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2010 Power and Energy Society

Student Poster Contest

Advanced Program – D R A F T

Monday 26 July 2010

Minneapolis Convention Center

Minneapolis, Minnesota, USA

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Welcome

The IEEE PEEC Student Activities Subcommittee welcomes you to Minneapolis, Minnesota for the 2010 Power & Energy Society General Meeting Student Poster Contest. This document has been put together to serve as a record of the outstanding work that has been prepared by almost 140 students from around the world. The material presented represents most all topics in power and energy engineering. The posters have been arranged by topic in the following broad areas: Transmission & Distribution, Electric Machinery & Measurements, Energy Development, Power Systems Analysis, Power Systems Control, Power Systems Economics, Power System Protection & Security, and Power System Stability.

The student program at the 2010 General Meeting is a true testament of the IEEE Power & Energy Society's commitment to internationalization and the development of future engineers. The student program at the General Meeting is made possible because of the support received from the Grainger Foundation.

Sincerely,
Student Activities Subcommittee

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Missouri University of Science & Technology

Dr. S. Suryanarayanan, Vice-Chair
Colorado School of Mines

Dr. A. Srivastava, Secretary
Mississippi State University

Dr. H. Louie, Secretary-Elect
Seattle University

List of Participants

Poster	Name	University
Distribution & Transmission		
XXXX	Juan Li	University College Dublin
XXXX	Farhad Shahnia	Queensland University of Technology
XXXX	Mohamed Elshaer	Florida International University
XXXX	Benyamin Moradzadeh	University of Tennessee
XXXX	Sumit Paudyal	University of Waterloo
XXXX	Peter Richardson	University College Dublin
XXXX	Iman Ziari	Queensland University of Technology
XXXX	Yu Takamizawa	Waseda University
XXXX	Valentina Cecchi	Drexel University
XXXX	Hao Chen	Iowa State University
XXXX	Yousef Pipelzadeh	Imperial College London
Electric Machinery & Measurements		
XXXX	Mahmoud Amin	Florida International University
XXXX	Yan Ma	Arizona State University
XXXX	Donald Fentie	University of Saskatchewan
XXXX	Yaw Nyanteh	Florida State University
XXXX	Xu Yang	University of Nebraska-Lincoln
XXXX	Hung-Ming Chou	Texas A&M University
XXXX	Yanni Li	Iowa State University
XXXX	Siyu Leng	Florida State University
XXXX	Prashant Kansal	Washington State University
XXXX	Shaotong Guo	Washington State University
XXXX	Jie Yan	Iowa State University
XXXX	Soma Shekara Depuru	University of Toledo, Ohio
XXXX	Krishna Prasad Bhat	University at Buffalo (SUNY Buffalo)
Energy Development		
XXXX	Don Jacob	The University of Texas at Arlington
XXXX	Maren Kuschke	TU Berlin
XXXX	Amirhossein (Amir) Hajimiragha	University of Waterloo
XXXX	Dingguo Lu	University of Nebraska-Lincoln
XXXX	Xiang Gong	University of Nebraska-Lincoln
XXXX	Juan Jimenez	Drexel University
XXXX	Murali Bottu	Missouri University of S&T
XXXX	Christopher Lohmeier	University of Nebraska - Lincoln
XXXX	Yuya Maruno	Waseda University
XXXX	Ashishkumar Solanki	University of Wisconsin - Milwaukee
XXXX	Andrew Tubesing	New Mexico Institute of Mining and Technology
XXXX	Haiping Yin	Univeristy of South Florida
XXXX	Chanxia Zhu	University of South Florida
XXXX	Taesic Kim	University of Nebraska-Lincoln
XXXX	Michael Knauff	Drexel University
XXXX	Amir Hossein Shahirinia	University of Wisconsin - Milwaukee
XXXX	Shengnan Shao	Virginia Tech
XXXX	Reza Arghandeh Jouneghani	Virginia Tech

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Poster	Name	University
XXXX	Yingzhong Gu	Texas A&M University
	Power Systems Analysis	
XXXX	Niannian Cai	Michigan State University
XXXX	Darshit Shah	Missouri S&T
XXXX	Laxman Subedi	Kansas State University
XXXX	Peng Zhao	CSM
XXXX	Bipul Luitel	Missouri University of Science and Technology
XXXX	Nadim Kan'an	MASDAR institute of science and technology
XXXX	Kai Yin Kenny Poon	Washington State University
XXXX	Nayeem Mohammad Abdullah	Florida International University
XXXX	Mostafa Sahraei-Ardakani	Pennsylvania State University
XXXX	Chuan Fu	Iowa State University
XXXX	Diogenes Molina	Georgia Tech
XXXX	Qiang Fu	University of Wisconsin - Milwaukee
XXXX	Nikhil Gudi	University of Toledo, Ohio
XXXX	Wencong Su	North Carolina State University
XXXX	Yurong Wang	The University of Tennessee
XXXX	Hui Zhang	Arizona State University
XXXX	Junhui Zhao	Wayne State University
XXXX	Qun Zhou	Iowa State University
XXXX	Mohamed Kamh	University of Toronto
XXXX	Amir Motamedi	University of Calgary
XXXX	Bharadwaj Ranganathan Sathyanarayana	Arizona State University
XXXX	Che Guan	University of Connecticut
XXXX	Sasidharan Sreedharan	Asian Institute of Technology-AIT
	Power Systems Control	
XXXX	Hugo Morais	Institute of Engineering Polytechnic of Porto
XXXX	Scott Ghiocel	Rensselaer Polytechnic Institute
XXXX	Pinaki Mitra	Missouri S&T
XXXX	Yingzhong Gu	Texas A&M University
XXXX	Mei Li	Iowa State University
XXXX	Ali Mehrizi-Sani	University of Toronto
XXXX	Chengrui Cai	Iowa State University
XXXX	Sanjay Chaudhary	Aalborg University
XXXX	Jing Dai	Georgia Institute of Technology
XXXX	Baohua Dong	University of Nebraska-Lincoln
XXXX	Yi Du	Georgia Institute of Technology
XXXX	Xianyong Feng	Texas A&M University
XXXX	Alexander Melhorn	The University of Tennessee
XXXX	Wei Sun	Iowa State University
XXXX	Sarina Adhikari	The University of Tennessee
XXXX	Huijuan Li	The University of Tennessee
XXXX	Seyyed Ali Pourmousavi Kani	Montana State University
XXXX	Dipendra Rai	University of Saskatchewan
XXXX	Chuan Yan	Missouri S&T
XXXX	Ramon Zamora	Mississippi State University
XXXX	Farshid Shariatzadeh	Mississippi State University
	Power Systems Economics	
XXXX	Yen-Yu Lee	University of Texas
XXXX	Yang Gu	Iowa State University

