposed to be perfect conductor. Surface

element MoM is used to set up the model. Following above steps, the resulting lightning electromagnetic field in frequency domain can be obtained, which is the sum of radiation field and scattering field. By using FFT, the corresponding time domain results for different lightning waveforms are also derived. Based on the calculation, the effect of large mountain on lightning radiation field is investigated. The mountain height and the distance from lightning source to the mountain are considered respectively and some useful conclusions are obtained.

A new method to obtain the lightning radiation electromagnetic field waveform based on virtual instrument

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Abstract—In order to acquire the real-time lightning electromagnetic radiation field in large extent, a new automatic acquisition system is developed based on virtual instrument. Besides the essential function components such as PXI-6608 Counter/Timer and PXI-5105 Data Acquisition Card, the lightning detection stations and GPS receiver are introduced to accomplish the signal synchronization and continuous acquisition as well. With the implementation of software programmed by using LabVIEW, the whole virtual instrument is controlled. Together with storage procedure, PXI-5105 is used to collect and store the lightning electromagnetic signals. The lightning electromagnetic signal is marked with a unique time received by 6608 Counter/Timer from GPS receiver. A complete lightning radiation signal acquisition is triggered by a write signal generated by the lightning detection system. Above method is

validated by experiment. Based on the collected data, further lightning
investigation can be performed.

The Analysis on Soil Structure for the Grounding Projects

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Abstract—In order to accurately obtain the working performance of the grounding grid, the soil structure must be analyzed precisely. In this paper, the objective function is set up based on the difference square of the estimated value and analyzed value. The genetic algorithm is introduced to get the optimum solution of the objective function.

Tranisent Simulation of Conductive Coupling of HV Transmission Line with Undergroud Pipelines

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Abstract—In order to investigate the influence of the lightning current that flows to the ground on the metallic pipeline buried below ground, this paper calculates the maximum transient voltage imposed on coating of the pipeline when significant levels

of lightning current flow to the nearby earth by using the frequency-based model of grounding grids calculation and combining the forward fast Fourier transform (FFT) and inverse FFT operation. It also computes the safety distances with and without grounding line. The computation results reveal that grounding lines can reduce the maximum transient voltage imposed on the coating of the pipeline and the denser the grounding lines are, the lower the maximum voltage is. Moreover, the calculation results are compared with those of the world popular software CDEGS and therefore the method is proved to be right.

Research on Control Strategy for High-Power High-Performance AC Power Supplies

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Abstract—This paper presents a novel control scheme suitable for high-power high-performance AC power supplies. The performances of the conventional current-regulated voltage-controlled system with bipolar PWM are first analyzed in detail. The proposed control scheme incorporates dual synchronous PWM technique of single-phase full-bridge inverter and multiple feedback loop. Thanks to this scheme, the AC power supply output voltage can maintain high-quality sinewave at low switching frequency and small output LC filter parameters. At the same time, the system has excellent voltage regulation performance, fast dynamic response, good disturbance rejection, high nonlinear load compatibility, and small voltage modulation value. The validity of the proposed control scheme has been verified on a single-phase 30KVA experimental

prototype.

Single-phase Adaptive Reclosure of EHV Transmission Lines Based on Shunt Reactor Current Identification

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Abstract—Aiming at EHV transmission lines with shunt compensators, a novel technique is proposed to distinguish fault nature according to low frequency components in faulted phase current of reactor at the recovery voltage stage. In order to identify the magnitude of low frequency components, a energy function is defined which can determine the fault nature in 2~4 fundamental cycles rapidly and accurately. The characteristics of faulted phase current are analyzed in detail. For a permanent fault, the current contains power frequency and decaying slowly DC components. While for a transient fault, the current contains power frequency and low frequency components. Theoretical analysis and EMTP simulation prove that the proposed identification scheme can distinguish the fault nature exactly and improve the success rate of reclosure significantly.

Novel Approach to Fault Classification in EHV Transmission Line based on Multi-information

Measurements of Fault Transients

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Abstract—Based on the qualitative analysis of different fault transients in EHV (Extra High Voltage) transmission line, the features of different transient components were given out. Taking various transient features into account and combining with the information theory, this paper proposed a new algorithm for fault classification based on multi-information measurements of fault transients, which took advantage of both information entropy measurement and complexity measurement. The proposed algorithm can classify different types of faults with different transient components and simulations proved it to be useful especially for the condition under which the fault voltage inception angle is zero and the high-frequency transient component is very low. Therefore, this algorithm would be available in providing a good approach to abundant fault information for transient protection and transient fault research.

On the Use of Wavelet Decomposition for Ferroresonance Detection in Power System

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Abstract—The wavelet transform has been applied for years in the fields of image compression, acoustic, ect. It has also been introduced in power system detection and analysis these years. In this paper, the application of the wavelet analysis on the ferroresonance in power system is introduced. A typical type of the ferroresonance resulted by the saturated voltage transformer (VT) is analyzed by the wavelet transform. The analysis shows the application of wavelet transform can detect the occurrence of the ferroresonance, and the frequency of the ferroresonance also can be determined. With the information that is provided by the wavelet transform, the power system can get a good protection from the ferroresonance.

Transient Modeling of Calculation Temperatures of Single-core Cables

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Abstract—Electrical cables are widely used in urban electrical transmission. It is necessary to monitor whether it operate normally or not. The conductor temperature is a key parameter should be monitored. However the conductor temperature of underground cables is very hard to measure for technical difficulties, the other option is calculation. The conductor temperature is associated with the temperature and thermal

resistivity of material surrounded (e.g. soil), which is diverse with season and its water content and make the calculation complicated and inaccurate. To avoid the effect of soil on the calculation, the transient thermal models of a single-core cable are set in this paper; temperatures of conductor and metal sheath are calculated based on the detected temperature of outer jacket, and Runge-Kutta method is used to solve differential equations. An emergency temperature rising test was undertaken, which confirms the correctness and accurateness of the calculation of cable temperatures.

Modeling and Simulation of Lightning Electromagnetic Transient and Identification of Shielding Failure and Back Striking in ±800kV UHVDC Transmission Lines

Part I: Modeling and simulation of lightning electromagnetic transient

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Abstract: Lightning stroke to transmission lines was introduced in this paper. Modeling and implementation method of tower, corona and insulator for lightning electromagnetic transient research was discussed. Comprehensive model for study of UHVDC lightning electromagnetic transient was built, and lightning caused fault and lightning disturbance were simulated in PSCAD/EMTDC based on the model, which offered a research platform for identification of shielding failure and back striking in ±800kV UHVDC transmission lines.

Modeling and Simulation of Lightning Electromagnetic Transient and Identification of Shielding Failure and Back Striking in ±800kV UHVDC Transmission Lines

Part II: Identification of shielding failure and back striking

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Abstract: The identification of shielding failure and back striking in transmission lines has always been a difficult subject. This paper analyzed the process of back striking and shielding failure in ±800kV UHVDC transmission lines. Because the mechanisms of produced transient zero module voltage and its propagation paths is different between back striking and shielding failure, their wavelet energy of different frequency bands of transient voltages is different. Thereby, from the perspective of protective relaying, this paper proposed an identification method to shielding failure and back striking in ±800kV UHVDC transmission lines based on wavelet energy. The data can be acquired from high speed protection device. The EMTDC simulation shows that the proposed method can effectively identify shielding failure and back striking in the whole UHVDC transmission lines, and is not affected by various wave shapes of lightning current.

Evaluation of Switching Overvoltage in 500

kV

Transmission Line Interconnection Nam

Theun 2

Power Plant to Roi Et 2 substation

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Abstract— This paper investigates the overvoltage due to different types of switching in Nam Theun 2 – Roi Et 2 500 kV network. The study is based on PSCAD/EMTDC performed for a guide line for 500 kV operations in Lao PDR. The appropriate representation for the various components such as transformer, transmission line, circuit breaker, surge arrestor and shunt reactor, have been selected. The study covers two most severe cases: line energization and reenergization due to single phase to ground and three phases to ground faults, and switching under different load conditions is considered. In the series of simulations, the maximum overvoltage is determined. The maximum switching overvoltage (SOV) from light load and three phases to ground fault are quite high. The efficiency of line terminal 444 kV surge arresters to controlled SOV along the 500 kV lines is clearly demonstrated.

A New Transformer Model Based on

Modified

Multi-Conductor Transmission Line Theory

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Abstract—To calculate the very fast transient overvoltages in transformer windings, amodel based on the modified multi-conductor transmission line (MTL) theory is proposed in this paper. In original MTL model, the lengths of all the conductors are considered to be equal and this approximation can cause inaccuracy. In fact, the lengths of the conductors are decreasing from the outside to the interior. This new model can settle this problem. Based on the original transmission line model, equations of curve-shaped MTL are deduced. The single-input and multi-output model of the modified transmission line model of the transformer is obtained in this paper and is used to calculate the voltage distribution of the winding. Some measurements are conducted to verify the calculation results. And comparisons between the original MTL model and the modified model are used to illustrate the deviations.

Investigation of Single Phase Reclosing

Using Arc

Model on the 500 kV Transmission Line

from Mae Moh to Tha Ta Ko

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Abstract—Single phase switching has become an increasingly more viable approach to the operation of EHV systems in recent years. Indeed, single phase reclosing, if successful, represents a significant step in improving system performance and is an attractive, economical means of obtaining acceptable transient stability with fewer lines. Single phase reclosing has the additional benefits of reducing switching overvoltages. This paper addresses the investigation of single phase reclosing using arc model on the on single and double circuit transmission line employing single phase switching due to single line to ground faults The work is performed by EMTP on the Thailand 500 kV transmission line from Mae Moh to Tha Ta Ko. A series of studies have been performed.

A New Approach to Coherency Identification of Generators Clusters Based On Wide Area Measurement System

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Abstract—Extended Equal Area Criterion Method (EEAC) is always applied for Transient Stability Analysis of large scale power system. The coherency identification of generators clusters after accidents is on the basis of EEAC Method, and the coherency identification of generators clusters used to take the complex power angle method as the criterion, which consume a lot of time and possess a relatively inefficient. A new approach to the coherency identification of generators clusters based on Wide Area Measurement System is proposed in this paper, which utilize the ratio of accelerated kinetic energy to distribute the

critical machines clusters. The concept of the ratio of accelerated kinetic energy and related algorithm are described in detail in this paper. Take the power grid of He Bei province in China as a calculation example to illustrate the feasibility and advancement of this approach.[1]
Keywords--Extended Equal Area Criterion (EEAC); coherency identification of generators clusters; the ratio of accelerated kinetic energy; wide area measurement system

Simulating Propagation Characteristic of UHF Signal for PD monitoring in Transformers by FDTD Technique

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Abstract—Partial discharge (PD) in transformer can be detected on-line by UHF technique. However, the relationship between the UHF signal received by UHF sensors and the PD sources is not very clear. It is very important studying the propagation properties of the PD signal. In this paper, the electromagnetic waves emitted by PD sources are investigated. The finite difference time domain (FDTD) technique is used to model wave transients. The model consists of a tank and a PD source. The wave transients at different time and position are simulated. The results show the propagation transients of the PD signal in the tank and wave propagation attenuates with distance between the source and the sensors.

The Influence of Transformer Oil Aging to Dielectric

Dissipation Factor and Its Insulating Lifetime

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Abstract The transformer oil was thermal aged at 115 by opened-cup deterioration method (GB7599 standard). using infrared spectroscopy analyzed thermal aging of transformer oil, according to absorption peaks absorption strong and changes of absorption figures to judge the change trend of functional group during oil aging . For evaluating the lifetime of transformer oil model, a constant-stress test was used in accelerated life tests, and inverse power model was used to fit test datas and calculated voltage endurance coefficients for the mean lifetime. The results show that the aldehyde and the acids compounds are produced in aging; The dielectric dissipation factor (tg) becomes the logarithm relation with acid number. The partial discharge (PD) has immediately effect on the electricity aging life of transformer oil, along with the electrical aging, its dielectric dissipation factor increases gradually.

Research of the Dielectric Loss factor tan of Transformer Oil by Multi-Parameter Regression Analysis

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Abstract: The dielectric loss factor tan is sensitive to the insulating ability and the aging degree of transformer oil, which is an important parameter to monitor the safe operation of transformer. The physical, chemical and electrical properties of transformer oil are affected by various factors and each one has interrelation with others. The properties of oil can be evaluated by establishing relationship model among them. The physical, chemical and electrical parameters of transformer oil have been studied with simulated thermal aging experiment and it is found there is interrelation among them. The model of functional relation for tan respectively with water content, flash point, viscosity, total acidity and service period are established by multiple linear regression analysis.

Permeability and its Influence on the Broadband Frequency Response of a Power Transformer

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Abstract—This paper considers the effect of the complex permeability of a power transformer core for the full FRA test spectrum (typically less than 10MHz). Current work in the area generally neglects the core beyond a few 100kHz. This paper demonstrates that the relative complex permeability is significant

at 1MHz and above unity until frequencies beyond 15MHz. The paper also demonstrates that for broadband small signal testing, such as FRA, the low field conditions induced by the injected signal result in a relative permeability that approaches the initial permeability of the core. This ensures that the relative permeability remains approximately constant over a large range of frequencies and will have a degree of independence with regards to the injection voltage source.

Power Transformer Dga Integrated Diagnosis System Based On Oracle Database

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Abstrac-- In the paper, a transformer dissolved gas analysis in oil (DGA) fault integrated diagnosis system based on Oracle is developed, and its modules are introduced. Fault diagnosis of transformer is based on three-ratio-method, grey relational entropy, fuzzy clustering, Artificial Neural Network, featured by its analytic hierarchy process to integrated analysis, so as to perfect existing diagnosis methods. The system has realized each module function by layers, and it can diagnose fault in power transformer. The system also can provide figure display and friendly help module. The effectiveness of the system is verified by DGA data in Yunnan Power Grid and other DGA data.

Key words: transformer; fault diagnosis system; dissolved gas Analysis

Insulators ESDD Predicting under Various Meteorological Conditions Based on Least Squares

Support Vector Machines

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Abstract— According to the data provided by "Optical Sensor System for the ESDD Monitoring of Transmission Equipment", an intellectual prediction model based on least squares support vector machines (LS-SVM) is built, whose input variables are temperature (T), relative humidity (H), wind velocity (WV), air pressure (P) and rainfall(R), and output variable is equal salt deposit density (ESDD). In this model, the non-sensitive loss function is replaced by quadratic loss function and the inequality constraints are substituted by equality constraints .Consequently, quadratic programming problem is simplified as the problem of solving linear equation groups ,and the SVM algorithm is realized by least squares method. Through Grid Search Method, the optimal parameters of LS-SVM are selected automatically, which has improved the speed and accuracy of the forecasting. The simulated results show that the predicted ESDD data are very close to the on-line measured ones. Therefore, the model presented provides a doable thought for the computerization of pollution area map of power network.

Application of Acoustic Emission Technology on Monitoring of Polluted Insulator Discharge

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Abstract—This paper presents a method for pollution insulator discharge monitoring based on acoustic emission (AE) technology. AE technology is a successful non-destructive detection method widely applied in many areas, including monitoring defects of electrical power equipments. In the process of partial discharge there is a continuous release of energy, including the emission of the acoustic energy. So the pollution severities of the insulators can be monitored and analyzed for flashover prediction and condition-based maintain, though online detecting the AE signals. Artificial contaminations tests proved that there is a corresponding relationship between the AE signals emitted by the polluted insulators and the development of contamination discharge.

Compare Contamination Discharge AE with Corona Discharge AE

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Abstract In order to know discharge type exactly, contamination discharge AE and corona AE of insulator are compared by experiments. Increase test voltage and vary work condition, at the same time, measure and record AE wave from contamination discharge and corona discharge, then the varying laws of AE with test voltage and with test time during the two discharges are analyzed and compared. Experiment result shows that corona discharge AE and contamination discharge AE can be both detected by AE sensor, and they appear both in periodicity and in axial symmetry in test voltage period. However, there are some obvious differences in the two discharges, such as AE event count in a test period, AE start voltage, test voltage stability, test time stability and AE’ s shape. So applying the differences to identify the discharge type of insulator should be effective and feasible.

Research on HV-Power Equipment

Diagnosis by

Infrared Image Edge Detection

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Abstract—As a method of fault diagnosis and state monitoring for HV-power equipments, infrared image analysis has been applied while edge detection is a crucial step of this image application. In this paper, a novel edge detection based on quantum-inspired is proposed. Quantum-inspired edge detection (QIED) is based on concepts and principles of quantum computing such as quits and superposition of states. And detailed process of this method and result using in power equipment infrared image are given. The experiment result shows that compared with conventional edge detection QIED can extract more useful information for fault diagnosis

Partial discharges characteristics of harmful conducting particles around spacer under ac voltage in atmospheric air

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Abstract—Harmful metallic particles inside gas insulated switchgears (GISs), which are the most problematic among various defects in a GIS, is significant to the reliable operation of such electric equipment in power transmission network. This paper investigates, on an experimental basis, the partial discharge (PD) characteristics initiated from particles under ac voltage in atmospheric air with those placed freely on the lower electrode' s surface of GIS model, having adhered to the insulated spacer' s surface, and fixed on the upper electrode' s surface, respectively. PD and breakdown characteristics in terms of the particle size (length and radius) and the location between the spacer and the particle have been studied in detail. All results are compared with each other to clarify the influence of the particle geometry size and location on PD characteristics. The amount of PD pulses in unit time, which shows the severe extent in PD, has been also investigated. The influence mechanism of the particle location on PD characteristics is discussed in this paper.

Fuzzy Clustering Analysis Based on Dissolved Gas in Power Transformer

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Abstract--Dissolved gas analysis (DGA) is one of the most useful techniques to detect the incipient faults of power transformer. However, the identification of the faulted location by the traditional method is not always an easy task due to absolute ratio and some of the gas ratio code (e.g. 011) outside normal operating condition by the IEC method. In this paper, a fuzzy set analysis theory and method were described and applied to the diagnosis of power transformer. The practical examples were cited.

Research on A New Method of Insulator Contamination Detection Based on 8mm

Radiometer

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Abstract—Based on the microwave radiometry, the brightness temperature of insulator contamination is introduced to the contamination detection with an 8mm microwave radiometer. And the relation between the brightness temperature and Equivalent Salt Deposit Density(ESDD) together with Nonsoluble Salt Deposit Density(NSDD) was analyzed by fitting the data from artificial contamination tests under dry and wet conditions, respectively, which obeys the law of power function. The exponent characterizing the influence of ESDD on the brightness temperature is independent of NSDD. And the influence of ESDD on the brightness temperature of contamination is smaller than that of NSDD. Based on the tests and analysis, a model of monitoring system is introduced with radiometer detection.

