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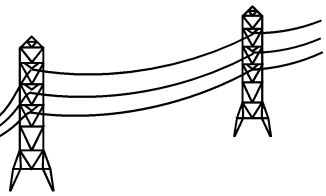

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ELECTRIC MACHINES AND DRIVES

ELECTRIC POWER INDUSTRY RESTRUCTURING

Abstract-- **US is the largest consumer and importer of energy. The Average cents for coal, natural gas and petroleum for the power plants in the US are 136.1¢, 596.1¢ and 429.4¢ per MMBtu, respectively. Wyoming alone produced 35.6% of total coal in the US and it also has large and increasing natural gas reserves. Both the Western and the Eastern US states pay high prices for electric energy, compared to the Wyoming. Rail road cost from Wyoming for coal transportation is twice than its mine mouth cost. Between 1993 and 2004 electric energy production from natural gas increased from 13% to 18%, even though, natural gas is the most costly fossil fuel for the power plant. This was done as a quick response to the shortage and several blackouts in the Western and the Eastern US. Natural gas-fired power plants could be built in a shorter time frame, where as coal-fired power plants require a long lead time. Long term planning and realistic load forecasting could save huge amounts in fuel cost and add stability and reliability margins in the system. Wyoming is suitable for producing more electric energy from both wind and coal and its geographic location can utilize the opportunity to meet the demands in both the Western and the Eastern US.**

Index Terms-- **Electric Energy Market, Wyoming's Energy, and HVDC Transmission**

ELECTRIC POWER MARKETS AND POWER PRICING

Abstract—**Short-term price forecasting in competitive electricity markets is critical for consumers and producers in planning their operations and managing their price risk. This paper adopts artificial neural network (ANN) model based on similar days methodology in order to forecast weekly electricity prices in the PJM market. To demonstrate the superiority of the proposed model, extensive analysis is conducted using data from the PJM Interconnection. The factors impacting the electricity price forecasting, including time factors, load factors, and historical price factors are discussed. Comparison of forecasting performance of the proposed ANN model with that of forecasts obtained from similar days approach is discussed. The forecasting error is the major concern for forecaster; a lower error indicates a better result. Accumulative error depends on forecasting period (hourly, daily, weekly, monthly, etc.). It will increase for a longer time forecasts. In this paper, the test results obtained by using the proposed ANN provide reliable forecast for weekly price forecasting as the mean absolute percentage error (MAPE) values obtained for the first and last week of February 2006 are 7.66% and 8.88%, respectively. Similarly, MAPE for the second week of January 2006 is obtained as 12.92%. Forecast mean square error (FMSE) and MAPE results obtained through the simulation show that the proposed ANN model is capable of forecasting locational marginal price (LMP) in the PJM market efficiently.**
Index Terms—**Competitive power market, artificial neural network, price forecasting, similar days.**

Abstract—**Price forecasting has become one of the main focus of electric power market research efforts. Existing price forecasting methods have shown a good ability to forecast normal electricity prices. However, none of the research efforts have demonstrated to be effective in forecasting price spikes in electric power markets. This paper presents a methodology to forecast price and spikes using system identification approach and radial basis functions neural networks. The results obtained using PJM interconnection data with mean absolute percentage error (MAPE) of less than 5% demonstrate the feasibility and accuracy of the proposed method.**

Abstract—**This paper studies Generation Companies (GENCOs) production decisions in ologopolistic electricity market. The model presented is based upon static equilibrium model solved sequentially. The main idea is to imagine the firms to be in a discrete time situation. The effect of technical constraints, such as time on/off, ramp up/down, startup cost and shut down cost, are not included in the model.**

Index Terms—**Electricity Market, Market Equilibrium, Ologopolistic Competition.**

MODELING ISSUES

Abstract- **A dynamic and steady state model of the Solid Oxide Fuel Cell (SOFC) is presented. Simulation results are shown. A laboratory prototype of the fuel cell is built. Both the dynamic and steady state results of the experimental model are verified with those obtained from simulation and show a close agreement with it. The proposed experimental model was designed to be connected to the grid as well as to supply isolated loads.**

The proposed model uses a dc motor as the prime mover for a separately excited dc generator, which represents the fuel cell. The fuel cell current and voltage are measured using a National Instruments (NI) data acquisition card and the control signal is fed back to change the generator's field current.

Index Terms- **Combined heat and power (CHP), Distributed Generation (DG), Fuel cell, Solid Oxide Fuel Cell (SOFC).**

Abstract—By looking at the hysterisis loop of a core, its non-linear magnetizing branch can be modeled by visual inspection. Three constants on the hysterisis loop reveal enough information about the core loss and non-linear inductance that power measurements and data-pairs can be avoided. An experimental hysterisis loop is taken from a CT and its model put together by visual inspection. The visual method presented is simulated and verified against an experimental hysterisis loop using SimPowerSystems as the circuit simulator.