Study on the hydrophobicity of HTV SIR treated by different corona intensity

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Abstract—HTV SIR has been widely used as the outer insulation aging mode for composite insulators[7]. With that, the
of composite insulators, which mainly depends on the unique hydrophobicity of HTV SIR after corona aging has been the
hydrophobicity of HTV SIR. In this paper, the influence of research interests[8-11]. There are conflicts on the effect of
corona intensity on the hydrophobicity of HTV SIR was corona intensity on the hydrophobicity recovery rates. The
investigated. The HTV SIR samples were aged under five levels inner interpretations are seldom given. In order to learn about

of voltage. The hydrophobicity loss and recovery were evaluated the effect of corona intensity on the hydrophobicity of HTV

by static contact angle. Experiments results show that the SIR, the hydrophobicity loss and recovery of SIR treated by

hydrophobicity won't lose until the corona intensity gets the five levels of voltage were observed and investigated in this corona onset electric field. Once the corona discharge occurs, the hydrophobicity loss will be accelerated with the enhancement of paper.

corona intensity. As for the hydrophobicity recovery, when the

corona duration is shorter, the hydrophobicity recovery quickens II. EXPERIMENTS

up with the increasing of corona intensity. The hydrophbicity

recovery, however, slows down by the enhancement of corona A. Test samples

intensity when the corona duration is prolonged to a certain The flat HTV SIR samples with 30mm diameter and 1mm

value. Meanwhile, it is noticed that under some aging condition, thickness were used in this study. In which, the 40wt% alumina the hydrophobicity of HTV SIR can't get recovery even if the tri-hydrate (ATH) was added to SIR and other fillers were also storage time is enough long. So it is assumed that there is no stuffed according to the conventional formula. Before the affirmatory correlation between the hydrophobicity recovery corona aging process, the samples were first immersed into speed and the corona intensity. Further analysis identify that the microstructure and chemical composition play an important role pure ethanol for a while to remove the dirtiness(leaving over

in the hydrophobicity recovery progress.

Design of Non-Contact On-Load Automatic Regulate Voltage Transformer

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Abstract-Because automatic-mechanic contact, tap-changing

switch does not fit for distributing transformer, almost all distributing transformers adopt no-load voltage-regulating. This paper introduces a distributing transformer which uses power electronic component as tap-changing switch of the transformer and realizes automatic on-load voltage-regulating under the control of single-chip. We present the structure, fundamental principle, design method of each link and experimental results of the distributing transformer. The results show that we adopt solid-state relay as non-contact tap-changing switch has merits that on-load voltage-regulating response quickly, small waveform distortion, long lifetime and low cost.

WAMS/SCADA Hybrid System State Estimation Algorithm with Double Constraints

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Abstract—The precision of traditional power system state This paper aims to construct SE objective function by estimation (SE) based on supervisory control and data importing the constraints of zero-injection nodes and WAMS

acquisition system (SCADA) is low. This paper aims to construct in the WAMS/SCADA hybrid system in order to improve the

a SE objective function combined with the constraints of zero- precision of SE. The optimal estimation can be derived from

injection nodes and wide area measurement system (WAMS) in the SE objective function with double order to improve the precision of SE, in the WAMS/SCADA constraints using the hybrid system. The optimal estimation can be derived from the optimization theory of Lagrange multipliers method. A

SE objective function with double constraints by the optimization standard test system has been used to prove the efficiency and

theory of Lagrange multipliers method. A standard test system the real-time performance of the proposed method, the

has been used to prove the efficiency and the real-time precision is improved and the real-time performance is similar

performance of the proposed method, the precision is improved in the certain scope comparing with the traditional SE method.

and the real-time performance is similar in the certain scope

comparing with the traditional SE method.

Multi-objective Evaluation for Distribution Network Basing on Hierarchical DEA

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Abstract—Studying the optimal subsection of distribution networks feeders, a subsection scheme synthesizing load and the length of subsections is presented. Hierarchical data envelopment analysis (DEA) method is proposed for multi-objective evaluation of subsection schemes. First, the scientific assessment system is established by using the analytic hierarchy process (AHP) and the weights of assessment criteria are derived from the judgment matrix. Secondly, the actual index data is used to structure DEA model, the schemes are evaluated quantificational with regard to different assessment criteria. Finally, each scheme is evaluated comprehensively. Using this method and the evaluation system to evaluate the subsection schemes, the evaluation results show that the assessment method is scientific and effective; the subsection method presented in this paper can better meet the economic and reliability requirements and is simple and practical.

increasing urgent demand for
useful knowledge rather than mountains of data during the emergency condition by the operators. Quick and correct fault diagnosis conclusion has realism meaning to reduce time of electric energy's interruption and improve the reliability of power supply. It is easier with complete and exact information than without. However, when distribution system occurs fault, the certainty and integrity of information will be damaged by a good many causations[1]. In order to improve the accuracy

Application of Mobile Agent Technology to Power

Generation Control in Microgrid Power System

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Abstract—A microgrid power system is required to be controlled by electric power energy flowing through the interconnected power line that connects the microgrid and a large power system. Load dispatch for power sources in the microgrid is required, but large scale SCADA is not anticipated. This paper proposes an application of a mobile agent technology for the electric power output control. The reason is the agent has flexibility and expandability, and it is suitable for the control of the microgrid in viewpoint of small controller. A minimization of generation cost is considered as an evaluation function, and an equal incremental cost loading method is applied. Simulation is carried out using load data measured in the university building and demonstrates applicability of the proposed control.

A real time simulation and forecasting apllication of Yellow River Diversion Project Conveyance line

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Abstract—The paper is concerned with a real time simulation managernent and forecasting system for water diversion infrastructure project. The Wanjiazhai Yellow River Diversion Project is a large-scale inter-basin water diversion undertaking with the target capability of transferring 1,200 million m3 of water annually. The project is one of many strategic measures to alleviate water shortage problems in the area, particularly for the three cities of Taiyuan, Datong and Shuozhou. DHI's MOUSE model has been applied as an application running in real time to provide short-term security checking and also to develop long-term optimal operational strategies to the entire conveyance system. A key aspect of the development of the system was the understanding of the differing control strategies between the process modelling and the SCADA system, as the model was required to be able to accurately predict the true operation of the system during emergency conditions and with operator intervention. The paper describes the applications development including the unique aspects of producing operational forecasting over a 7 day period to develop safe, economic and reliable operations in an hydraulically complex water diversion scheme.

The Research and Application on Water Transport Control Operating Modes

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Abstract—This paper is related with the research and application on automation control systems in water diversion conveyance line project. Because the uniqueness and importance of the project, the process of the system design, implementation and testing was of paramount importance. This issue was approached from the plantwide control perspective. The main tool used was a concept of the conveyance line operating mode. The paper discusses the operating modes used for the conveyance line automation and their impact on the project development.

The Real-time Assessment of Electric Distribution Network Load Capability

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Abstract—To improve the security and reliability of a distribution network, several issues, such as influences of operation constrains, real-time load margin calculation, and online security level evaluation, are with great significance. In this paper, a mathematical model for load capability online assessment of a distribution network is established, and a repetitive power flow calculation algorithm is proposed to solve the problem as well. With assessment on three levels: the entire distribution network, an sub-area of the network and a load bus, the security level of

current operation mode and load transfer capability during outage are thus obtained. The results can provide guidelines for prevention control, as well as restoration control. Simulation results show that the method is simple, fast and can be applied to distribution networks belonged to any voltage level while taking into account all of the operation constraints.

Influencing Factors of the Induced Voltage in Signal Cable of Electrified Railway

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Abstract—This paper built a model of tractive power supply system, analysed the influence on signal cables due to tractive power supply system through the software ATP-EMTP and found out influencing factors of the induced voltage in signal cable core of railway system. Simulation shows that: Structure and size of signal cable, earthing methods and earth resistance of the signal cable sheath are three of the most important factors. There are several ways to reduce the induced voltage in signal cable core, such as reduce the earth resistance of cable sheath

and increase the number of earthing contacts of cable sheath.

Shielding Effectiveness and Coupling Characteristic of Metallic Enclosures with Apertures under EMP

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Abstract— Shielding effectiveness (SE) and coupling characteristic of metallic enclosures with apertures excited by EMP are investigated. The coupling results of different configurations and number of apertures are discussed. The coupled electric field strength is the highest in the small area adjacent to the aperture. The electric field evolvement exhibit resonant behaviour evidently and the resonant peak is present at the center inside the enclosure. For the case of the same area of a single aperture, the SE of the enclosure with rectangular aperture is lowest, and which with circle aperture is highest. The SE of the enclosure with double-layers wall is improved significantly. Besides, keeping the total area unaltered, dividing the single larger aperture into multiple smaller apertures, the SE of the enclosure will be increased.

Investigation on probabilistic distribution of wiring harness radiated immunity of power transmission line

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Abstract—Based on the nodal admittance method which is
convenient to analyze the responses at terminals of II. NODAL ADMITTANCE EQUATIONS OF MULTICONDUCTOR multiconductor transmission lines excited by EM field, Mento TRANSMISSION LINE EXCITED BY EXTERNAL FIELD
Carlo method for the characterization of wiring-harness
susceptibility to external interference is applied. The problems of A. Nodal AdmittanceEquations of line excited by external
field-coupling onto high voltage alternate current (HVAC) field
transmission line and high voltage direct current (HVDC) Considering distributed transmission line loaded by terminal resistances are considered. generated by external fie lds outhrec e tealleognrga phtr' asn semqiusastiioonn s linoef The external field is modeled by a uniform plane wave with random parameters. Investigated configuration is wave with multiconductor transmission line are (1) [5].
three random parameters of polarization angle, incident angle
and azimuth angle, and the set of random values is generated by
computer. The formulas of response of multiconductor line are
applied, and the amplitude of voltages or current is computed for
every set of random values. When the range of incident
parameters of wave is of [0, /2], the probability distributions of
terminal currents and voltages are investigated.

Research on crosstalk of shielded cable used by power system

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Abstract—Crosstalk in power control shielded cable was
investigated in this paper. The interference source is used to
simulate switching interference in gas insulated substation with
rise time of 5ns. Using simple experimental configuration
crosstalk was researched by experiments. Comparison of the
simulated and experimental results shows that the experimental

process is viable. The error analysis is staged in conclusions. And applying this experimental process further research will be staged.

Investigate and Control of Power Transformer Noise

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Abstract-The importance and recent achievements in the field of noise control of power transformer are expounded in this paper. Oscillation is presented as the reason for the transformer and cooling system noise. The methods used in transformer noise research are summed up. Generally speaking, far-field radicalization noise can be analyzed by summing up statistic data and setting calculating model, and sound intensity method is more accurate in measuring noise level of a transformer compared with traditional sound pressure method. The measures for controlling the transformer noise are introduced in detail. High- quality silicon-steel is suggested to be used, as well as adopting some effective measures when design, machining and install transformers. Assuasive equipments, muffler, sound insulation board and isolation booth, which will result attenuation in noise transmission, are proposed in order to reducing noise. Lastly but not the least important, opinions on the trend of the transformer noise control are bring forward.

A New Algorithm to Identify Transfer Functions of Antennas Used in EMC Measurement

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Abstract—Due to the non-flat amplitude-frequency characteristics of the antennas used in EMC measurement, it is desired to establish the equivalent transfer functions of the antennas so as to make digital correction to the measured data, from which the actual electromagnetic interference can be traced back. This paper describes a new algorithm for the fitting of measured frequency domain responses with transfer function approximations. This is achieved by replacing a set of starting poles with a set of zeroes calculated from another transfer function whose starting poles are given in advance. Simulation shows that, the proposed algorithm can render good performance in fitting accuracy.

Assessing Method of Voltage Sag Frequency Caused by Transmission Line faults

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Abstract —Fault location on transmission line influences the characteristics of voltage sag at given bus. It is difficult to determine the fault pattern and voltage sag frequency. A new method based on maximum entropy principle was proposed to assess sag frequency synthetically considered different fault types and objective probability distribution of fault location in the power system. The faulty line intervals were derived from analytical approach and sample data moments were used as

constraint conditions. The probability value of fault location was determined by maximizing the entropy function. The voltage sag frequency was calculated using the proposed method. Applied in IEEE 30-bus reliability test system, simulation results show that the method is veracious and practical.

Study on Method of Transient Huge Currnet Measurement by Magnetic Sensor Array

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Abstract—For solving the transient current measurement problem in the process of Power system running, this paper used the Boundary Element Method to research, and analyzed the method of solving the eddy current field non-source area scalar magnetic potential by the boundary element method with surface impedance concept: to measure the magnetic field of a particular point by the Magnetic Sensor Array, and to solve the inverse problem of reconstructing transient current by the same idea, the model building process of the algorithm was proposed, and the simulation’s results showed the efficiency.

Analysis Model of Electromagnetic Interference Flowing in a Substation Cable

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Abstract—This paper describes constitution of analysis model of electromagnetic interference in substation secondary system. Substation cable is the key part of the model. It’ s modeled by transmission line model or multi-conductor transmission line model. Electromagnetic interference couples to secondary system via substation cable. External electromagnetic field, ground potential difference and busbar interference voltage are used to express electromagnetic interference sources and included in the model.

Analysis and Calculation on Indices of Voltage Sag

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Abstract—Voltage sag has become one of sharpest issues on power quality in modern social. In this paper, voltage sags indices such as SARFI, severity index, energy index are summarize, analyzed and compared, and the energy index is improved. Four indices are proposed, that is: statistical index, severity index, event time indices and cost indices, and the recommended reason is also explained.

Stress Determination of Oxide Film Formed on

Lanthanum Ion-Implanted Pure Nickel

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Abstract—This electronic document Isothermal oxidation kinetics of pure nickel and its lanthanum ion-implanted sample are studied at 900 . Scanning electronic microscopy (SEM) and transmission electronic microscopy (TEM) are used to examine the surface morphology and microstructure of oxide films. Laser Raman spectrometer and X-ray diffraction spectrometer (XRD) are used to study the stress level in oxide films formed on La-free and La-implanted Ni. Secondary ion massive spectrum (SIMS) is used to examine Ni, O and La element distribution in depth in oxide films. Results show that La-implantation remarkably reduces the growing speed and grain size of NiO film; Meanwhile it changes the oxide film growing mechanism from predominant cation outward diffusion to anion inward diffusion. The finegrained La-containing NiO film can relieve part of internal stress via high temperature creeping, and results in heterogeneous stress distribution in depth. XRD and Raman testing results show the stress declination effect due to La-implantation, and discrepancy between the two testing results is analyzed regarding to the rare earth effect during the film growing process.

A Converter of High Voltage Capacitor Charging Power Supply Using Piezoelectric Transformer

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Abstract—In order to adapt the miniaturization and low EMI of pulsed power supply, a novel Quasi-resonant piezoelectric transformer converter for high voltage pulse capacitor charging was developed. The system has the advantages of simple structure, absorbing the switch capacitive parameters and zero voltage switching (ZVS). Therefore, this converter is suit to operate under high-frequency conditions. The working principle of converter was introduced briefly, the working modes of inverter were analyzed and the formula calculating the resonant inductive and switch frequency was listed. At last, the design instance was described, the result of reality and calculated were well consistent.
Keywords- piezoelectric transformer; converter; Quasiresonant; quantum-mode control

A HIGH-ENERGY GRAPHITE SPARK GAP SWITCH

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Abstract—High-energy switch and trigger systems are required for a range of capacitor bank applications such as for electromagnetic rail, coil, and electro-thermal guns. Spark gaps can be made from brass copper or other metallic electrodes. Under high current and high charge transfer the metal may vaporize and create some deviations in trigger performance. A new approach using graphite electrodes avoids the disadvantages of metal electrodes because no metallic plasma is generated. This paper summarizes recent developments in this kind of switch design in our laboratory. The switch is a two-electrode switch and is triggered by an overvolting “series-injection” of a

high-voltage pulse. The trigger generator TG-160 is a MARX generator which applied an overvolting pulse directly to one of the spark gap electrodes, open circuit output voltage of TG-160 is 120kV, with a 30ns rise time, and the pulse width of 160ns (FWHM). Electrode erosion surface of different materials was investigated in switch life testing.

Research of Conduction immunity of control shielded Cable

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Abstract— Nodal admittance equation is derived based on chain parameter matrix for multiconductor transmission lines excited by distributed source. This method can be simply used in analysis of complex network excited by distributed source. Based on this method conduction immunity of shielded cable was analyzed, and it is verified by comparison with the reference. In the conclusion of this paper the authors also present view that in theory research of conduction immunity interference source should be applied at middle point of line, and this can be well simulated the actual situation.

The Influence of Gap Length on Flashover under Nanosecond Pulsed Coaxial Electric Field

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Abstract—Under nanosecond pulsed coaxial electric field, surface flashover voltage over the interfaces between nylon 1010 and transformer oil increases almost linearly with gap length, and the steeper rising edge of applied pulse, the higher flashover voltage. Surface flashover properties are closely related to the electric field at the triple junctions of solid-liquid-electrode and the field gradient along the interfaces. Although the increased difference between inner and outer electrode radii will enhance electric field strength at the triple junctions and nonuniformity degree of potential distribution along interfaces, it reduces simultaneously terribly the surface field strength of coaxial inner electrode, so that flashover voltage doesn’t descend, but ascends almost linearly with gap length. The average flashover strength in coaxial electric field can be estimated by that in uniform electric field for large enough difference between inner and outer electrode radii, which is useful to practical engineering design for coaxial pulsed power apparatuses.

Experimental Study and Numerical Simulation on Interaction of Plasma Jet and Liquid media

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Abstract The interaction mechanism of plasma jet with liquid media is one of the most important problems in the study of interior ballistic of electrothermal chemical propulsion. The propagation form and the interaction mechanism of plasma jet in water are studied experimentally in this paper. The plasma jet is generated by the discharging of pulse power in a polyethylene capillary. The construction and consecutive expansion process of plasma jet in water are recorded by high

speed digital camera system. The effects of discharge voltage and boundary shape on the propagation form are studied. The expansion velocity of plasma jet in water is gotten. The results indicate that the expansion construction of plasma jet in water is a typical Taylor cavity, the entrainment phenomena of plasma jet to water is visualized in pictures, and there are strong interactions in the surface of Taylor cavity. Based on the experiments, numerical simulations of the interaction of non-steady plasma jet with liquid media are carried out. The change characteristics of pressure and velocity in plasma jet flow field have been obtained.

A Zero Current Switching Half-Bridge Power Supply for High Speed Drilling Electrical Discharge Machining

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Abstract—High Speed Drilling Electrical Discharge Machining (HSDEDM) uses controlled electric sparks to erode the metal in a work-piece. Through the years, HSDEDM process has widely been used in high speed drilling and in manufacturing large aspect ratio holes for hard-to-machine material. The power supplies of HSDEDM providing high power applications can have different topologies. In this paper, a HSDEDM power supply prototype has been developed, utilizing the Zero Current Switching (ZCS) Pulsed Width Modulated (PWM) half-bridge topology with a minimal component count and inherent protection under short circuit conditions. This topology has an energy conservation feature and removes the need for output bulk capacitors and resistances. Energy used in the erosion process will be controlled by the switched IGBTs in the halfbridge network and be transferred to the gap between the tool and work-piece. The relative tool wear and machining speed of

our proposed topology have been compared with that of a normal power supply with current limiting resistances.

A Novel Detecting and Controlling Strategy of the Discharge Status in High Speed Wire Electrical Discharge Machining

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Abstract—There are three discharging statuses—open, discharge and short-- in high speed wire electrical discharge machining (HS-WEDM). This paper proposes a novel detecting and controlling strategy of the discharge statuses in HS-WEDM. Floating threshold of voltage which changes with the mode of gap current is proposed in this paper; three basic discharge statuses are detected and controlled by this method. Thus the fine precision and the sensitive of detection will be achieved. Normally, most of the used detecting methods are about fixed voltage threshold detecting technology, these methods can not be used on the range of the current is large and the non-rectangle discharge current waveform. In this paper, the Floating threshold of voltage with the mode of gap current following is used to detect the discharge statuses, and the problem about the gap voltage waved with the gap current can be settled effectively. The random gap current wave also can be detected by this method.

Intermediate Frequency Vacuum Arc under Axial Magnetic Field

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Abstract—Vacuum switch has advantages of small volume, light limit[3],[4]. Arc voltage is an aggregate quantity that reflects
weight and large capacity of interrupting current. It has current flow conditions between contacts[5]. When vacuum arc
superiority in aviation field. In this paper, intermediate is constrained by axial magnetic field(AMF), arc voltage falls,
frequency(400Hz-800Hz) vacuum arc generating in an improved the input energy of inter-electrode decreases and the current
weil oscillating circuit is studied in cup-type vacuum interrupter interruption ability of VI improves, the AMF has received
with axial magnetic field, upper limit of current interruption, arc much attention[2],[6],[7],[8],[9]. Current frequency influences
voltage and its noise component, anode melting phenomena and arc voltage and its noise component[5]. High frequency current
the correlations between the measured arc voltage and the interruption ability is primarily depending on the momentary current frequency are investigated.

The Study on the Anode Current Density Distribution in a Moving Arc Root

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Abstract—This study aims at the reconstruction of anode twodimensional current density distribution in a moving arc root using algebraic reconstruction technique(ART). The principle of the multi-angle slit-cavity electrode is proposed to obtain the linear current distribution of arc root in diverse directions on the basis of work made by Drouet and his cooperators. The iterative reconstructive algorithm associated with ART is introduced. The measured results of linear current distribution in seven directions are processed with the ART algorithm, and two-dimensional

current density in arc root is obtained.

Impact of Inner Electrode Diameter on Surface Flashover under Nanosecond Pulsed Coaxial Electric Field

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Abstract—Either surface flashover voltage over interfaces between Nylon 1010 or polymethyl methacrylate(PMMA) and transformer oil nonlinearly increased and was immediately saturated with diameter of coaxial inner electrode under nanosecond pulsed coaxial electric field, and more larger inner electrode diameter more closer flashover voltage for both. Surface flashover properties are closely related to the electric field at the triple junction of solid-liquid-electrode and the field gradient along the interfaces between solid and liquid, so that the greater inner electrode diameter the higher flashover voltage was owed to resultant depressed field strength at triple junction and averaged potential distribution along interfaces.

Smooth Mode-switch Control for the Powertrain of Parallel Hybrid Electric Vehicle

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Abstract—**The coordinated control of internal combustion engine and electric**

machine is vital to
improve driveability and reliability of Parallel hybrid electric vehicle (PHEV). This paper address to the mode-switch problem for powertrain of PHEV, construct a model-based rapid control prototype as a controller by MATLAB/SIMULINK software and dSPACE system for mode-switch control, come up with a mode-switch control strategy which employ the quick transient response of electric machine to compensate the deficiency of transient torque performance of internal combustion engine.
Aiming at the general characters of mode-switch, a experiment schedule was implemented on the PHEV test bench, Comparing to the control method by estimating the engine toque with steady torque map, the experiment result show that the control strategy proposed in this paper can reduce the torque and speed fluctuation significantly during the course of mode switching in PHEV.
Keywords—parallel hybrid electric vehicle; mode—switch; control strategy

Strategic Bidding Model for Power Generation Company Based on Repast Platform

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Abstract **- The bidding strategies of power generations in the market are a dynamic and complex problem. It is difficult to analyze and computer with the traditional mathematical methods, which is conspicuous in the middle or long-term transactions. This paper proposes a model，it is the middle or**
long-term bidding strategy in two-tiers electricity market that is based on the optimal power flow (OPF) . Uncertainties in the outside world are regarded as the agent (Agent) of "external environment." Under this conditions, Agent through environment evaluation judges to select viable strategic. Through learning from experiences and opponent’ s behaviors, Agent guides the purpose of the best production. The adaptability and superiority of this model is tested based on Repast with a
standard IEEE-5 bus 6 notes test system.
Keywords – electricity market, reinforcement learning, RL; Agent; Repast

Optimization of Thermal Discharge Scheme for the Phase II Project of Rizhao Power Plant

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Abstract—Rizhao sea area was characterized by a twodimensional hydrodynamic model using the split steps finite method with triangle grids. The simulated tidal current field showed reasonable agreement. Heat transport and horizontal distribution of temperature in the sea water around Rizhao Power Plant was numerically simulated based on the tidal current field. The impact of different design schemes of thermal discharge from Rizhao Power Plant on water environment was predicted taking into account outfall location, water discharge and temperature rise. The optimal scheme is recommended according to the prediction results, i.e. the cooling seawater of both phase I and II projects discharges from the outfall P1. The recommendation is not only in accordance with Marine Functional Zoning of Rizhao but also economically reasonable.
Keywords—hydrodynamic model; thermal discharge model; numerical simulation; scheme optimization

The power distributions on series connection motors

Abstract—The driving mode by two hydraulic motors and reducer is widely used in many types of equipment, which adjusts velocity and torque by the way of changing the relationship of the two motors- series connection or parallel connection. It is generally believed that the power distributions on the two motors are the same, which is to say that the two motors' load-bearing states are identical. In this paper, using the method of emulation analysis and experiment, the conclusion is drew that there is comparatively large difference about the power distributions on the two motors, and the most part of load
is bear by one motor.
Keywords- series connection motors; power distributions; load-bearing states;

emulation analysis; dynamical property experiment

Construction of UHV Demonstration and Test Projects in China

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Abstract—the UHV AC and DC demonstration lines and test bases, several first UHV projects in China, are under construction. The UHV key technologies research achievements can be directly used in the construction of the test lines and test bases, the former research achievements can be validated; the equipment can be applied and tested. Hence, the test lines and bases have the abilities to validate the prophase research achievements in China, the performance and reliability of the equipment, which are very important for the design, operation and maintenance of future UHV projects in China. The design parameters and construction of UHV AC, UHV DC test and demonstration lines, UHV AC, DC test bases of SGCC are introduced in this paper.
Keywords— Alternating current (AC); direct current (DC); test and demonstration line; ultra high voltage (UHV); UHV AC test base; UHV DC test base; UHV AC transmission line; UHV DC transmission line

Methods Study and Appliance of Forecast Acid Fracturing Production in Fractured and Cavernous Carbonatite Reservior

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Abstract—Acid fracture treatment is one of the most effective way of stimulation in fractured and cavernous carbonatite reservoir. Because there are too many factors that influence the acid fracture effect, such as geologic factor, technic factor, material' s factor, it is difficult to forecast the effect of acid fracture before the treatment has been done. The relationship between these factors and result of acid fracture is very complex, and it is different from hydraulic fracture in clastic reservoir . Although much more experience has been gathered from exercise, the relationship between affect factors and effect is also very difficult to be found. This paper designs two ways to solve this problem. One way is based on experts' experience and statistical method, and, another way is artificial neural network.

By using practical data, and compared these two ways, we find that the precision ratio of the first way is 66 percent and another is 86 percent. Both of these two ways are suitable to forecast the effect of acid fracture in fractured and cavernous carbonatite reservoir. Furtherly, the artificial neural network is better.
Keywords:Fractured and cavernous carbonatite; Acid fracture treatment; Neural network

A New Type of High Efficient LGM Vertical Mill

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Abstract—LGM vertical mill (LGMVM) is a new type of high efficient and low energy consumption mill. It has been designed and developed on the basis of certain domestic and overseas advanced technologies of powder processing. Its characteristics include that low energy consumption, low noise, and so on. It uses centrifugal force caused by rotation of rollers as grinding force, and mills the material. This paper analyses the data gathered from the spot experiment of LGMVM, and proves the design of the LGMVM is rational and excellent.
Key words—LGMVM, rational design, low energy consumption, low noise

Improving Energy Efficiency in a Power Park by the Integration of a Hydrogen Steam Reformer

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Abstract – This project aims at creating an energy park in the suburbs of the Italian town Bari. This energy district is located in an area devoted to social housing and close to some significant energy users (airport, hospital and other major facilities). The use of combined heat and power would allow to produce on-site electricity at low cost and it would allow to benefit of the heat produced from the generation process. The model towards which it stretches is a eco-compatible city, or an urban settlement in which the city activities develop in harmony with the environmental sustainability principles. In order to achieve this goal, the on-site production of hydrogen is implemented to push hydrogen-based public transportation by buses and shuttles. The
integration of cogeneration/trigeneration with hydrogen steam reforming is the best practice we propose here. The heat from the exhausted gases of gas turbines is exploited to generate steam utilized in the Hydrogen Steam Reformer. This design could lead to fuel savings of 30% in steam reforming. Moreover, the rational use of energy and sustainable urban mobility makes, more comfortable, the living and working spaces, and also it makes healthier, more efficient and attractive the entrepreneurial and professional new business in a popular
district. Index Terms – Combinated Heat Cooling and Power, Energy
Efficiency, Power Park, Hydrogen, Steam Reforming, Urban Regeneration

Bottom water energy control to enhanced oil recovery

in bottom-water reservoir

Calculation method for artificial-interlayer shape of bottom-water reservoir

Abstract—How to control bottom water energy reasonably and effectively of bottom-water reservoir is puzzling Field Engineer until now. The key technique of development for bottom-water reservoirs is to depress or control water cone, prolong water free production period as much as possible. In order to settle the question, this paper, based on static mechanism and kinetic equation of underground fluid, the model for calculating the height of the artificial-interlayer with curvilinear side surface is
established. The model quantitatively describes the relationship between the artificial-interlayer height and oil yield, reservoir thickness, radial distance from well axis, reservoir permeability and crude oil viscosity etc. The maximum artificial-interlayer height and radius, the artificial-interlayer heights at different
radial distances can be obtained according to this model. Build calculate method of the artificial-interlayer height model, the analytic solution of the model can be gained if interlayer liquid is plane radial flow and the non-Darcy flow is not considered; Through a field case, the characteristics of artificial-interlayer form are analyzed, and rules of artificial-interlayer conformation are obtained when artificial-interlayer liquid with different volume, viscosity and velocity injected, which provides a reference for the development of bottom-water reservoir.
Keywords- bottom-water reservoir; water cone; artificialinterlayer; calculation model; analytic solution

The influence of using the diversion tunnel on hydraulic transient of hydropower plants

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Abstract— Reconstructing the diversion tunnel as a permanent construction is not new in large underground hydropower plants' design, however most of them are taken as spillway tunnels or tailrace tunnels. A new design method of using diversion tunnel was proposed for further utilization. This paper analyzed the influence of using diversion tunnel on hydraulic transient of hydropower plants, including shaft surging, water hammer and dynamic properties of the governing system of the turbine. Calculation results verified the assumption that using diversion tunnel could reduce chamber diameter of surge shaft. The results provide reference to future design for underground hydropower plants.
Keywords—tailrace system; diversion tunnel; surge shaft; hydraulic transient

New Design Method of Reversible Pump and its Performances

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Abstract—**A new inverse design method of reversible pump is proposed. Partial differential equation is used to generate the blade three dimensional model, and the inverse design of impeller is transformed into the boundary-value problem on meridian plan. A new distribution function is proposed to specify the boundary condition of the boundary-value problem. In the present work, the partial differential equation is also used to discretize the meridian plan. Solve the boundary-value problem, and we can get the three dimensional model of impeller. The parametric design of impeller is achieved. The three dimensional interior flow of the reversible work in pumps and turbines condition are calculated to compute the characteristic performance curves. The performance curves are analyzed to get the hydraulic parameters relations between pumps and turbines condition. Finally, according to these relations we find the optimum design of the PAT using trial-and-error step size along the gradient direction.**
Keywords—inverse design; pump as turbine; partial differential equation

The Leak Property Research of Polymer Fluid in Helical Gear Pump

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Abstract—It is founded to the leak model of clearance of polymer fluid with utilization the origin equation in this paper, and the hidden function of the best clearance is obtained, simultaneously it is proceed to the numeric calculation. The investigative results offer the important theory foundation of the design of polymer gear pump. The power loss of leakage is got through the clearence leakage capacity, and the friction power loss is attained by the velocity distributing. The mathematic calculation models of the optimal clearence are obtained, at the same time the example and the calculation results are given out. The researchful result indicates that the wasting friction power of transmission power-law is much more than that of transmission Newton liquid, and the optimal radial leakage and axial leakage of power-law are biggest.

Key words—Polymer fluid; Helical gear pump; Leak property

Numerical Simulation-Driven Hydrodynamic Optimization for

Rehabilitation &Upgrading of Hydro Turbines

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Abstract—The rehabilitation and upgrading of hydro turbines for hydro power plants remain constantly growing in the world, especially in China. An optimization design methodology adapted to rehabilitation and upgrading projects of hydropower plant by means of digital design and performances estimation based on 3D viscous flow numerical simulations of the complete hydro turbine passage at multi-operating conditions is presented in this paper. The proposed methodology enables to take the constraints and objectives specific to such a design problem which most of the main dimensions of the existing turbine differ significantly from the dimensions of a new design into account. The use of multi-points performances estimation based on 3D viscous flow numerical simulations can guide us to optimize the components to be renovated and keep good match in hydraulic performances with the existed for a larger operating range, thus reducing R&D cost for rehabilitation and upgrading projects. A validation of the methodology on rehabilitation project of YINXIUWAN hydro power plant will be presented in the paper, it shows that performances of the retrofitted hydro turbine can be reliably estimated based on numerical tests, and the numerical tests proposed in the paper can substitute for the traditional model tests in the retrofit of a hydro turbine, and the presented optimization design procedure can be as a target oriented and cost effective development in rehabilitation and upgrading projects of hydro power plant.
Keyword Rehabilitation and upgrading; Hydraulic optimization design; Hydro turbine; Numerical simulation; Performance estimation;

Quality factor identification for

stacks in

resonant thermoacoustic system

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Abstract：In thermoacoustic systems, stacks with different matrix geometry and material coupled with different acoustic systems present different heat dynamic performances, which have influences on the efficiency of energy conversion. Then the quality factor is used to evaluate the performance of each matrix and verified experimentally in thermoacoustic system. It is showed that the pin-array matrix has the best quality factor and the lowest dissipative performance compared with other matrix.

Keywords：Resonant frequency, Stack, Quality factor, Matrix

Scheme Design and Analysis on Light Hydrocarbon Recovery System for Town Natural Gas

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Abstract—The development of cryogenic separation technology promotes the progress of light hydrocarbon recovery technology. According to the character of town natural gas in Shenyang city, this paper describes the design of a natural gas light hydrocarbon recovery system. Based on this system, the paper analyzes the relation between the liquefaction rate and the condensation pressure and temperature of the light hydrocarbon, Then it gives the condensation pressure of 3.2MPa and the condensation temperature of 208K; According to the product specification, it confirms some basic

parameters of the distillation column as the design pressure, the number of actual stages, the feed stage etc.. It also analyses the temperature distribution of the cold and hot fluid and the average logarithmic mean temperature difference (LMTD) of the heat exchangers. Finally, it uses large chemical process simulation software to simulate the light hydrocarbon recovery system, and gives the thermodynamic parameters of the key points. These provide the fundamental basis for engineering design and operation of the light hydrocarbon recovery system.
Keywords- Natural gas; Light hydrocarbon recovery; Scheme Design; Distillation Column

A Variable Heat Flux Line Source Model For Boreholes In Ground Coupled Heat Pump

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Abstract—Line heat source model is a type of classical heat transfer analysis model for modeling the heat transfer process of ground heat exchanger(GHE) in ground-coupled heat pump system (GCHPs). In this paper, considering the disadvantage of the classical constant heat flux line heat source model, a variable heat flux line source model is developed to simulate the heat transfer of GHE of GCHP operated in variable heat flux by quoting the idea of superposition principle, step load and borehole resistance. The validation on the updated line source model was undertaken by analysis and comparison with the improved and validated cylindrical source model. The results indicate that the developed variable heat flux line source model can simulate the heat transfer process of ground heat exchanger effectively and can be used as a reliable calculation model for vertical U-tube GHE.
Keywords-Ground coupled heat pump;ground heat exchanger; variable heat flux line source model; superposition principal

Forecast of Solar Irradiance Using

Chaos

Optimization Neural Networks

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Abstract—In this paper, artificial neural network is combined with wavelet analysis for the forecast of solar irradiance. This method is characteristic of the preprocessing of sample data using wavelet transformation for the forecast, i.e., the data sequence of solar irradiance as the sample is first mapped into several time-frequency domains, and then a chaos optimization neural network is established for each domain. The forecasted solar irradiance is exactly the algebraic sum of all the forecasted components obtained by the respective networks, which correspond respectively the time-frequency
domains. On the basis of combination of chaos optimization neural network and wavelet analysis, a model is developed for more accurate forecasts of solar irradiance. An example of the forecast of day-by-day solar irradiance is presented in the
paper.
Key-words: forecast of solar irradiance, wavelet transformation, Chaos Optimization Neural Networks

A Compound Scheme of Islanding

Detection

according to Inverter

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Abstract— Nowadays, with the rapid development of distributed generation, it has an increasing rate of permeation, the islanding phenomenon in grid-connected run mode brings hazards to network, electrical equipment and life safety. So, it is necessary to effectively detect the islanding condition and swiftly stop the run mode of grid-connect. In this paper, three-phase inverter and network systems was taken as an example, several existing methods were introduced and the advantages and

disadvantages were compared of several existing methods by using MATLAB simulation software for the realization of the simulation, the proposed combination of a variety of detection methods for the detection program .
Keywords—Distributed Generation; Islanding Detection; Inverter; Compound Scheme; MATLAB