Index Terms— **core, current, model, equation, hysterisis, loop, magnetizing, saturable, simpower, simulink, transformer, visual.**

Abstract -- **The paper presents new models of DC–DC converters. The sub-circuit formed by the voltage source, switching transistor, and diode, is replaced by an independent square-pulse current source, while the rest of the circuit remains unchanged. Using Fourier series representation of current-pulse square wave, the current source is describe as a sum of sinusoidal currents, thus the system is considered linear. The system's state-space representations in the time domain and s-domain are derived. Comparison of the buck converter state-space representation of both models is**

POWER ELECTRONICS

In this paper a nonlinear robust control law based on the Successive Approximation of Generalized Hamilton- Jacobi-Issacs (GHJI) equation is proposed for the Cuk converter. The cost function of GHJI equation is estimated by using Radial Basis Functions (RBF). The proposed control law stabilizes the system and guarantees a constant output voltage in spite of disturbances in input voltage and output load. Computer simulation shows the robustness of the control system.

***Abstract*—This paper presents a novel b-shaped L-type transformerless hybrid active power filter (HAPF) for reactive power, current harmonics and neutral current compensation in three-phase four-wire distribution power system. The passive filter (PF) is tuned to compensate the dominant harmonic current and also reactive power of the load, while the active power filter (APF) compensates the remaining harmonic and reactive powervalues. With appropriate design of the system parameters, the novel HAPF topology can prevent most of the fundamental voltage and current across the APF. This results in a great reduction of the APF's VA rating, but without significantly deteriorates the system compensation capability. Moreover, transformerless HAPF benefits by eliminating the transformer phase shift, voltage drop, harmonics loss, bulky size and expensive cost. As a result, the proposed HAPF is characterized by small APF capacity, economical cost, well filtering effect and easy realization. And it is suitable to be implemented in high voltage and current conditions. A DC-link power flow controller is also employed to uniform its voltage level. Finally, simulation results are given to verify the viability and effectiveness of the novel HAPF.**

***Index Terms*—Power electronics, power quality.**

***Abstract*—A new three-phase high power factor rectifier based on Zeta converter is presented. A resonant inductor and capacitor are added to the circuit to create zero-current switching condition for the switch. The circuit is operated in the PWM mode by putting a parallel switch and diode in series with the resonant capacitor. Different operating modes of the new topology are presented in detail. The simulation results verify the analysis.**

***Index Terms*— Soft switching PWM; Three-phase PFC; Zero-current switching**

POWER QUALITY

***Abstract*--A power quality investigation and analysis for an energy facility are presented. The energy facility has been experiencing problems with uninterruptible power supplies and 24 V dc power supplies for their distributed control system due to the start-up of the generators. Power quality monitors were installed at various locations throughout the facility. The results and recommendations from the analysis are documented.**

Abstract—**The time-varying nature of waveform distortions requires a precise analytical tool that is essential in power quality analysis. The time-frequency representation (TFR) provides a powerful method for identification of the time-varying nature of the waveform distortions. The paper presents a comparative study on four techniques for analysis and visualization of waveform distortions with time-varying amplitudes. The techniques include the traditional fast Fourier transform (FFT) and three TFR techniques, which are the Short Time Fourier Transform (STFT), the Discrete Wavelet Transform (DWT), and the S-Transform.**

Index Terms—**Fast Fourier transform, power quality, S-Transform, Short Time Fourier Transform, time-varying waveform distortions, Wavelet Transform**

Abstract-- **The problem of, testing for, and solutions to electromagnetic interference are introduced and analyzed. The industry direction is looked at for explanation of techniques and ideas. These topics were gathered through research. The principal results are that electromagnetic interference is growing because of technological advances in electronic devices and communication demands. The solutions to this problem are effective and need to be implemented in order to reduce the occurrence of electromagnetic interference.**

Index Terms -- **Anechoic chambers, electromagnetic compatibility, electromagnetic interference.**

POWER SYSTEM ANALYSIS/COMPUTATION

Abstract—**Significant attention has been paid to the renewable energy resources such as wind power in recent years. It has potential benefits in curbing emissions and reducing the consumption of irreplaceable fuel reserves. However, the penetration of wind power into traditional fuel-based generation systems will also have some implications such as security concerns due to its unpredictable nature. Thus, in economic power dispatch with wind power penetration, a reasonable tradeoff between system risk and operational cost is desired. In this paper, a biobjective economic dispatch problem considering wind penetration is formulated, which treats economic and security impacts as conflicting objectives. Different fuzzy membership functions are used to reflect the dispatcher's attitude toward the wind power penetration. A modified multi-objective particle swarm optimization (MOPSO) algorithm is adopted to develop a power dispatch scheme which is able to achieve compromise between economic and security requirements. Numerical simulations including sensitivity analysis are reported based on a typical IEEE test power system to show the validity and applicability of the proposed approach.**

Abstract—**Subsection 1221(a) of the Energy Policy Act of 2005 calls for a study to determine national interest electric transmission corridors. These corridors are defined as "any geographic area experiencing electric transmission capacity constraints or congestion that adversely affects consumers." This paper presents a method to define a "direct flow" between two hubs using the power transfer distribution factors (PTDFs). With these hubs properly defined, the hope is to be**

ABSTRACT---**The author presents a commentary on traditionally accepted power concepts in classical electric power engineering. A revision of traditional terminology is proposed.**

Abstract—**The electric power courses at Western Kentucky University emphasize proficiency in both electric machines and the integration of these machines into complex systems via transmission lines. The electric machines considered are electromagnetic devices governed by abstract principles. Recently, the courses have been enhanced by the use of commercial finite element method (FEM) software, which calculates approximate solutions to the governing differential equations and permits visualization and animation to assist in the understanding and design of the devices. This paper will describe how the technology is being used to improve an evolving project-based electric power curriculum.**

Index Terms—finite element method, electromagnetic, machines

POWER SYSTEM MEASUREMENTS AND STATE ESTIMATION

Abstract: **This paper addresses the use of innovative and unconventional instrumentation technologies for power systems. The main focus is on giant magnetoresistance, Faraday and Poeckels and other optical effect devices, Hall effect devices, satellite measurement technologies, mechanical measurements, lab on a chip / chemical sensing, and video technologies. It is suggested to utilize overhead conductor mechanical and thermal measurements to provide corrections for state estimation applications.**

***Index Terms*: sensors, instrumentation, power system measurements, voltage, current, power.**

***Abstract*—A method for real time monitoring of overhead transmission line sags has been proposed. Mechanical state estimation is used to determine the sag value of each span of the transmission line using real time data. Use of separate tension sensors for critical spans enhances the sag estimation process. The estimated sag values can be used to calculate the clearance values to check for compliance with the national electric safety code (NESC).**

***Index Terms*— Conductor sag, state estimation, overhead conductor, available transfer capacity, tension, ruling span.**

Abstract--**This paper presents a robust state estimator for power system containing unified power flow controller. The state estimation problem is formulated as an optimization problem using weighted least absolute value criteria, with a set of equality and inequality constraints. The interior point optimization method is applied to primal and dual formulation in order to solve this problem. The modified IEEE 14-bus system is used to demonstrate the effectiveness of the proposed algorithm. The simulation results indicate that the method yields good estimation of the system states for a power system with UPFC.**

Index Terms—**Flexible ac transmission system devices, interior point method, state estimation, unified power flow controllers.**

Abstract—**Static state estimation in electric power systems is normally accomplished without the use of time-history data. This paper presents preliminary work on the use of the discrete-time Kalman filter to incorporate time history into the state estimators. Transitional state equations are derived via linearization of the power flow equations. A simplified example using a decoupled real power flow solution demonstrates this technique.**

Index Terms—**Kalman Filter, Electric Power System, Static State Estimation, Time History**

POWER SYSTEM OPERATIONS AND SCHEDULING

Abstract – **Deregulation creates competition amongst generator companies. The generator company objectives are to maximize their profit and to place proper bids in the market. In order to do this they need to determine the schedule and operating points based on the load and price forecasts. The traditional unit commitment problem aims at minimizing the cost of operation subject to fulfillment of demand. However in a deregulated environment the traditional unit commitment objective needs to be changed to maximization of profit with relaxation of the demand fulfillment constraint. This paper applies a genetic algorithm technique to price based unit commitment (PBUC) for GENCO with 3 generators and compares the solution with that obtained by dynamic programming. Proposed algorithm can be extended to 'n' number of generators.**

Index Terms - **Price based unit commitment, genetic algorithm, deregulation, dynamic programming.**

Abstract – **A unit commitment problem has long been known in the class of short-term functions and decisions, inherited from vertically integrated utility. In the competitive environment, the problem has become more complicated due to the fact that any action taken will now influence profitability of decision maker such as generation companies, load serving entities, and so forth. Thus, not only do economic agents face operational risks, but they also need to procure their operations against financial risks from volatility in fuel, contract, and electricity prices. This leads to the evolution of stochastic unit commitment in this paper integrating risk management tools, i.e.,**

basis for grid modernization through communications and computing for improved voltage support in multi control area system.