Optimal Frequency Performance of a Standing-wave Thermo-acoustic Cooler

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Abstract—The optimal frequency characteristics of a standingwave thermo-acoustic cooler filled with parallel plates are investigated in this paper. The expression for the optimal frequency of the cooler at the maximum cooling load is derived. Numerical examples are given to show the effects of the plate spacing and the portrait temperature gradient along the plates on the optimal frequency. The results obtained herein can provide some theoretical guidance for the design of practical thermoacoustic coolers.
Keywords—optimal frequency; thermoacoustic cooler; parallel plates; cooling load

The Efficiency Evaluation of Electric Power Market Considering Transmission Congestion

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Abstract—In electricity market, the power transactions needs to be executed under strict physical and other constraints, such as transmission congestion which may lead to the decrease of market efficiency. In the paper, under considering transmission congestion, it establishes the model that reflects market
transaction, including generator output and sale price. Then it gives index system which is used to evaluate market efficiency under congestion. Finally, it utilizes IEEE 30-bus test system to illustrate the application of proposed method. The numerical results show that the transmission congestion may reduce social
welfare and bid up sale price. And based on optimal power flow model, it also provides an efficient way of relieving congested line.
Keywords- electricity market; transmission congestion; market efficiency

Power Distribution System Design for a FPGA-based Ground-Penetrating Radar Receiver

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Abstract—Power Distribution System (PDS) development of compact, low-cost ground penetrating radar (GPR) receiver based on Field Programmable Gate Array (FPGA) environment is presented. Four key steps of PDS design: transient current, target impedance calculation; bypass capacitor determination;
Voltage Regulator Module (VRM) design and inter-planar capacitance calculation are discussed in detail. The design and fabrication process of PDS as well as FPGA-based GPR receiver board are introduced. The frequency spectrum of designed PDSs and data capture experiment results demonstrated that the PDS and other critical hardware components on the receiver are fully functional.
Keywords-PDS; FPGA; GPR; VRM;

Overall Energy Efficiency of Lubricant-injected

Rotary Screw Compressors and Aftercoolers

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Abstract—This paper shows how to analyze the overall energy efficiency of two typical equipments of compressed air system: lubricant-injected rotary screw compressors and aftercooler. Firstly, air power, a proposed effective tool of weighing energy, is introduced as the quantitative standard of energy in compressed air. Then, compression process of lubricant-injected rotary screw compressors for air production is analyzed deeply and the state change of compressed air is discussed in detail. Compressed air's air powers in the one-stage compression air system including onstage compressor, intercooler, and aftercooler are discussed particularly. After discussion on the compressor's adiabatic and isotonic efficiencies, the efficiencies of compressor and aftercooler are defined with air power and their overall energy efficiency is proposed as the final energy- conversion efficiency. The efficiency analysis methods discussed in this study will be greatly helpful to an energy-saving equipment selection and energy assessment for pneumatic system.

Keywords- overall energy efficiency; lubricant-injected rotary screw compressor; aftercooler; air power; energy saving; energy loss

Numerical Simulation Study for Improvement of Polymer Flooding by Viscoelastic Effect

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Abstract—In this article, a finite volume method for the numerical solution of viscoelastic flows is presented. The flow of Phan-Thien-Tanner(PTT) model fluid through an abrupt expansion has been chosen as a prototype example. The conservation and constitutive equations are solved using the

finite volume method (FVM) in a staggered grid with an upwind scheme for the viscoelastic stresses and a hybrid scheme for the velocities. An enhanced-in-speed pressure-correction algorithm is used and a method for handling the source term of the momentum equations is introduced. Improved accuracy is achieved by a special discretization of the boundary conditions. Stable solutions are found for high Weissenberg number, further extending the range of simulations with the FVM. Numerical results show the viscoelasticity of polymer solutions is the main factor influencing sweep efficiency.
Keywords—Finite volume method; PTT; Viscoelasticity; Sweep efficiency

Effects of Superconducting Fault Current Limiter on Power Distribution Systems

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Abstract—Mathematical models for the studied power distribution system and its superconducting fault current limiter (SFCL) are given. Based on these models and EMTP, the influence on the peak value of short circuit current, the non-fault line voltage of feeder, and the voltage over SFCL due to the
limiting resistance of SFCL and the fault detection time is analyzed. The results show that SFCL can drastically limit the peak value of fault current, and it is helpful when switch faults occur. In addition, SFCL is in favor of maintaining the transient non-fault line voltage and increases the power quality.
Keywords—power distribution system; superconducting fault current limiter; fault current limiting resistance; fault detection time

Study on adaptability of polymer flooding technique

in reservoirs with different

water-wash degree

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Abstract—The lab experiment with different water-wash natural cores for polymer flooding adaptability is established based on coring interpretation data of xing12-3-jian3222 well of Pu I3 layer in Daqing oil field. The water displacement efficiency of the cores are 70□80%,4□□50% and 10□20% respectively. Besides, feasibility of reducing residual oil after water flooding with the high concentrated and high molecular mass polymer is analyzed. Displacement effect of polymer is studied with 3 parallel cores by commingled injection and separate production. The results indicate that the adsorption of high molecular mass polymer and injection pressure gradient are affected more markedly by concentration than molecular mass in different water-wash degree reservoirs. Residual resistance factor and displacement pressure gradient increase with the concentration increase. The residual resistance in strong and moderate water-wash reservoirs can be met, and the injection capacity in weak water-wash reservoir is good with the polymer of 1.3g/L $25\times10_4$ molecular mass. The parallel cores displacement results show that the profile controlling methods before high molecular mass polymer flooding can adjust the injection profile of moderate and weak water-wash reservoirs effectively and the producing degree are enhanced. The recovery efficiency is enhanced 21.12% when 1/3 profile modification radius with compound-ion profile control agent and $25\times10_4$ molecular mass polymer with 1.3g/L used, which improved 4.06% than 0.64PV polymer slug alone.

Keywords—water-wash degree; polymer flooding; residual resistance factor; profile controlling; recovery percent

Decoupled State-Feedback and Sliding-mode Control for Three-Phase PWM Rectifier

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Abstract—A nonlinear mathematical model of three-phase voltage source PWM rectifier is established in the dq rotating frame. Aiming at the poor dynamic performance of conventional PI controlled three-phase PWM rectifier, a control system with double close-loops of voltage and current is designed based on the mathematical model of 3-phase PWM rectifier. A sliding-mode control algorithm on synchronous rotating reference frame for the out-voltage-loop is proposed. Then, a decoupled state-feedback control method is applied to the current loop. The whole system is modelled and simulated between the proposed method and conventional double PI control. The results show that the proposed controller confers faster dynamic performance and robust performance.

Keywords-AC-DC power conversion；voltage control；Sliding-mode control；unity power

Research on earth potential interference and antiinterference measures

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Abstract—The cause and damage of earth potential interference are analyzed and studied in this paper， especially influence by nonuniform distribution of earth potential in power plant and transformer station， such as interference by impulse voltage caused by lightning current and big power frequency current， arc interference caused by earth short circuit in transformer station. On the basis of research on cause， approach and modus of interference， technology measures are proposed.
Keywords—earth potential distribution; earth potential interference; anti-interference measures

More Residual Crude oil Can be Displaced out by Micro-Forces in Chemical Flooding

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Abstract—Experimental results indicate that the displacement efficiency (De) after flooding by driving fluids with and without elastic characteristics is different at the same pressure gradient. Macro forces cannot explain the difference of the De by different driving fluids. Therefore, the changes of micro forces acting on residual oil by driving fluids with elastic properties and the increase in the De are analyzed. In this paper, through experimental analysis, the influence of elastic characteristics of the driving fluid on De is analyzed. The effects of change in micro forces on residual oil are analyzed. This micro force does not change the pressure gradient and mainly acts on the protruding portion of different types of residual oil, causing the protruding portion to change shape and mobilize or migrate. The results on

visualization core models confirm the above calculation and
analysis, the De after flooding by fluids with different elastic
properties are given.
Keywords—Residual oil, Displacement oil efficiency, Micro-Forces, Chemical Flooding, Crude oil

Design, Control and Simulation of a Non-linear-Load Current Disturbance Generator with Energy Feedback Technology

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Abstract— This paper deals with a high-powered, low-loss and digital current disturbance generator. It can produce harmonic current, active current, inductive reactive current and capacitive reactive current, so it is able to simulate kinds of actual industrial situations. By using energy feedback technology, the generator feeds the power consumed by the current disturbance back to the grid. Thus, it can save a lot of energy, and the lab will need less power capacity. The unit of feedback can also compensate the harmonic current and reactive current, so the generator has little impact on the power grid. Simulation result verifies the correctness of analysis and the validity of the project.
Keywords— Current Disturbance, Energy feedback, Control, Energy Conservation

Research on Rapid Power Grid Synchronization

Parallel Operation System

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Abstract—A multi-functional system is proposed in this paper, which adopts high power controllable turn-off power transistors as the core of its converter and adopts the technology of sine pulse width modulation (SPWM) to control the opening and closing of them. It can be used for rapid automatic power grid synchronization, ring net parallel operation, voltage boosting, current boosting , and other functions. In this paper, the multifunctional system and its applications are also discussed.
Keywords- power systems; rapid parallel operation; rectifier; inverter; SPWM

Analysis and Study for the Mechanical Characters of the High-Frequency Chopper Cascade Speed-Adjustment Driver

Abstract – The high-frequency wave chopper cascade speedadjustment driver system has an overt advantage on energy saving and improvement on high voltage, huge power fan blower and water pump. As a result, It is widely used at lots of technical locale in China. However, for the different control mode with traditional shifting phase burst mode, some changes have taken place on the main circuit and inner characteristic of system .So It is very necessary to analyse and study the mechanical characters of system. In this paper, the radical theory about chopper regulation system is introduced and the relation between input and output of the main circuit deeply analysed. The equations about mechanical characteristic including two available work district of system are put forward .At last, according to the above conclusions, the curve about the mechanical characters of chopper cascade speed-adjustment drive system is painted.

Index Terms – wave chopper; cascade speed-adjustment; mechanical characters; duty ratio

Numerical simulation of mixing mechanism in aerial dynamic field of new type combustion system

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Abstract—In order to solve the problems of oxygen deficient combustion and poor mixing effect of in W-flame boiler, a new type dynamic field was put forward, in which the straight flow of tertiary air-ejecting was changed into the swirl flow, and the cold model of boiler flow filed was simulated by FLUENT in this paper. For the purpose of assessing the mixing mechanism of the new type aerial dynamic field, a concept of mixing factor was introduced and the model to describe the mixing behavior was established according to particle's velocity turbulence, density distribution and relative velocity to the whole space. Simulation results show that the new type aerial dynamic field has such advantages as: well entrainment phenomena in the early period, and good mixing effect in the later period, compared with the straight jets of the same velocity.

Key words: W-flame boiler; tertiary air; aerial dynamic field; mixing factor; numerical simulation

Dynamical Simulation of Laboratory MicroGrid

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Abstract—A MicroGrid can increase the reliability of energy supplies by disconnecting from the grid in the case of network faults or reduced power quality. The techniques that have been investigated to control MicroGrids in both modes are summarized as well as those proposed to maintain stability during the transitions from one mode to the other. This paper □□□□□□introduces the MicroGrid planning structure in Shandong Electric Power Research Institute (SEPRI) and discusses the various feasible control approaches used and presents for MicroGrid. Then, based on modeling different types of distributed generations and energy storage equipment, the SEPRI MicroGrid model was simulated with several operating modes under peer to peer control strategy. The importance of an energy storage to assist stability during transition between the operating modes is emphasized.

Keywords-□□□□□□□□□□; peer to peer; Dynamical Simulation;

Special Electro-hydraulic Valve □□□□Hydro-viscous Drive Used in Thermal Power Generation Plant

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Abstract—When applied on the pulverized coal blowers or water-feeding pumps which are driven by huge electrical motors in one thermal power generation plant, acting as a kind of the soft start-up device, Hydro-Viscous Drive(HVD) can help to save a lot of energy. The principle and structure of HVD is introduced in the paper. Through theoretical analysis of the HVD set start-up steadiness, the conclusions were obtained that the non-linearity of the pressure performance curve and dynamic pressure instability of the pilot-operated electro-hydraulic pressure relief valve, which is used for the HVD speed regulating purpose and usually works within micro flow-rate and low oil pressure state, are the main causes of the poor start-up steadiness. So a special speed regulating valve for HVD set is developed, with which the start-up steadiness of HVD set is much improved.
Keywords—energy saving, soft start-up, HVD, special speed regulating valve, oil film

New Method of Saving Energy for Automobiles

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Abstract—When the coaches and trucks are moving, the heads of the automobiles endure the strong press of the wind. If the wind can be used to generate the electricity, it will save a lot of energy. Based on the idea, an experiment was designed in this paper. A model automobile was modified to produce and store the electricity. The experiment results show that the method is feasible to save energy for automobiles.
Keywords— saving energy, automobile, wind power

A Prototype of Flywheel Energy

Storage System

Suspended by Active Magnetic

Bearings

with PID controller

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Abstract—In this paper, a prototype miniature of flywheel energy storage system is developed. The structure and dynamics characteristic of the flywheel energy storage system are discussed. The system consists of a disk-shaped rotor, active magnetic bearing (AMB), PID controller, displacement sensor and cabinet, etc. The rotor is suspended by three active magnetic bearings (AMB). A mathematical model of the system is deduced and each degree of freedom motion is treated separately for the control system. PID control is applied to the AMB. The experiments have been carried out to measure the dynamic response of the rotor to direct disturbance. The results indicate that the PID controller possesses good performance.
Keywords—energy storage; flywheel; active magnetic bearings; PID control

Exergy Transfer Analysis of Thermal

Driving Oil

Process

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Abstract—The signification of the exergy transfer phenomenological equation for multi-potential fields is introduced, and the concept of field influence factor of exergy transfer resistance is defined. Based on the analysis of the field structure for the thermal driving process, the exergy transfer analysis target is advanced, including the driving work(exergy), driving power(exergy flux), driving resistance(exergy resistance) and the field influence factor of exergy transfer resistance. In the end the aforementioned is illustrated with the hot water driving process. The numerical simulation result can reasonably illuminate the mechanism of some technical measures, such as high temperature decreases viscosity, high pressure gradient increases driving force, high pressure and low water rate decreases driving resistance.
Keywords—thermal driving; exergy; exergy analysis; exergy transfer analysis; multi—field cooperation

Discrimination of Reservoir Driving Mode Based on Exergy Transfer Theory

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Abstract—Thermodynamic essence of reservoir driving process is studied, which is a typical exergy transfer problem that uses multi-potential fields as driving source to achieve the purpose of oil displacement. The discrimination of reservoir driving mode is derived on the basis of the establishment of driving potential field exergy transfer, which includes driving work (exergy), driving power (exergy flow density), the driving work rate and the driving power rate. Finally with the two-dimensional axial symmetry of hot water flooding process as an example, the main driving mode is distinguished.
Keywords-reservoir seeping; exergy; exergy transfer; field cooperation; driving mode

Design of Adaptive Increment Controlled Hybrid-type Active Power Filter

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Abstract—HAPF (HAPF) is composed of an active power filter (APF) and a passive power filter (PPF), for integrated harmonic compensation of unbalanced or nonlinear loads and compensation of reactive power. The PPF tunes at special harmonics and compensates reactive power to improve the power factor. The APF is composed of two full controlled three-phase PWM inverters. It traces harmonic current on system line, and works as a controlled voltage source, injecting current into system to eliminating harmonic current generated by nonlinear loads. In structure design, the PPF supplies fundamental series resonance brunch for APF to avoid enduring fundamental voltage. It lowers the rated capacity of APF and reduces the volume of APF. The adaptive increment control method is employed, which is simple and fast responding. It enables the control of APF independent of the parameters of PPF. It makes the filter flexible to harmonics, and overcome the effect of input current of APF. Simulation and experiment have been carried out. The result shows that the design achieves expected goals. The harmonic in system is reduced below expect level, and the filter is fast response and adaptive to the harmonic current.

Keywords-Hybrid active power filter; adaptive increment control; PWM; harmonic; close loop control; hysteresis; currentinvertor

Testing Anti-frozen Characters of Air-water Plates Heat Exchangers by FLUENT

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Abstract—Physical structure are compared between air-water were obtained, which can provide theoretical help for the
plate heat exchangers (PHE) and tube-fin type heat exchangers in design and the manufacture of the air-water PHE.
this paper, which show that the air-water PHE has the stable character in handling the cold air below 0 because of its compact and knock-down structure. Then the courses of water being iced in the motionless state and in the flowing state were simulated by the CFD software Fluent with the model of Solidification/Melting. The results show that the corrugated passages of the air-water PHE are anti-frozen structures for flowing water, which is appropriate to the air-water plate heater's optimization and manufacture.
Keywords- air-water PHE; anti-frozen; simulated ;FLUENT

Design and Performance Analysis of High Power Static 400-Hz Supply

Abstract- Static power converters are used for many applications, like frequency converters for motors, uninterruptible power supplies(UPS's), general power supplies, and also with ground power units(GPU) for airplanes. This paper analyses the performance of high power static 400Hz supply system. In such a system, the topology is a three singlephase H-bridge inverter with a multi-limb output transformer with Star-Star connection. In this paper, we compares two ways of control. In the supply system, we adopt a fully digital control method. The method can be used for inverter, which is used in 400Hz aircraft ground power units. In order to improve the

output voltage’s waveform. It uses a harmonic controller for controlling the output voltage’s low order harmonics. We test on a 90-kVA 400Hz GPU prototype based-on a 16-bit fix-point DSP, which show good performance of the proposed method feeding linear or unbalanced load.
Keywords- Static power converters, Harmonic Controller, THD, Digital Control

Study on percolation law in low permeability reservoir of deformble media

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Abstract—According to the basic idea of fluid-solid coupling theory, combining percolation mechanics with rock-soil mechanics and considering threshold pressure gradient and fluid-solid coupling character of low permeability reservoirs, a numerical model is established, which can describe the fluid-solid coupling character in saturated deformable low permeability reservoirs and can be solved by coupling numerical method combining finite difference with finite element. The percolation law for deformable medium in low permeability reservoir is studied. The typical examples indicate that the dynamic variation of petrophysics parameters, stress-strain and their effects on producing performance can be predicted by this method. Through comparing the result of the numerical simulation with the one which doesn’t consider the fluid-solid coupling effect, it is seen that the fluid-solid coupling effect of low permeability reservoirs can not be neglected.
Keywords-low permeability reservoir; deformable media; percolation; mathematical model; numerical simulat

Structure Research and Design of Brushless Doubly-fed Machine

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Abstract—Having advanced in recent years, Brushless Doubly Fed Machine (BDFM) becomes a novel AC variable frequency control machine which has a broad vista of application in wind power generation system. Researchers focus on machine structure presently. Based on accurate analysis of electromagnetism relation, this paper firstly presents double-cage stator core structure in order to improve insulation of power winding and control winding. Non-salient pole rotor core and hidden end collar new rotor structure is also presented. Magnetic field of the new structure BDFM is analyzed and calculated by ANSYS. The results show that new structure obviously advances efficiency of rotor magnetic field pole-number conversion and improves machine operating performance.

Keywords-BDFM; double-cage stator core structure; non-salient pole rotor; hidden end collar rotor

PFC research based on the new integrated controller

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Abstract—This paper introduces the new PFC integration control chip-UCC28019, provides the PFC circuit based on UCC28019 and the essential circuit parameter computation method. The actual power factor is 0.998 through testing a 350W prototype, this paper presents the experimental waveforms. The experimental results have proved that the PFC circuit has these characteristics: simple circuit, conveniently to debug, high power factor, complete protection features, reliable and stable work.
Keywords-UCC28019 ; PFC ; regulator design

Heat Transfer Performance of Phase Change Heat Storage with Helical Coil Structure

Abstract—In view of the fact that solar energy is difficult to match the heating requirements of architecture, the phase change heat storage with helical coil structure is designed, in which paraffin is chosen as phase change medium. The heat performance of the storage unit under four different kinds of operation conditions is researched by experiment. By analyzing the moving law of phase change interface in the melting process of phase change medium, the optimized design of heat accumulator is proposed. A fitting formula is also obtained by introducing non-dimensional parameters to provide the foundations for engineering application.
Keywords-phase change; heat accumulator; heat storage; helical coil

Optimum Structure of Regenerator in Standing-wave Thermoacoustic Refrigerator

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Abstract—The purpose of this paper is to study the optimal size for a regenerator consists of circular tubes in a thermoacoustic refrigerator. The maximum cooling load per unit area is taken as the objective, and the optimal circular tube inside radius is obtained respectively. The effect of temperature gradient, wall thickness of circular tube, angular frequency and phase difference on the optimal circular tube inside radius are studied. The results obtained herein can provide some theoretical guidance for the optimum design of the regenerator in a thermoacoustic refrigerator.

Keywords-Circular tube; Cooling load; Regenerator; Thermoacoustic refrigerator

Thermoacoustic refrigeration device

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Abstract—A thermoacoustic refrigeration device (TAR) includes an acoustic wave generation device arranged directed to the channel of a hollow tube, and a regenerator provided at a predetermined position in the channel of the tube. A temperature gradient is obtained across the regenerator by an acoustic wave emitted from the acoustic wave generation device. Therefore, a TAR realizing a gas stirling cycle approximating the Carnot cycle which is an ideal gas cycle, and realizing simplification of the structure and high efficiency of the device is provided.

Keywords- Thermoacoustic refrigeration; Stirling cycle

A Novel Fast Speed Regulation Control Strategy for VVVF in HVF

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Abstract: This paper introduces a new fast speed regulation

control strategy for HVF (high voltage frequency-converters) to facilitate the squirrel cage AC-motor reacting possibly fastest to the speed commands without over-current and instability. The basic principal is to regulate the frequency to follow the target currents which again follow the desired torques determined by the mechanical character of the load using the PI controller. Other aspects like electromagnetic torques instability and different loads are also taken into consideration. The result from simulation by PSCAD shows that by using this strategy, the motor can response to the speed commends much more quickly.
Key words: high voltage frequency-converters; speed regulation control; electromagnetic torque; target current

Applying "Thermal Storage Cooling Tower" to Shift On-Peak Electric Energy Demand of Underground Commercial Building

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Abstract—Cold storage system called "thermal storage cooling tower" which works with cooling water of air-conditioning system is introduced. By setting packing materials above the air conditioning pool of underground commercial building, a new type heat and mass transfer device is developed to replace the original combination of cooling tower and thermal storage tank. Running the equipment with proper control strategies, the performance of the chiller will be improved and the on-peak electric energy load can be shifted. With time-of-use electricity charging rates, the approach can save expenses. Such system has been applied in a building located in Shanghai city. A related simulation has been performed based on the experimental data of

the engineering. The results verify the conclusions of previous analogous research work.
Keywords-On-peak energy demand; Underground building; Thermal Storage; Cooling Tower

Improved Efficiency Optimization for Vector Controlled Induction Motor

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Abstract—In order to get good dynamic performance, induction motor adopts constant rated flux for vector control in servo system. However the motor has lower efficiency especially at light load. If the motor controlled with adjustable flux for maximum efficiency, its dynamic performance can not meet the demand of the system. The research is to solve the mutual conditionality of dynamic rapidity and high efficiency. A flux regulator has been added in vector control. It is controlled by speed and requiring torque, and timely adjusts flux to keep good dynamic performance and high efficiency. The simulation results of a case verify the validity and feasibility of the proposed approach.
Keywords- Induction Motor　Dynamic Performance　Vector Control　High Efficiency

Integrated and Cost-effective Design Utilizes LNG Cryogenic Energy for Power Generation

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Abstract—Recycling valuable LNG cold energy released in the gasification process for power generation is the main cold energy utilization mode in present LNG receiving terminals, it can reduce the cost of LNG regasification, relieve CO2 emission, and provide electric power demand for receiving terminals. Aiming at the current low exergetic efficiency of the Rankin and Directexpansion system in LNG receiving terminals, based on the existing technology and demand of receiving terminals, a new integrated and cost-effective design is carried out to recycle the LNG cold energy to power generation in this paper. In the improved processes, LNG cold energy is employed to cool chilling water to meet the cooling demand from air-conditioning, air compressor and intake gas for gas turbine of LNG receiving terminals. On the one hand, it saves 1124kW power consumed by refrigerator to produce chilling water; on the other hand, low temperature overplus heat cooled by circulating cooling water in gas-fired power plant is used to heat natural gas and propane working fluid, which result in the total expansion work power of natural gas and propane turbine increased by 2558kW, and the natural gas and propane thermal efficiencies are increased by 55.2% and 22.5%, respectively. Compared with the original processes, about 61.5kW power is recycled per LNG ton in the new Rankin and Direct-expansion power generation technique, the energetic and exergetic efficiencies are increased by 38%, meanwhile it gains annual economic benefits of 30.92 million Yuan for the LNG receiving terminals.

Keywords-LNG; cold energy; power generation; Rankin; Direct-expansion; exergy

Study on the Application of Weathering and Cold-formed Steel in Transmission Tower

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Abstract—Application of weathering and cold-formed steel in transmission lines can reduce steel consumption and environmental pollution. Some advances in studies on the weathering and cold-formed steel in transmission tower are introduced. Firstly, corrosion-resistant tests of weathering steel samples under different simulating technical atmospheres were carried out separately for 240 hours. It shows that the corrosion degree of joint samples is higher than that of single chip samples, and the corrosion-resistant performance of weathering steel is superior to common carbon steel. The corrosion-resistance of weathering steel meets with the requirement of transmission tower. Secondly, experiments and finite element analysis for coldformed angles and a 220kV prototype tower were completed, the stability coefficient fitting curves as well the modification formulas of slenderness ratio for cold-formed members were determined. Ultimate loads calculating by the fitting curve were well agreed to the experimental values, especially for the members with small slenderness ratios. Weight of cold-formed steel tower can be reduced by more than 5% percent after considering the strength enhancement. Cost of weathering and cold-formed steel transmission tower is nearly equivalent to that of hot-rolled steel tower with hot galvanizing. So application of this new style steel can bring great social effects and economic returns. The research results provide important reference to the application of weathering and cold-formed steel in transmission tower.

Keywords-weathering steel; cold-formed steel; bolted joint; corrosion-resistant test; prototype test; transmission tower

Study of Energy-saving Pulse Power for WEDM Based on Pulse Width Modulation

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Abstract: The energy efficiency of traditional pulse power for Wire Electrical Discharge (WEDM) is less than 25% because of the use of current-limiting resistance. The new type of energy-saving resistor-less pulse power proposed in this paper employs the structure of a dual-arm power amplifier, the strategy of single-arm ulse idth odulation (PWM) and the control mode of cutting off long-time short circuit. Heat generated by current-limiting resistance and useless power consumption caused by long-time short circuit is avoided, and therefore the energy efficiency is increased.
Keywords: WEDM; Energy-saving Pulse Power; PWM

Using Artificial Neural Networks for Representing the Brake Specific-Fuel Consumption and Intake Manifold pressure of a Diesel Engine

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Abstract— It is very common that diesel engines are equipped with Exhaust Gas Recirculation (EGR) and Variable Geometry Turbo-charger (VGT). Due to more and more stringent emissions laws and high pressure on fuel economy, new technologies, such as, variable valve actuation, are introduced to diesel engines. The additional degree of freedom caused by the new technologies will cost ECU and increase the complexity of the mapping and calibration. Therefore, neural networks are needed to represent intake manifold pressure and BSFC. On the other hand, in the general air-path control, intake manifold pressure and the break specific fuel-consumption (BSFC) are important variables. It is essential that they can be represented by neural networks. In this paper non-linear autoregressive exogenous input (NLARX) neural networks are used to represented the intake manifold pressure and BSFC, respectively. It is shown that NLARX neural networks could represent intake manifold pressure and BSFC quite well.
Keywords-BSFC; variable valve timing; intake manifold pressure; neural networks; NLARX

13 Mode Fuel Benefit Investigation Using Variable Valve Timing in a Heavy Duty Diesel Engine

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Abstract— Variable valve actuation in heavy duty diesel engines is not well documented, partly because of diesel engine nature, such as, unthrottled air handling, which gives little room to improve pumping loss; a very high compression ratio, which

makes the clearance between the piston and valve is little when the piston reaches the top dead center. It is a long time that diesel engines are running by EGR and VGT. The goal of this research work is addressed the issue about how much fuel benefit diesel engines at 13-mode cycle could be achieved using variable valve timing in a heavy duty diesel engine. Late inlet valve closing strategy will be used. In order to see how much fuel efficiency could improve in addition to EGR and VGT, EGR and VGT are fully controlled in a closed-loop. This paper examines fuel improvement in different speeds and torques. Finally, we could see that 3.28% BSFC benefit at 13-mode cycle could be achieved. The reason of this benefit is that fixed valve lift engine makes a compromise between high speed engine performance and low speed fuel economy, late inlet valve closing optimizes valve timing at each engine torque and speed.
Keywords-BSFC; variable valve timing; 13-mode test; late inlet valve closing; valve lift

A research of game-based bidding model for green electricity in competitive power market

Abstract—The voluntary purchase mechanism of green electricity and the trading mechanism of green certificate are restricted by the economic development level, customers' environmental protection consciousness, etc. In this paper, the game-based competitive bidding model of green electricity and conventional power (coal-fired power) is constructed. The green electricity is inferior to the conventional power because of the restriction of cost and scale under the present bidding system without regard to the environmental cost. Suppose there's financial subsidy or transfer payment for the green electricity from the government or the government increases the emission cost of conventional power, we extend the above bidding model. The result shows that the green electricity can bid in the competitive power market.
Keywords- green electricity; power market; bidding mechanism; game model

Modeling and Simulation of the Low-Pressure Rectification Column in an IGCC Power Plant

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Abstract—The technology of Integrated Gasification Combined Cycle (IGCC) is one of the most promising power producing and coal utilization types. A typical IGCC power plant mainly consists of an air separation unit, gasification system, and the combined-cycle unit. This paper closely investigates the upper part of the rectification column, which is the core of the air separation unit. The first principles mathematic model of the column is firstly developed, and the pressure, temperature and static liquid nitrogen, oxygen and argon concentrations in the upper column are presented. Starting from the steady-state, various step changes of the mass flows are introduced to simulate the dynamic characteristics of the system.
Keywords- IGCC; air separation unit; rectification column; modeling and simulation

Ecolo ical Sound Operation of Cascade Reservoirs on Lower Yalong River

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Abstract—The research progress of ecological sound operation of reservoir is Summarized into two aspects simulation method and optimization method. Through analyzing the decisive role that flow regime plays in the river ecosystem, an effective way to realize the harmony between human and nature by operating a reservoir to control the flow regime is found out. On Lower Yalong River of China, based on the rational flow cross-sections choice according to the location and regulating ability of each reservoir, a number of flow variation control schemes are presented with respect to the ecological requirement of these two flow control points. Then, a long-term optimal operation model is established and solved to maximize the total output of power generation of the cascade reservoirs . The total power generation amount and reservoir release discharge process corresponding to each flow variation control scheme are obtained. These influences on energy output of each hydropower stations are analyzed and compared. Moreover, a power loss index for ecological water demand is defined to quantify the influences on total power generation amount of different flow control schedules.

Keywords- cascade reservoirs; ecological sound operation; natural flow regime; optimization

Research on Diesel-water coal slurry blends Combustion on Diesel Engine of Generating Unit

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Abstract On a diesel engine of generating unit, investigated the control strategy of the diesel-water coal slurry blends combustion and the speed of the diesel engine, and developed an electronic control unit. The experimental results show that this control strategy can limit the engine speed, output voltage and frequency of the generating unit to a regulated range, and keeping them steadily.
Keywords-component diesel engine generating unit diesel-water coal slurry blends control strategy

Design CEMS For Flue Gas From Thermal Power Plant

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Abstract—Continuous Emission Monitoring Systems (CEMS) generally refers to a packaged system of gas analyzers, gas sampling system, temperature, flow and opacity monitors that are integrated with a data acquisition system to demonstrate environmental regulatory compliance of various industrial sources of air pollutants. CEMS are useful tools in gathering process emissions data for environmental compliance demonstration and process control and optimization. Accurate, reliable emission monitoring can be tricky. Probes must be designed and built to provide reliable service without plugging or corrosion. The sample transport system must deliver a representative sample to the analyzers without sample loss or degradation, and the analytical system must provide reliable and unbiased results taking into account any interferents present in the gas stream. This paper will mainly design a set of CEM system for flue gas from thermal power plant.
Keywords—Continuous Emission Monitoring System (CEMS); flue gas; thermal power plant

The comparisons of Selective Catalytic Reduction of De-NOx on Iron -based materials

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Abstract: Elementary studies of different catalysts on the fluidized bed are done based on iron and iron oxides in selective catalytic reduction (SCR). Under different temperatures and catalysts, there are distinct conversions. This paper compares the conversion of Fe、Fe_2O_3 and Fe_3O_4 within a certain temperature range. The result indicated that the iron oxide has some activation of De-NOx , in particular the maghemite ， the conversion of NO_x on the pure maghemite reaches 91% at 250℃
.

Key words: De-NOx; Fe_2O_3; Fe_3O_4; SCR; XRD; ammonia; mössbauer

Research on new fuels from biomass

The challenge from the hydraulic and tribological point of view

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Abstract— The present paper will give an introduction to the work within the Cluster of Excellence (CoE) “Tailor-Made Fuels from Biomass (TMFB)”, funded by the German research foundation to research on fuels from biomass for the next generation. The fluid properties of these new fuels differ a lot from conventional fuels. The paper will show the approach for

finding technical solutions to deal with these challenges. The critical aspects in the injection systems for combustion engines will be presented. Furthermore the investigations to characterise the new fuels will be explained. One of the focuses is set on the fluid properties under high pressure conditions. The test rigs that had to be designed for measuring viscosity and bulk modulus will be presented. The design of a tribometer will also be presented to study the interaction between fuels and surfaces for mixed lubrication condition. The investigations on the properties of the new fuels are needed to parameterise simulation models of the injection system which will be set up parallel to the experiments.

Keywords – fuels from biomass, tailor made fuels, tribological investigations, high pressure fluid properties, fuel tribometer

Investigation of Wind Farm on Power System Voltage Stability Based on Bifurcation Theory

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Abstract—Voltage stability has been well investigated for the traditional power system using bifurcation theory since two decades ago. This paper studies the impact of wind farm on voltage stability of power system with and without reactive power compensation devices. The static reactive compensation devices including static capacitor banks and static var compensators (SVC) are used to improve the maximum loadability. The continuation method for power flow is used to obtain the system PV curves and determine the maximum loadability. The type of instability could possibly be of either Hopf. bifurcation or saddle node bifurcation. The equivalent wind farm model is established to replace the whole wind farm with a high number of wind turbines. The IEEE 14 bus benchmark system is used to demonstrate the reactive power compensation devices to support the voltage stability after wind farm integration into a power grid.

Keywords—Voltage Stability，Hopf Bifurcation Wind Farm，Static Reactive Compensation

Research of the Rotational Effects on the Aerodynamics Characteristics of Horizontal Axis Wind Turbine

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Abstract—The flow field of the NREL phase VI horizontal axis wind turbine has been modeled with a full 3-D steady/unsteady RANS approach. In the investigations a full Navier Stokes code FLUENT is used instead of engineering models. The calculations are compared with the measurements of the Unsteady aerodynamic experiment at the NASA Ames wind tunnel at wind speeds between 8m/s and 15m/s in steps of 1m/s for different angles of attack and stalled conditions. Computed pressure distributions and aerodynamic coefficients and the performances evidence the presences of augmented lift and stall delay for the span sections at r/R= 0.30 and r/R= 0.47.

Keywords—rotational effects;Wind turbine;CFD; augmented lift; stall delay; performance

Gaisfier Following-Based Coordinated Control for the IGCC Power Plant

Abstract- This paper proposes a gasifier following-based coordinated control strategy for the IGCC power plant. The gasifier and the combined-cycle model are integrated to form the IGCC power plant model and a load and pressure controller is designed to reduce pressure variations with load changes. Simulation results show the good load-tracking property and satisfactory control performance of the proposed controller.

Keywords— IGCC power plant; coordinated control system;
gasifier; gas turbine

Trend forecast for the influence of the Three Gorges project on the water environmental capacity of Dongting Lake

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Abstract—Based on a series of research works on water environment monitoring and water resources protection in Dongting Lake, this paper discusses the strategy of sustainable development about the requirements of water function and protection objectives, and quantitatively analyzes the variation trend of water environmental capacity of major pollutants before and after the running of the Three Gorges project. It is analyzed that the water environmental capacity of Dongting Lake can increase in dry season and the value can decrease in a small scope in wet season, due to the remarkable change of the hydrological conditions caused by the running of the Three Gorges project.