Index Terms—Voltage monitoring, grid modernization, communications in electric power system, performance index, system decomposition, multi-control area operations.

DISTRIBUTED GENERATION AND RENEWABLE ENERGY

Abstract—Power deregulation, which resulted in restructuring of the power industry, and shortage of transmission line capacities have led to increased interest in the use of distributed generation (DG) sources, mainly at the distribution level near load centers, for support of the utility grid. Moreover, technological advances in renewable (wind, solar) and other alternative energy DG (AEDG) sources, e.g. microturbines and fuel cells, coupled with environmental concerns over the use of conventional steam power plants have developed especial interest in their use. However, because of the non-dispatchable nature of renewable energy and slow nature of some alternative energy power generation sources, e.g. fuel cells, multi-source operation of these sources and/or their parallel operation with a storage device is necessary to make their operation more reliable. This paper discusses the need for multi-source operation of AEDGs. It reviews four different AEDG sources - wind, solar photovoltaic (PV), microturbine, and fuel cells – and discusses their multi-source operation for better power management and reliability.

Index Terms – Alternative energy, distributed generation, multi-source operation

Abstract— This paper presents a dynamic model of SOFC and the response of the fuel cell for sudden load changes. Slow response of the fuel cell prevents it from following the load. Hence connection with the DC/DC buck-boost converter is required. The models are developed in PSCAD with and without a feedback control system. Power characteristics obtained in order to validate the need of the DC/DC converter which allows the SOFC system to be used for load following applications.

Index Terms— Dynamic model, Solid Oxide fuel cell, DC/DC converter, load following.

Abstract—With new developments in technologies, grid-connected photovoltaic (PV) systems are becoming increasingly attractive as a generation technology, due to many factors, including environmental concerns and transmission congestion management. Additionally, PV generators are often paired with energy storage elements, such as batteries, to store excess power generated during off-peak hours to be returned to the system when generation is more expensive. For system economic operation, the PV/Battery commitment and dispatch must be optimal. However, the generation is not known in advance, as it is dependant on weather factors that are not completely predictable. This paper presents a unit commitment and economic dispatch solution for the PV/Battery system using fuzzy optimization to model the uncertainty in PV generation based on mixed-integer programming.

Index Terms— Day-Ahead Scheduling, Fuzzy Optimization, Photovoltaic

Abstract -- **The potential of offshore wind is among the newest technologies in renewable energy. Utilizing a 10% wind speed increase over open waters, an increase in power production can be seen of approximately 30%. In the present study, a location on Lake Michigan is determined based on the wind resources, lakebed depth, and ease of access to existing onshore substations and transmission lines. An analysis of the wind resources at the site will be used to determine if the development of the site is feasible. A turbine review and park layout analysis is completed to give the base for Part 2 (the design phase). Part 2 outline is presented.**

Index Terms -- **Offshore wind, Lake Michigan, Wind Speed Analysis.**

Abstract—**Alternative energy sources are becoming a focus in the energy industry as the world realizes that its dependency on fossil fuels must diminish because of pollution, oil prices, and other factors. For this reason, it's important that students do have exposure to some of the alternative energy sources available in the 21st century. The analog model power system provides students with the opportunity to explore and understand a typical power transmission system. Course intructors wish to expand and improve this system to include alternative energy sources. This project facilitates the learning experience for students and enables them to experiment with fuel cells as distributed generation sources.**

Index Terms—**Hydrogen Fuel Cell, Alternative Energy, Synchronization, Analog Model Power System.**

TRANSIENT STABILITY/VOLTAGE STABILITY

Abstract—**This paper is aimed to the analysis of the inclusion of a pulse width modulated (PWM) AC link unified power flow controller into a power flow and the transient stability formulation in order to regulate the active and reactive power flow on the corresponding transmission line. Such model is tested on a multi-machine power system.**

Index Terms— **ac-ac power conversion, power electronics, power control.**

Abstract—**Steady state analysis cannot provide the details of how system evolves in cascading failure. Dynamic response of generator plays an important role in power system operation and blackout events. In this paper, classical generator and detail generator models are integrated into system model for cascading dynamic simulations.. The cascading scenarios are compared using both steady state and dynamic simulations. Classical models are simpler; however, the detailed generator model is more accurate. Generator performance of speed deviation and angle deviations as well as the bus voltage profile are investigated for various scenarios. The IEEE 118-bus, 20-generator test case is used as the test system.**

Index Terms—**Blackout, generator modeling, power system dynamic performance, transient stability.**

POWER LINE INSULATORS AND CIRCUIT BREAKERS