Keywords—Dominant function; water environmental capacity; impact; Dongting Lake; Three Gorges Project

Simulation and Experimental

Research on Shunt Active Power Filter

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Abstract—Active Power Filter (APF) is one of the effective means to eliminate power harmonics and improve power quality, and it has broad application prospects. The shunt APF and its structure and working principle are studied in this paper, and existing circuit topologies of shunt active power filter are introduced. A three-phase threewire APF system is simulated first with analysis of simulation results, then a 3kW shunt APF device with the MCU-DSP-based control circuit is designed and assembled. And the analysis of the results of commissioning proves the correctness of design and theory.

Keywords- Active Power Filter (APF); Instantaneous Reactive Power; Harmonic Suppression

Experimental Study on Microwave-Induced NO Decomposition on Activated Carbon Bed

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Abstract—The reduction of NO was successfully demonstrated in this paper to develop a NO removal process by microwaveinduced decomposition method for combustion flue gas. The absorbent of the microwave energy used in this experiment was activated carbon. Simulated flue gas containing NO gas was passed through the activated carbon bed and microwave energy was then applied for decomposition of the NO. It was found that more than 96% of NO was decomposed to nitrogen (N_2) under the microwave irradiation. Activation energy of the thermal decomposition was lower than conventional decomposition and microwave could play a role of catalyst in the reaction. Therefore this method is surely expected to be useful for the prevention and reduction of air pollutants.
Keywords—denitrification;flue gas;microwave;activated carbon; experimental study

Study on the Desulphurization Characteristics of Industry Alkaline Wastes during Coal Combustion

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Abstract—The desulphurization characteristics of industry alkaline wastes and limestone were studied by means of flue gas analyzer and the high temperature tube reactor. Pore structure and desulphurization product characteristic were investigated respectively by mercury porosimeter and XRD diffraction technology. The reasons why wastes and limestone hold the

different desulphurization capability were deeply discussed. The result shows that white clay and carbide slag could capture the release of sulfur at 800~1100℃. Salt slurry and red mud could capture the release of sulfur at first stage at 800~900℃. But when the experimental temperature rises to 1000℃, the sulfur capture abilities of them depress. Pore structures of waste are higher than that of limestone. This makes the sulfation reaction goes further. To sum up, wastes have better sulfur capture ability.
Keywords—industry alkaline waste; desulphurization; pore structure; XRD; limestone

Study on Factors Affecting Early Strength of Paste-Like Backfill Material*

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Abstract: Mining with backfill is one of main issues of green technique in coal mine. Early strength of backfill material is a key to backfill mining technique. The influence of cementing material type, density of slurry and content of sialite on early strength of paste-like backfill material is studied experimentally. The result shows that strength of backfill material with sialite is higher than that of backfill material with ordinary portland cement; 8-hour strength of paste-like backfill material varies approximately linearly with both density of slurry and content of sialite; Density of slurry and content of sialite each affect nearly equally the 8-hour strength of paste-like backfill material.
Key words: paste-like backfill material; early strength; sialite; density

Effect of hydration conditions on lime structure and SO_2 removal characteristic

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Abstract—Effects of two hydration condition parameters (initial hydration water temperature and hydration time) on hydrated lime structure and SO_2 removal characteristic was studied. The optimum parameters were obtained experimentally, which were 70 ℃ for initial hydration water temperature and 60 minutes for hydration time.
Keywords—hydration condition; lime structure; SO_2 removal

Investigation of the performance of Fe-based catalysts for NOx reduction with NH_3

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Abstract— Selective catalytic reduction (SCR) with ammonia is a well-proven technique for NOx removal in power stations. It is very effective in NOx reduction with an efficient up to 98%. However, the current SCRs have a limitation on operation temperature and a narrow operation temperature window. Metal Fe based catalysts were used in the investigation to improve the low temperature performance of NOx conversion. The temperature range studied was between 150 °C and 350 °C with an interval of 50 °C. The honeycomb catalysts were prepared by an impregnation method. The study also included characterization of catalysts by XRD, H_2-TPR and SEM methods.
It is found an increase in metal Fe content from 2 to 6 % wt. offers an improvement in the catalytic performance. However, a further increment in Fe content will result in a decrease in its performance. More than 90 % NOx conversion rate could be

achieved over the Fe-based honeycomb catalyst at a low temperature by doping the catalysts with Ni and Zr at different weights. Among all the catalysts studied, the mixed metal catalyst of Fe-Ni-Zr is found the most potential one, not only because of its higher NOx conversion rate at a low temperature, but also because of its wider operation temperature window.
Keywords- NH_3-SCR; ceramic honeycomb; Fe-based catalysts; Low temperature

Doubly Fed Induction Wind Generator Model and Its
Operation Investigation

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Abstract—A Doubly-Fed Induction (DFIG) wind generator dynamic model is developed in PSCAD. Then a novel active power control strategy based on the indirect speed control is introduced to implement the power control tasks and the limits of these controls are also discussed. The novel strategy ensures that wind power generators without wind speed measurement can achieve the balance control and maximum power tracking to perform active power control tasks constrained by the available wind. In the simulation study, a single-machine infinite bus system with a wind turbine rated at 2MW is conducted to demonstrate the behaviors of the generator in both steady state and transient state. The simulation results show a good performance of the dynamic model and the effectiveness of the control strategies.

Keywords-DFIG; direct power control strategy; power control tasks; control strategy.

Coal Water Mixture Preparation
Technology and
Application in Replacing Oil to
Generate Electricity

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Abstract— This paper analyzed coal consumption status in China. The preparation technology and special equipments for Coal Water Mixture are introduced. The application of Coal Water Mixture used to replace oil to generate power is given.
Key words— Coal Water Mixture; Slurry Preparation; Replace Oil Generating Power

Study on removal of SO_2 for power plant

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Abstract SO_2 of boiler flue gas can be absorbed by Pyrolusite to produce $MnSO_4$. The experiments of removal of SO_2 were carried out in the absorption tower of padding. The pH value of pulp is controlled by rhodochrosite. The results showed that the absorptivity of SO_2 was above 95%, absorptivity of flue dust was above 90% and the by-product technical grade $MnSO_4$ was produced. The technique is a new technology on: removal SO_2 of boiler flue gas;. waste treatment.
Key words boiler flue gas pyrolusit rohodochrosite flue gas desulfurization(FGD) manganese sulfate

Nanofiltration and Ion-exchange Alkalinization for Water Conservation and

Zerodischarge in Circulating Cooling Water System

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Abstract—Pipe corrosion, scaling and microbial growth in the circulating cooling water system cause many problems which threat the stable and safe operation of power plants. In order to solve these problems in circulating cooling water system, this paper puts forward an innovative method, nanofiltration and ion-exchange alkalinization technology, for water conservation and zerodischarge and describes the principle and practice of this technology to ensure that the concentration factor of circulating cooling water can reach up to 10.

Keywords—nanofiltration and ion-exchange alkalinization; circulating cooling water; water conservation; zerodischarge

Instability of Rock-Fill Spur-Dykes Downstream of Hydropower Station and Countermeasures

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Abstract—Breakdown of rock-fill spur-dykes occurs very often in natural streams downstream of hydropower station due to rapid flows. In this paper the laboratory investigations in an openchannel flume have been presented, showing how the stability of the dykes is influenced by the flow downstream of hydropower

station. The main factors, which results in the breakdown of the spur-dykes, are analyzed and the countermeasures against the collapse are summarized. Furthermore, the layout of geotextile soft mattress as a countermeasure against the indirect damage is suggested based on the measurements of turbulent flows around the spur-dyke. Also, modification in cross-section of spur-dykes is proposed as a countermeasure against the direct damage.
Keywords: rock-fill spur-dyke; instability; hydropower station; countermeasure

Simultaneous Removal of Multi-Pollutant by Ozone Oxidation Integrating with Chemical Absorption

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Abstract—In this paper, we focus on the properties of simultaneous removal of multi-pollutant (ozone oxidation and chemical absorption). The oxidation process is modeled employing "full" chemistry and simulated in a perfectly stirred reactor (PSR). For the simulated flue gas stream, the volume fraction of NO_2, NO_3, N_2O_5, SO_2 and SO_3 are 1.48E-4, 1.29E-4, 2.1E-5, 1.6E-3 and 5.8E-7 at the outlet of reactor, respectively. The results compare and show good agreement with earlier experimental findings. The absorption process is analyzed by means of gas-liquid-solid equilibrium theory, chemical equilibrium theory and electro neutrality principle. The results obtained using the analysis shows good agreement with the simulated results employing chemical thermodynamic equilibrium and Gibbs energy minimization theory.
Keywords-Ozone Oxidation; chemical absorption; Multi-Pollutant Removal; Chemical Kinetic Mechanism; thermodynamic

Analysis

Preparation of Oxygen-deficient Ferrite $Fe_3O_{4-\delta}$ from Magnetite and Reducing SO_2 to S_0

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Application SEM to Analysis Formation Characteristic of Soot Aerosol

Emitted from Lump-Coal Combustion in Fixed-Bed

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Abstract: The objectives of this work are to study the formation characteristic of soot aerosol derived from lump-coal combustion in different experimental conditions in fixed bed. A laboratory-scale movable-fixed bed, water-cooled soot aerosol collection system, and electric reactor have been designed and used in the process. Three kinds of coals, sized at 3-5 mm, have been heated in the experiments. The temperature and residence time of gases in hearth has been regulated. Scanning Electron Microscope (SEM) has been employed to measure shape characteristic of soot aerosol samples. The conclusions can be drawn: the diameters of soot aerosol particles are decreased by oxidation reaction with temperature increase; the diameters of soot aerosol particles are increased and the agglomeration reaction are decreased with extension of gases residence time; and more soot particles are agglomerated in highvolatile coal combustion process.

Keywords: lump-coal, combustion, soot, fixed bed, SEM

Dynamics Research on Natural Gas Storage and Transportation by Gas Hydrates

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Abstract—At present, pipeline natural gas (PNG) and liquefied natural gas (LNG) are the main technologies for natural gas storage and transportation. But it is not economic to explore those scattered, remote and limited high well-pressure gas fields by PNG and LNG technologies. So the new technology should be investigated. Natural gas hydrate (NGH) approach is expected to resolve these problems. In this paper, the effects of ultrasonic power, temperature, pressure, and hydrate reaction history on the induction time of NGH (mol percent of methane, ethane and propane are 91.89 %, 5.04 %, 3.07%, respectively) were investigated. The experiments were carried out in a highpressure system with ultrasonic (the frequency 20 kHz an adjustable power 0~150W). The experimental results show that in the ultrasonic system the longest induction time is 2.5 days and the shortest is 0.14 days. While in the quiescent system the longest induction time is 8.5 days and the shortest is 4.9 days. Under the same conditions the induction time decreases with the pressure increase or ultrasonic power increase. And when the ultrasonic power keeps constant, the induction time increases linearly with the temperature increase. In order to investigate the influence of hydrate reaction history on the induction time the rehydrate experiments is done after melt for one night. It is found that the induction time is very short and random, the longest of which is 4 minutes and the shortest is less than 1 minute in the ultrasonic field.

Keywords—ultrasonic; natural gas hydrates; induction time

Selective catalytic reduction of NO by

NH_3 over fresh

and sulfated CuO/□-Al_2O_3 Catalysts

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Abstract—CuO/□-Al_2O_3 granular catalysts were synthesized by the sol-gel method. Performance of the CuO/□-Al_2O_3 catalysts for the selective catalytic reduction (SCR) was explored in a fixed bed adsorption system. The optimum temperature ranges for SCR of NO over the fresh CuO/□-Al_2O_3catalyst are 250□450□. The maximum activity maintains near to 99% at 350□. The operating temperature range is increased on the sulfated catalysts. The oxidation property becomes weak when the catalysts are sulfated. The transient behaviors of NH_3 and NO were also studied; it was found that the SCR reaction was zero order with respect to NH_3 and first order with respect to NO. The sulfation on the catalysts improves the adsorption capacity of NH_3 and reduces the adsorption capacity of NO. The adsorbed of NO has little influence on denitrification activity in the actual SCR process.

Key words: sol-gel method; CuO/□-Al_2O_3; NH_3; NO; SCR

Manganese-based catalysts

supported on titania for

the oxidation of nitric oxide

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Abstract—Manganese-based catalysts supported on TiO_2 were studied for the oxidation of NO to NO_2 in excess oxygen to remove NO from flue gas. Catalysts were prepared by

incipient impregnation, excessive dipping and ultrasonic improved impregnation. The effects of precursor, manganese loadings, preparation method of catalysts and calcination temperature of catalysts on NO oxidation were investigated in details. Mn/TiO_2-10% catalysts made from $Mn(NO_3)_2$and prepared by excessive dipping had the highest NO oxidation. More than 60% NO conversion was obtained at 200under the condition of 500 ppm NO, 3% O_2 and the balance N_2, GHSV=19,200 h^{-1}.
Keywords—*NOx; NO oxidation; Manganese; TiO_2;*

Experimental Research on Fractal Characteristic of Ca-based Desulfurization Sorbents

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Abstract—Based on the fractal theory, two different experimental methods were employed to determine analyze the fractal dimension of the Ca-based sorbents. Fractal dimension of the Pore boundary of the Ca-based sorbents calcinated at various temperatures were measured firstly by using the Scan Electron Microscope (SEM) and the improved box-counting program, the relationship between the pore boundary fractal dimension and temperatures was derived. Moreover, the factors that affect the fractal dimension, such as additive amount and temperature, were studied by using the mercury porosimetric method. It showed that more additives or higher temperature all decreased fractal dimension of the sorbents and both the two methods presented in this paper could effectively determine and analyze the dimension of the sorbents.
Keywords—*Ca-based sorbents; fractal; SEM; calcination*

Numerical Modeling and Experiment

Investigation of A Typical Low-NOx swirl burner

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ABSTRACT—Cold flow field of a typical low nitrogen oxides (NOx) swirl burner were studied by numerical simulation bases on solving three-dimensional (3d) Reynolds average steady Navier-Stocks equations with Realizable k-ε turbulent model which can reflect strongly swirling flow fields more accurately than the standard k-ε model. Different air distribution modes are chosen to be the boundary conditions which are similar to the model test modes and it proved the correctness of the mathematical model by contrasting with the measured data of the test on the model of the burner. The results of the simulation indicated that when the other air velocity magnitude is the same, the different central air has a great effect on the formation of the recirculation zone near the outlet of the burner; the effect of the internal secondary air on the recirculation zone took the second place; the effect of the outer secondary air on the formation of the recirculation zone were not obvious. When the air velocity magnitude is all the same, the different internal secondary air blade position can influence the swirl strength which is very effective on the formation of the recirculation zone.

Keywords: Numerical Simulation, Nitrogen Oxides, Swirl Burner, Recirculation Zone, swirl strength

Study on a new traveling wave thermoacoustic engine with external excitation

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Abstract—A new external excitation traveling wave thermoacoustic engine has been designed and fabricated. With the length 1051mm and height 242mm respectively, the engine, which has been designed to have the maximal input of 600 W, has two external excitation and two thermal excitation, that is driven by external excitation or thermal excitation, or combination drive, This experimental facility has small size, lower onset resonance temperature and higher pressure radio, which is of great significance for introducing a variety of energies of low grade into thermoacoustic engines. This paper puts emphasis on the engine itself and the composition of the measurement system.
Keywords—thermoacoustic engine; regenerator; heater; external excitation

Study on High Temperature Properties and Application of Cr_3C_2□Cr□Fe Coating

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Removal of vapor-phase elemental mercury by novel chemically promoted noncarbon sorbents

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Abstract—Adsorption experiments of vapor-phase elemental mercury were carried out using bromine and iodine modified Kaolin, Zeolite, Bentonite and Chitosan in a laboratory-scale fixed-bed reactor. VM3000 online mercury analyzer was applied to detect the inlet and outlet Hg^0 concentrations. The characterizations of the sorbents were analyzed using Fourier transform infra-red spectroscopy. The results indicated the iodine was found in the inlayer of Bentonite, and the chemical reactions of iodine and sulfate ion with the amide of Chitosan were occurred. Fixed-bed absorber tests showed that compared to Kaolin and Zeolite, the modified Bentonite exhibited excellent mercury capture because of its unique structure. Mercury removal efficiency of Chitosan sorbent could be promoted from 50% to 100% when added appropriate amount of H_2SO_4. The iodine-modified sorbents demonstrated higher mercury capture efficiency than that of bromine-modified sorbents. Moisture presence can decrease the Bentonite's capacity for mercury uptake, while that of chitosan sorbents exhibited opposite tendency due to their unique physicochemical properties.
Keywords-*chitosan; bentonite; mercury capture; iodine; modification*

Research on The Management of Thermal Discharge by Coastal Power Plant

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Abstract—With the quick development of power plnat industry, the effect quantity of thermal discharge incearses gradually and so dose its on water enviormnent. But it doesn’t have special criterion of the warm water drainage at present. Based on the comprehensive summary of the progress in related area and the present situation of the warm water in our country, the paper indicates our country environmental management’s problems of the warm water. Take the Qingdao Power Plant for example. Two dimensional model of the transport and diffusion for the warm water is established. According to this numerical model, the concentration distribution of the warm water in the warm water drainage and the area of its influence are numerically predicted. Analyze the effects on ocean ecosystem brought by the warm water. Finally, propose strategy in management of warm water and utilization of waste heat.
Keywords—*Thermal dischage; Environmental management; Numerical simulation; Ecosystem;Coastal power plant*

Application and Improvement of the Interlayer Thermal Engine Powered by Ocean Thermal Energy in an Underwater Glider

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Abstract—The thermal engine can utilize ocean thermal energy to drive the underwater glider which has an important advantage in range due to huge heat capacity of the ocean. However, weak performances such as low heat transfer rate and overlong heat

transfer time limit its application and scope. For overcoming above defects, a unique interlayer thermal engine is presented by this paper. Experimental results show that the heat transfer rate can be improved significantly by the new configuration, while heat transfer time can be obviously reduced by a significant improvement in the hydraulic system of thermal engine.
Keywords— interlayer thermal engine; ocean thermal energy; underwater glider

Study on Bioenergy Utilization Benzene/Ethanol Extractives of *Eucalyptus urophylla* Wood by Py-GC/MS

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Abstract—Wood extractives for bioenergy with high additional value is looked upon as a strategy task. In this paper, the chemical components in the benzene/ethanol extractives of *Eucalyptus urophylla* wood were isolated and identified by Py-GC/MS so as to increase economic benefits. The relative content of each component was determined by peak area normalization. 73 compounds in the extractives were identified. The mainly abundant constituents were ergosta-4,6,22-trien-3.beta.-ol (11.6%), .beta.-sitosterol (10.02%), hexadecanoic acid (7.18%), phenol, 2,6-dimethoxy- (6.46%), carbon dioxide (5.62%), 9,12-octadecadienoic acid (Z,Z)- (5.5%), 2-octanamine, n-(1-methylheptyl)- (3.27%), benzene, 2-methoxy-1,3,4-trimethyl- (3.16%), ethyne, fluoro- (2.77%), 4.alpha.-methylcholest-7-en-3-one (2.36%), 2,3,5,6-tetrafluoroanisole (2.22%), squalene (2.13%),

oleic acid (2.13%), (z)6,(z)9-pentadecadien-1-ol (2.06%), phenol, 4-ethyl-2-methoxy- (2.03%), etc. The most components from benzene/ethanol extractives of *Eucalyptus urophylla* wood could be used as fine bioenergy, biomedicine, and other high additional value products.

Keywords—bioenergy; Eucalyptus urophylla wood; Py-GC/MS; benzene/ethanol extractives

Determination of Bioenergy Components of Acetic Ether Extractives of *Eucalyptus urophylla* Wood by Py-GC/MS

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Abstract—Wood extractives for bioenergy with high additional value is looked upon as a strategy task. In this paper, the chemical components in the benzene/ethanol extractives of *Eucalyptus urophylla* wood were isolated and identified by Py-GC/MS so as to increase economic benefits. In this paper, the chemical components in the □□□□□□□ □□□□□ extractives of *Eucalyptus urophylla* wood were isolated and identified by Py-GC/MS. The relative content of each component was determined by peak area normalization. 91 compounds in the extractives were identified. The mainly abundant constituents were ergosta-4,6,22-trien-3.beta.-ol (10.43%), 1,2-benzenediol (7.01%), hexadecanoic acid (6.14%), butylated hydroxytoluene (6.01%), 9,12-octadecadienoic acid (Z,Z)- (4.29%), phenol, 2,6-dimethoxy- (3.3%), carbon dioxide (2.56%), 4.alpha.-methylcholest-7-en-3-one (2.56%), phenol, 4-ethyl-2-methoxy- (2.54%), 9,17-

octadecadienal, (Z)- (2.3%), ethanone, 1-(3-methoxyphenyl)- (2.09%), phenol, 3,4,5-trimethoxy- (2.04%), hydroquinone, mono-tms (2.04%), oleic acid (1.94%), and so on. The benzene/ethanol extractives of *Eucalyptus urophylla* wood could be used as fine bioenergy, biomedicine, and other high additional value products.
Keywords-bioenergy; Eucalyptus urophylla wood; Py-GC/MS; acetic ether extractives

Studies on effect of peracetic acid pretreatment on anaerobic fermentation biogas production from sludge

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Abstract—To enhance anaerobic fermentation biogas production, excess sludge from Hanxi waste water plant of Wuhan City was first pretreated by peracetic acid (PAA), then anaerobic digested for 20 days in 35℃. An anaerobic digestion process without pretreatment was conducted as reference for comparison purpose. The results showed that organic matter dissolved from sludge after PAA pretreatment, soluble chemical oxygen demand (SCOD) increased 99, 227, 261 and 277%, mixed liquor suspended solid (MLSS) reduced 20.0, 25.0, 27.0 and 28.8%, according to the PAA concentration of 0.011, 0.027, 0.133, 0.266%. At the PAA concentration of 0.011%, there was almost no PAA or H2O2 left in excess sludge solution after 12h’ reaction, so it wouldn’t disturb the following anaerobic fermentation. After the anaerobic fermentation for 20 days, the total biogas production of PAA pretreated sludge enhanced 72% than that of the raw sludge, and the MLSS reduction ratio was 31%, which was conducive to reclaim the energy and decrease the excess

sludge.

Keywords—excess sludge; peracetic acid; anaerobic fermentation; biogas

Sewage sludge solar drying practise and characteristics study

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Abstract—The aim of this work consists in investigating the sewage sludge solar drying speed with the objective to find out the natural solar drying application possibilities in different seasons. The sewage sludge samples were drying in a lab greenhouse without active ventilation during summer, autumn and winter and the correlations between drying speed and weather were found out. Furthermore, surface configuration of the sludge layer during solar drying was investigated and it is found that the surface area is only connected to its moisture content whether in summer or in autumn. Investigation found that the sludge layer of 25mm in thickness decreased its moisture content from 5.16kg $_{water}$/kg $_{dry\ matter}$ (83.76% by total mass) to 0.78 kg $_{water}$/kg $_{dry\ matter}$ (44% by total mass) after 125 hours even there were rains during the drying process in summer; while in winter time it took almost 23days for the same drying effect. The surface area was found to change only according to its moisture contents during the drying process. Finally the paper recommends the applicable natural solar drying speed for different seasons.

Keywords— sewage sludge; solar drying; greenhouse; seasons; surface area

Study on a New Utilization Method for

Dry and Semi-dry Desulfurization FDG Residues

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Abstract: At present, most of the dry and semi-dry flue gas desulfurization (FGD) residues are simply stored and have become an obstacle to the popularization of the FGD technologies. The utilization of these residues needs to be solved urgently. Based on sufficient studies of the composition properties of the FGD residues, a completely new utilization method was put forward to produce sulfoaluminate cement in this paper, and experiments were carried out. In the experiments, the residues and some other materials were utilized to prepare raw meals according to appropriate element matching proportion. It was proved that, on a certain calcining condition, the raw materials could be converted to cement clinkers with mineral compositions being calcium sulfoaluminate ($Ca_4Al_6O_{12}SO_4$) and dicalcium silicate (Ca_2SiO_4), and with excellent mechanical strength properties. This utilization method, which can consume massive these residues, may have a wide prospect of application.

Keywords: semi-dry FGD; desulfurization residues; comprehensive utilization; sulfoaluminate cement

Study on the Prediction Model and Software of Environment Contaminants in

Coal-Burning Power Plants

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Abstract—The model and software for systematically estimating the concentration of the main contaminants (dust, SO2, NO_x, CO_2, F, As, Hg, Cd, Pd etc) in exhaust gas and wastewaters from coal-burning power plants were studied. The prediction of contaminants in exhaust gas was based on conventional calculating models. The key factors are ascertained the material conservation theory and the on-line data of coal quality are used to build the formula for calculating the quantity and the concentration of the gas contaminants. The prediction of contaminants in water was based on the status quo of ashflushing systems in national power plants through studying the ash-water in two different systems separately. The power plant monitor and prediction software using VB and access database were developed based on the above prediction model. The prediction result from the software shows that the opposite error value about the prediction and measure was all less than 10%, this proved the estimate was authentic.

Keywords- Estimating model, Software, Contaminants, Coalburning power plant

Experimental investigation on pressure drop profiles in a Swiss-roll combustor

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Heat transfer analysis of Swiss-roll combustor for ventilation air methane

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Abstract—A thermal equilibrium model of SRC (Swiss-roll combustors) for VAM (Ventilation Air Methane) combustion was developed. Temperature distribution of the combustor was calculated. The effects of inlet velocity, channel structure, and diameter of combustion chamber on the TCC (Temperature in Combustion Chamber) were investigated. It is found that even when the methane volume concentration of inlet VAM remained 1%, the TCC can be higher than 1400K, which exceeds the temperature needed for stable and sustained combustion. The TCC is significantly affected by channel width and channel length, while less by inlet velocity compared with them and the diameter of combustion chamber has little effect on the TCC. Faster inlet velocity and narrower channel width are favorable for enhancing heat transfer and increase the TCC, and longer channel length could increase the TCC effectively, but the factors of temperature, flow resistance, cost, etc. should be considered comprehensively in the design of Swiss-roll combustor.

Keywords—heat transfer analysis; Swiss-roll combustor; VAM

Artificial Ageing of Bottom Ashes

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Abstract—Artificial ageing of incineration bottom ashes with saturated air was investigated in this paper. The process could reduce the pH of bottom ashes below 10 within one month. This result can be used to design bottom ashes heap to accelerate the curing process of bottom ashes and reduce the storage time of bottom ash in incinerators. Artificial ageing might improve the technical quality of bottom ashes by reducing the leaching of trace elements within the landfill standard limits, although the leaching of alkaline-earth metals increased. The quality upgrade of bottom ashes might promote the utilization of bottom ashes.
Keywords—*incineration bottom ashes; artificial aging; leaching*

Research of the Load Forecasting Model Base on HHT and Combination of ANN

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Abstract—A new forecasting model based on HHT and combination of ANN is proposed in the paper. Load data can be decomposed into several IMF components and remainder by EMD firstly. Through calculating the spectrum of decomposed series by Hilbert transform algorithm, we can choose one appropriate forecasting model for each low frequency component, while use combination of ANN model for the high frequency component, according to low frequency components having stronger regularity and periodicity than high frequency components. Simulation results indicate that accuracy of the forecasting model discussed in the paper is higher than any one sole model and the traditional linear combination model.
Keywords—*HHT; spectrum; combination of ANN model; one sole model; traditional linear combination model*

Arithmetic Research of Performance Monitoring

Models for Reheat Unit in Dynamic Procedure

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inpuoowuesr cuanlcitusl,a ttihoins $Q_{tp} = D_0 * h_0 - D_{fw} * h_{fw} + D_{rh} * h_{rh} - D_{rc} * h_{rc}$, (1)

paper analyzed the dynamic property and inherent mechanism of

reheat unit in load-changing procedure. In order to ensure the where D_0, D_{fw}, D_{rh}, and D_{rc} represent flow (t/h) of primary

accuracy of the calculation, real-time arithmetic models were put steam, feedwater, hot-reheat steam, and cold-reheat steam

forward and compared with conventional method to study the respectively, and h_0, h_{fw}, h_{rh}, h_{rc} represent enthalpy values

influence on performance index in dynamic procedure, including (kJ/kg) of relative parameters respectively.

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a0n0dM dWiff erreehnecaet Usually, there are no flow measuring points for cold-reheat unit to

verify and evaluate its rationality quantitatively and steam and hot-reheat steam, thus how to obtain values of these

qualitatively. The results show that the proposed arithmetic two parameters correctly in dynamic procedure becomes the

models have superiority over conventional methods in aspects of key in calculation of on-line heat consumption.

reasonable trend and easy calculation in dynamic procedure. Ignoring influence of steam-gland leakage and valve

arithKmeyewtico;r d sd-pyenrafmorimc apnroccee dmuroen i toring; reheat unit; real-time

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The Design of Reserve Market Basing on Reserve

Responsibilities Bilateral Contracts

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Abstract—Two kinds of reserve market model are introduced in this paper, which are PoolCo Model and Bilateral Contracts Model. The advantages and shortfalls of these kinds of reserve market are introduced and compared. In order to realize the transition from the traditional industry structure to the competitive electricity market smoothly, the project of reserve market basing on reserve esponsibilities bilateral contracts for China is designed at length. At first, the fundamentals of assigning the reserve responsibilities are brought forward. Then, the measures of assigning the reserve responsibilities between the generators are designed, which are the Direct Assigning Measure and the Actual Value Convert Assigning Measure, at the same time the measures of assigning the reserve responsibilities between the suppliers and big Customers are designed. At last, the principles and measures to dispatch the generators when the reserves are needed by the power system are designed, which are Simple dispatching Measure and Improved dispatching Measure. The design is simple and easy to be applied at the beginning of Chinese electricity industry reform.

Keywords— Power Market Regulation and Deregulation; Ancillary Service; Reserve Market; Reserve Responsibilities; Bilateral Contract

The Optimized Allocation of Mobile Emergency Generator Based on the Loads Importance

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Abstract—The optimization algorithm of allocation problem of mobile emergency generator (MEG) under a certain budget is analyzed in this paper. The classification of loads is discussed firstly, and then the index to describe the severity of the loss of a certain load is obtained. Three hierarchical problems are proposed. By solving one integer programming problem and a dynamic programming problem, three problems are solved, and the optimized plan can be obtained.
Keywords-Urban Power Network, Load, Importance, Mobile Emergency Generator, Integer Programming

The Structure Optimization Of Flat Tube Fin In Direct-Cooled Condenser Of Electric Power Plant

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Abstract—To improve the efficiency of direct air-cooled condenser and optimize the physical structure of the flat tube fin, the 3D physics-mathematics models are set up and a CFD (Computational Fluid Dynamics) solver is employed to perform the numerical simulation. The flat wave-fin tube and the flat vertical-fin tube are calculated separately. In six wind conditions, the heat transfer coefficients, flow losses, heat dissipation, and the average surface temperature changes of the two kinds of fins are analyzed. The following conclusions are drawn: in vertical-fin flat tube, air flow space is larger and the turbulence intensity is lower. The average surface heat transfer coefficient of vertical-fin flat tube is smaller than the wave-fin flat tube. The flow loss of vertical-fin flat tube is less than the wave-fin flat tube by about

28.3 %. That will greatly reduce the power demand of the cooling fans and the energy loss of the whole power plant. The overall efficiency of the power plant will be improved. The heat dissipation amount of the vertical-fin flat tube is larger by about 8.82% than the wave-fin flat tube. The average surface temperature of the vertical-fin flat tube is higher than the wavefin flat tube by 0.1 %. The numerical simulation results revealed that the flat vertical-fin tube is more efficient than the wave-fin flat tube in vapor condensation process.
Keywords—flat tube; wave-fin; vertical-fin; numerical Simulation

Implementation of AC Optimal Power Flow Based Financial Transmission Right Auction under Static Security Constraints

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Abstract—As a financial instrument for hedging risk, financial transmission right (FTR) has been put into application in some power markets. Based on AC optimal power flow (OPF) a new FTR auction model was proposed under considering of the contingency constraints. With the *n*-1 static security constraints, this model is solved by the AC-OPF based on Monte Carlo simulation. Firstly the contingency set is selected by the probabilistic algorithm, and then the expected values of clearing results and frequency distribution plots are obtained through the optimization results. The numerical results of IEEE 30-bus system demonstrate the rationality and feasibility of the proposed model.

Keywords— Power Market; Financial Transmission Right; AC Optimal Power Flow; Monte Carlo Simulation

Empirical Study on the Relationship of China’s Energy Consumption and Industrial Structure Change

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Abstract—In order to understand the law of China's energy consumption growth, we use cointegration method and set up the vector error correction model to do quantitative analysis on the relationships among China’s three industries’ output values and its energy consumption. Our results can be summarized as follows: i) There is one-way causality relationship between the energy consumption and the output value of the first and the second industry, but no obvious causality relationship exists between the energy consumption and the output value of the third industry; ii) The impacts of the energy consumption on the output value of the first and the second industry are not the same in the short term; iii) The increase of energy consumption has positive effect on the first and the second industry’s development in the long term. Knowing these clearly will help us take more specific measures to balance the energy demand and supply.

Keywords—industrial structure; energy consumption; relationship; empirical study

Model of Forecasting System Marginal Price for

Power Market in Southwestern China

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Abstract—System marginal price (SMP) is the uniform price that reflects the short-term relationship between demands and supplies in power markets. To forecast SMP accurately, a computational model based on grey theory was proposed. The model can process irregular original data by accumulated generating operation (AGO) and get regular results. According to the regular results, a computational real-time forecasting system can be established. Test and simulation were completed by MATLAB according to the specific data of SMP from California power market. Considering the possible difference between weekend and workdays, two types of data were singled out randomly to calculate. Results show that the model can provide a great deal of flexibility for applications. The forecasting system has been applied in power market in southwestern China and it has been proved that the reliability, accuracy and real-time performance can be used as needed.
Keywords- forecasting; SMP; grey theory

The Action of Structure and

Efficiency on Chinese

Energy Intensity

An Empirical Analysis Based on AWD changes and factors

decomposition of Chinese

energy from 1978 to 2007

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Abstract—an Adaptive weighting Divisia Index Method is applied to analyze the structure and efficiency quotient mix in affecting Chinese energy intensity through rearranging and reanalyzing the past 30 years' data. Based on the analysis, this paper concludes that the changes in China's energy intensity in the previous phase are mainly caused by efficiency factors, and by estimation it shall be affected by structural factors in certain period of future. Subsequently, potential direction of energy conservation in future is suggested in the context of economic evolvement of China. In addition, the upturn in energy intensity after 2000 are particularly analyzed and interpreted comprehensively.
keywords: *energy intensity; The decomposition model; structure quotient; efficiency quotient*

A model of decline rate of the total energy intensity based on the index decomposition method

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Abstract—firstly a model of decline rate of the total energy intensity is established by using the index decomposition method in the paper. The influence of industrial structure, industrial energy intensity and industrial energy structure on the decline rate of the total energy intensity can be analyzed by using the model. Secondly an empirical analysis of decline rate of the total energy intensity of Jiangsu Province is considered. .It has been confirmed that the shortage of the effect of energy intensity and industrial energy structure causes the decline rate to rise by □□□□□□% only in 2005 compared to that in 2000.
Keywords- decline rate of energy intensity; index decomposition;

industrial structure; industrial energy structure; industrial energy intensity

The Application of Association Rules in Boiler Operation Optimization based on Organizational Evolutionary

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Abstract—complicated onlinear relationships exist among many data in the real-time control-process of large power plant. And data-mining technology could find knowledge, analyze parameters and adjust them. This paper ascertained target-value by means of data mining, which supported energy-loss analysis. The paper introduced relative theory on data mining, studied and applied target-value model of thermal supervised parameters in the way of Organizational Evolutionary Algorithm. Across analyze real-time operating data of thermal units, and mined the target-value models for main supervised parameters of boiler. The results supply a new idea and effective method for target-value models.

Keywords- organizational; evolutionary; target-value; data mining ; operation optimization; boiler

An Empirical Analysis for China’s Energy R&D Expenditures Based On The Entropy Theory

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Abstract—According to the energy research and development (R&D) expenditure data of large and middle sized enterprises and research institutions in different energy industries and regions, the statistical methodology is used on the basis of entropy theory to analyze the industry entropy, province entropy and region entropy of energy R&D expenditure in the years 2003-2006 in China. It is found that the entropy value of industry dimension experiences the course of “drop-drop-rise”. Generally speaking, the course is quite stable and slightly fluctuated. The province entropy value of the R&D expenditure is close to the theoretical maximum, the fluctuation is slightly small compared with the theoretical maximum, and all the change scope is basically consistent. The regional entropy value of energy R&D expenditure decreases makes the regional distribution curve of R&D expenditure the “trumpet” shape.

Keywords- China’s energy industry; R&D expenditure; entropy theory; difference

Study on Charging of Electricity Transaction

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Abstract — Being a platform for electricity trade, electricity trade center needs a huge investment for its construction and operation, and the approach of ROI (Return of investment) will greatly influence the efficient and fair operation of the whole electricity market. Based on the theory of transaction cost, this paper proposes a suitable approach to get the investment’s return under current situation in China in order to balance all

expenses of trade center. Meanwhile, this paper designs a transaction charging framework and also have detailed descriptions of transaction principles, charging objectives, items and cost allocation according to the behaviors of market participants and their involvements.
Key words: cost allocation; electricity transaction; charging for transaction; electricity market

Research on the Admission Standard of Large Consumers Direct-purchasing Based on the Externality Theory

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Abstract—Large consumers direct-purchasing is a very important stage of opening up user options. And the identification of large consumers' qualification is the important prerequisite of direct-purchasing reform. Based on the externality theory of public economics, considering state energy industry and environment protection policies, and the status of regional economical development, this paper develops a series of standards to qualify large consumers that not only consider the scale of electricity consumption but also consider consumers' industries, business lines, and recent years' newly added electricity consumption. In the end, the state can meet the reform objectives, such as large consumers can improve the utilization rate of energy; regions can improve their economical sustainable development, etc.
Keywords-large consumers direct-purchasing; externality; large consumer admittance; profession classification; electricity market

Study on the Embodied Electricity in the International Trade of China

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Abstract—This paper estimates the embodiments of electricity associated with international trade of China so as to give a more complete and balanced picture of China's total electricity consumption. A trend covering years 1995–2006 is carried out to study the development of electricity utility efficiency and electricity consumption pattern associated with Chinese exports and imports. According to our results, besides the year 1996, both direct and indirect electricity embodied in Chinese exported commodities increases over the period under study. From 1995 to 2006, Chinese direct electricity trade balance is in surplus for six years and in deficit for six years, while the total electricity trade balance is in deficit for 11 years except in minor surplus in 1996. The electricity used through manufacture in export-related sectors accounts for a large proportion of the nation's total electricity demand, indicating that export-related production is a main reason for China's electricity consumption.

Keywords-input-output analysis; embodied electricity; international trade; China

Power Energy Efficiency with Environmental Restrict: View from Shadow Price

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Abstract—This paper proposes a new method to deal with directional technology distance function. We propose a new concept: partial directional distance function, which describe the distance of one element(including inputs, outputs, desirable and undesirable) in their direction given the partial distance of the other elements. Based on this, we present the multi-goals programming problem and its solution arithmetic. Then we present the measure of partial marginal effect and the shadow price of resource/environment to outputs. At last, we apply the methodology to empirical data. It turns out this method is feasible and very useful.
Keywords- power energy efficiency; partial directional distance function; style; shadow price; environmental restrict

An Empirical Analysis of Energy Efficiency in North-East China

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Abstract—North-east China as the nation’s manufacturing base relies heavily on energy supply. Index decomposition analysis reveals that energy consumption is determined mainly by production effect, followed by intensity effect and structural effect. Data Envelopment Analysis shows that there is lack of efficiency in production mainly caused by energy waste. In specialty, energy consumption is determined by secondary industry for its regional character, and meanwhile energy waste is also a major factor to impede efficient production, so there is a mutual impact between energy efficiency and production efficiency. There is a requirement of industrial restructuring and

technological innovation at both government level and firm level to reduce energy consumption.
Keywords-energy efficiency; decomposition analysis; Data Envelopment Analysi

Study on Optimized-select Model of Investment Decision in the Electric Project Based on Grey Comprehensive Related Degree

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Abstract—It puts forward and uses the method to improve grey related analysis in the investment decision of the electric project, introduces the concept of the theory of the gray target sets up comprehensive difference matrix in order to improve the sensitivity and accuracy of the scheme optimum seeking while calculating Then it fixes every index weight through membership degree, and then calculates and arranges in an order to the weighted average comprehensive value. It can offer the optimized-select scheme for investment decision of the electric project according to its appraisal result.
Keywords-electric project; weight; grey comprehensive related degree

Economic Operation And Control Management In Water Diversion Project

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Abstract—The paper is concerned with implementation of control and management systems for water diversion infrastructure project. The Yellow River Diversion Project(YRDP) is a large scale inter-basin water diversion undertaking with the target capability of transferring 1,200 million m3 of water annually. The hydraulic structures and equipment were designed and selected with a view that a responsive control system should be able to maintain the conveyance line in balanced flow in wide range of flow rates utilizing small buffering capacities along the line while pump units operate in a narrow band of the highest efficiency. Distributed nature of the conveyance line and large scale hydraulic equipment necessitated arrangement of conveyance line management facilities in a multi-tiered structure maximizing flexibility of operations. The paper characterizes the main control issues identified in the conveyance line and compares characteristics obtained through simulations and actual measurements on site. It outlines major features of the control and management system developed and implemented for YRDP and how the key requirements of safety, reliability and economic operations were achieved.

Keywords-Satety,Reliability,Economic Operation, Control Management,Water Diversion Project

Evaluation of Distribution Communication Network Various Access Means Basing on Preferable DEA

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Abstract—Communication network is an important part of distribution automation system (DAS). The construction investment and system performance to a large extent determine the success or failure of building DAS. The features, requirements and networking mode of distribution communication network and commonly used means are given firstly, and one multi-index evaluation thought which combines the qualitative and quantitative analysis together to evaluate different communication means is proposed, then an evaluating indices system for wireless communication means is provided, including three factors that are economy, reliability and technology. At the same time the preferable data envelopment analysis (DEA) method is introduced into the estimate system to comprehensive evaluate the benefit of the evaluation model. The feature of preferable can resolve the problems well occurring when combining qualitative and quantitative analysis, and the feature of nondimensional resolves the error problem occurring when multi-index conversing each other in evaluation. Finally the method is applied to plan one city’s communication network of DAS; the communication means which has the highest benefit index will be selected as the preferred means. The evaluating method also provides the scientific basis to the construction of communication network of DAS.

Keywords-distribution automation; wireless communication; economical analysis; the preferable DEA method

Spatial Econometric Analysis of Energy Efficiency Convergence of Chinece Provinces

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Abstract—Spatial patterns of energy efficiency and its spillovers have always been key issues in the energy economics. What are the effects of energy consumption and efficiency convergence? What are the driving forces behind the spatial convergence process? This paper investigates the convergence process of the energy efficiency in 29 provinces of China over 1995-2004. The data trends show some evidence of convergence over 1995-1999 while divergence over 2000-2004. And the carefully spatial econometric analysis of spatial lag model (SLM) and spatial error model (SEM) verify that energy efficiency over the same period show a convergence process or divergence in the provinces of OLS estimate when other factors are controlled.

Keywords-Energy efficiency;Convergence;Spatial econometrics; Chinese provinces

Econometrical Analysis to the coal consumption and economic growth in China

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Abstract—Based on the basic analysis of China’s newest coal consumption data, the theory of co-integration is used in this article to analyze the co-integrate relationship between coal consumption and economic growth and the Granger causality model of coal consumption and economic growth is established, leading to the conclusion that there is no longer long-term co-integrate relationship between coal consumption and economic growth, and that a one-way cause-effect relationship

from GDP to coal consumption is existent. Then the article continues to research the effect on reverse 0.931507 proportion of energy consumption and the contribution on positive 0.01947 proportion of economic output exerted by coal consumption. Finally we come to the conclusion that too large proportion of coal consumption significantly caused the lower energy efficiency, and that the contribution to economic output by coal consumption is lower than that of average energy consumption.
Keywords- coal consumption energy efficiency; co-integration the Granger causality

Electricity Demand Side Management and its Different Promotion Measures

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Abstract—On the basis of introducing the principle of economizing electricity measures, aiming at the resistance presently met in the promotion of electricity demand side management (DSM), this paper raised an objection about making the electricity company as the implement body of DSM, and offered a guidance that who is willing to benefit, who should take on the promotion of DSM. According to different types of economizing electricity measures, promotion tactics of DSM were suggested as follows: Electricity company charges with load control; Government department makes economy measures of saving electricity; Investment company or energy intermediary company accepts responsibility for promoting equipment of store-up electricity, Organizes and acts DSM by project, Project’s proportion of cost-benefit and form of paying will be negotiated by contractor unit and consumer both sides; Government department is in charge of paying and decomposes DSM task of economizing electricity by high efficiency; Through project management, competitive – bidding, Winner will perform DSM project. Its auditing, supervision and acceptance will be done by government department.
Keywords- demand side management (DSM); load curve;

energy efficiency; project management.

Energy Saving Study on the Tension System of a Tensioner for a Pipelaying Vessel

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jEAinnNggG iCn eUSehPriiBmng in WCQQ oiiAnn llgg

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S&cEielneccetr i&ca Tl Eecnhgninoeloegriyn g

Abstract: Energy saving is a crucial factor in industry. This whole pipelaying process is a cycle:
start speed-up or
paper discusses the energy saving of the tension system of a speed-down stop start .After the pipelaying, the
tensioner for a vessel. The tension system includes the hydraulic motor stops.
pressure clamping system and the AC servo motor. According to
aconnaslyusmisp, tiionn tfhaec tohry disr athueli cp opwreers ssuoruer csey. sSteom w et hhea vme
acihno seenne rtghye . ANALYSIS OF HYDRAULIC PRESSURE SYSTEM ENERGY
A7V.80.EL which is a kind of high-efficiency, energy saving, and SAVING
high power variable capacity pump. Furthermore, we adopted
MCU to control the flow rate and pressure of the system. In the A. Analysis of Energy Consumption Factor
AC servo motor system, according to the characteristic of high-power motor, we route a start and stop control through the In the hydraulic pressure system, energy loss Lx
transducer and fuzzy control in the working process to reduce equals [4]:
the energy consumption. The test results indicate the energy
saving effects.
Key words: energy saving; tension system; variable capacity
pump; AC servo motor; fuzzy control

Study on Utilization Ratio of SO2 Sorbents in Semidry Flue Gas Desulfurization Technology

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Abstract: From the angle of chemical compositions of the desulfurization products, the utilization ratio of SO2 sorbents in semidry flue gas desulfurzation (FGD) technology was discussed in this study. Five desulfuzation residue samples, which were got from the semidry FGD devices of five different power plants, were analyzed about the chemical compostions. It was found that CaCO3 took up a big proportion among the desulfurzation products. Through calculation and deduction, the CaCO3 should have been generated from the desulfurization process. This consequence does not accord with the routine researches in which the effect of CO2 usually isn't considered. Then experiments were carried out and it was proved that the competitive reactions with the sorbent Ca(OH)2 between CO2 and SO2 do exist. Therefore, the problem that the sorbent utilization ratio is low in semidry FGD technology was put forward and given explanation. Measures must be taken to prevent the reaction between CO2 and Ca(OH)2 in order to improve the semidry FGD technology.

Key words: semidry FGD; competitive reactions; desulfuriztion residues; utilization ratio of SO2 removal sorbents

Study on coal plasma ignition and combustion in a primary combustor

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Abstract—To evaluate performance a coal plasma ignition primary combustor, an axis-symmetry numerical simulation was carried out to study flow and combustion field. The gaseous phase is described within the framework of the Eulerian representation and the solid phase, the Lagrangian representation. It is found that less volatile matter requires higher temperature for the volatile emission, therefore high power plasma torch required. Volatile content, coal/air weigh ratio, plasma power, and operating velocity are key parameters for plasma ignition coal. For 20m/s velocity, coal/air weight ratio 0.3 kg/kg, 100KW air plasma torch, 20% volatile matter, the primary combustor can provide stable and effective combustion. As air and coal mixture velocity increasing or decreasing plasma power, the wall temperature of primary combustor decreases. However, the flame goes downstream and its stabilization becomes weak. Reduced mixture velocity and strong swirl velocity will help flame spread in radial direction, however, this leads to increasing pressure drop and high wall temperature of primary combustor. It is also concluded that the effect of detailed chemistry must be introduced into numerical model to study plasma coal ignition characteristics.

Keywords-plasma ignition; numerical simulation; primary combustor; coal combustion

Determination of bioenergy Components in Benzene /ethanol Extractives of Cunninghamia lanceolata Wood by Py-GC/MS

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Abstract—As a ideal raw material in bioenergy, extractives of Cunninghamia lanceolata wood are severely wasted. Therefore, the chemical components from Cunninghamia lanceolata wood were extracted with benzene /ethanol and identified by Py-GC/MS after concentration. Relative content of each component was determined by area normalization. 83 compounds of the extractives were identified. The main constituents were anthracene, 9-dodecyltetradecahydro- (11.78%), cedrol (9.12%), 1Hcycloprop[e]azulene, 1a,2,3,4,4a,5,6,7b-octahydro-1,1,4,7-tetramethyl- (6.22%), 1H-3a,7-methanoazulene, 2,3,4,7,8,8a-hexahydro-3,6,8,8-tetramethyl- (5.46%), 1-naphthalenepropanol, .alpha.-ethenyldecahydro-.alpha.,5,5,8a-tetramethyl-2-methylene- (4.09%), 1-naphthalenepropanol, .alpha.-ethenyldecahydro-5-(hydroxymethyl)-.alpha.,5,8a-trimethyl-2-methylene- (3.64%), phenol, 2-methoxy-4-propyl- (3.34%), .alpha.-bisabolol (3.27%), germacrene B (3.19%), 2(1H)-pyridinone, 1,4,6-trimethyl- (3.14%), hexadecanoic acid (3.09%), etc. The benzene /ethanol extractives could be used as bioenergy and biomedicine.
Keywords- Cunninghamia lanceolata; benzene /ethanol extractives; Py-GC/MS; bioenergy

Study on Benzene/Ethanol Extractives of Eucalyptus urophylla Chips for Bioenergy with High Added Value by Py-GC/MS

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Abstract—The increasing demand for paper in Asia is being met by the use of Eucalyptus urophylla to a large extent. However, some pulp mills may be forcedly closed because the Eucalyptus urophylla chips contain extractives severely enough to pollute the water. In this paper, the chemical components in the benzene/ethanol extractives of Eucalyptus urophylla chips were isolated and identified by Py-GC/MS to produce bioenergy with

high added value. 114 compounds in the extractives were identified. The mainly abundant constituents were .beta.-sitosterol (10.00%), acetic acid (7.34%), phenol, 2,6-dimethoxy- (4.95%), 6H-dibenzo[b,d]pyran-6-one, 7,9-dihydroxy-3-methoxy-1-methyl- (4.09%), phenol, 2-methyl- (3.71%), sesquirosefuran (3.36%), carbon dioxide (2.56%), acetone (2.49%), ethanone, 1-(3-methoxyphenyl)- (2.31%), stigmasterol (2.19%), etc. The most components from benzene /ethanol extractives of fresh Eucalyptus urophylla wood are not only abundant and healthy to human, but also can be used as fine bioenergy.
Keywords-bioenergy; biomedicine; Eucalyptus urophylla; benzene /ethanol extractives; Py-GC/MS

Study on High-Grade Bioenergy Utilization of Acetone Extractives of Eucalyptus urograndis Wood

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Abstract—As a waste in pulp, the acetone extractives of Eucalyptus urograndis wood severely polluted the water and wasted a lot of bleaching agents. Therefore, Py-GC/MS was used to analyze high-grade bioenergy utilization of acetone extractives of Eucalyptus urograndis wood. The relative content of each component was determined by peak area normalization. 33 compounds in the extractives were identified. The mainly abundant constituents were ergosta-4,6,22-trien-3.alpha.-ol (12.95%), carbon dioxide (12.02%), cyclopentadecanone, 2-hydroxy- (8.21%), .beta.-sitosterol (7.6%), 1,2-benzenediol (5.97%), phenol, 2,6-dimethoxy- (5.45%), R-(-)-cyclohexylethylamine (4.64%), vitamin E (4.51%), phenol, 3,5-diethyl- (4.38%), acetone (4.16%), 4.alpha.-methylcholest-7-en-3-one (3.54%), 1,2,3-benzenetriol (3.33%), 1-phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a-octahydro-1,4adimethyl-7-(1-methylethyl)-, methyl ester (2.69%), hexadecanoic

acid (2.56%), brucine (2.41%), 4-hydroxy-3-methylacetophenone (2.16%), etc. The most components from acetone extractives of Eucalyptus urograndis wood can be used as fine bioenergy, rare biomedicines, and so on.
Keywords-bioenergy; high-grade utilization; acetone extractives; Eucalyptus urograndis wood; Py-GC/MS

In Situ Measurement of Ground Thermal Conductivity Based on Analytical Solution Models

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Abstract—Determination of ground thermal properties is an important part of the design of ground-coupled heat pump system (GCHP). The number of boreholes and the depth and cost of each borehole are mainly dependent on the estimate of the ground thermal properties. This paper summarizes various determining method of ground thermal properties, the test apparatus, test procedure, theory basis and arithmetic on the in situ measurements of ground thermal properties based on analytical solution models are analyzed in detail, which includes the data curve-fit method based on the line heat source model and parameters estimation method based on the line heat source and cylindrical heat source model. The calculated precisions of the three methods are compared by an example calculation, the influence of test duration on calculated results is investigated. The results indicate that the estimate value of ground thermal conductivity by data-curve fit method is appreciably bigger than that by parameter estimation method and the calculated results are affected by the test duration.
Keywords ground-coupled heat pump; ground thermal properties; in situ measurement; analytical solution models; line heat source mode; cylindrical heat source model

Numerical Simulation of Air conditioning Vehicle Using Computational Fluid Dynamics

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Abstract—By the steady state incompressible Reynolds-averaged Navier-Stokes equations, turbulence model, the finite volume method with interlacing of discretization, the three-dimension airflow and temperature fields inside a passenger vehicle are calculated numerically. The solar radiation and body heat are additional source term of energy equation, the influence of passenger and solar radiation on airflow and temperature fields is investigated. The results show that existing supply modes make the superior flow distribution homogeneous, body heat has much influence on airflow and temperature fields and solar radiation has little influence on airflow field, but much influence on temperature field. According to the standard QCn29008.9-1991, the experiment is carried out in the air-conditioned vehicle, which verify the correctness of numerical simulation. It is also shown that the prediction results of airflow and temperature to be used for evaluating the thermal comfort in the design procedure.

Keywords-passenger vehicle; Temperature field; airflow field; Numerical simulation

Analyzing the Stability of two-echelon Supply Chain Systems

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Abstract—In allusion to the condition of adopting mostly (R,S) replenishment policy when analyzing the bullwhip effect based on inventory policies, replenishment policies and demand forecast policies and measuring the amplificatory extent with linear control theory, in this paper we apply transfer functions to study the stability of a two-echelon supply chain system that operates under the general Bowman linear replenishment, coming to the parameters' ranges that ensure the stability of a supply chain system. The results provide the suppliers, distributors and retailers some methods to decrease the order amplification.

Keywords-supply chain systems; stability; transfer function; replenishment policy; demand forecast