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Poster	Name	University
XXXX	Anita Ann Jose	Kansas State University
XXXX	Yanli Wei	The University of Tennessee
XXXX	Ali Al Awami	University of Washington
XXXX	Niamh Troy	University College Dublin
XXXX	Chanwit Boonchuay	University of Tennessee
XXXX	David Pozo	University of Castilla - La Mancha
XXXX	Yi Sun	The University of Hong Kong
XXXX	Yan Yang	The University of Tennessee
XXXX	Nanpeng Yu	Iowa State University AND University College Dublin
XXXX	Shan Jin	Iowa State University
Power Systems Protection & Security		
XXXX	Wenhao Zhang	Myongji University
XXXX	Ning Kang	University of Kentucky
XXXX	Hua Lin	Virginia Polytechnic and State University
XXXX	SeungYong Seo	Myongji University
XXXX	Trevor Sawatzky	University of Saskatchewan
XXXX	Mariya Babiy	University of Saskatchewan
XXXX	Binod Shrestha	University of Saskatchewan
XXXX	Hanif Livani	University of Nevada Reno
XXXX	Robert Green	University of Toledo
XXXX	John MacCormack	University of Calgary
XXXX	Sara Eftekharnejad	Arizona State Univ
XXXX	Maryam Hassani Variani	University of Tennessee
XXXX	Padmavathy Kankanala	Kansas State University
XXXX	Pedram Jahangiri	Mississippi State University
XXXX	Sudipta Lahiri	Drexel University
XXXX	Salman Kahrobaee	University of Nebraska-Lincoln
XXXX	Caixia Wang	Iowa State University
XXXX	Emil Johansson	Norwegian University of Science and Technology
XXXX	Hao Huang	The University of Tennessee
XXXX	Lei Tang	Iowa State University
XXXX	Yusuf Yare	Missouri S&T
XXXX	Guodong Liu	University of Tennessee
Power System Stability		
XXXX	Yuichi Morishita	.
XXXX	Jimmy Peng	University of Auckland
XXXX	Felix Rafael Segundo Sevilla	Imperial College London
XXXX	Jiakun Fang	Huazhong University of Science and Technology
XXXX	Jawad Arif	Imperial College London
XXXX	Zhiqiang Jin	The University of Tennessee
XXXX	Theresa Odun-Ayo	Missouri University of S&T
XXXX	Joseph Makasa	Missouri S&T
XXXX	Jonathan Berardino	Drexel University
XXXX	Atsushi Enomoto	Waseda University
XXXX	Anshuman Vaidya	Missouri S&T
XXXX	Yunfei Wang	University of Alberta
XXXX	Yasser Wehbe	University of South Florida
XXXX	Ralph Wilson	Florida State University

Abstracts

1. Juan Li, Chen-Ching Liu, Kevin Schneider
   University College Dublin
   Poster Title: Distribution System Restoration Based on Graph Theoretic Algorithms
   Abstract: The distribution system restoration aims to restore loads after a fault by altering the topological structure of the distribution network while electrical and operational constraints have to be met. Such a network reconfiguration process is usually achieved by changing open/closed states of some tie and sectionalizing switches in the distribution system. This poster presents a graph theoretic distribution restoration strategy that maximizes the amount of load to be restored and minimizes the number of switching operations. The spanning tree structure in graph theory is employed to describe the radial distribution network. Graph theoretic algorithms are applied to search for the candidate restoration strategies. Three-phase power flow calculation is applied to eliminate the infeasible solutions and reduce the searching space. Simulation results obtained from the taxonomy feeders demonstrate the effectiveness of the proposed approach.

2. Farhad Shahnia, Ritwik Majumder, Arindam Ghosh, Gerard Ledwich, Firuz Zare
   Queensland University of Technology
   Poster Title: Sensitivity Analysis of Voltage Imbalance in Distribution Networks with Rooftop PVs
   Abstract: A comprehensive voltage imbalance sensitivity analysis and stochastic evaluation based on the rating and location of single-phase grid-connected rooftop photovoltaic cells (PVs) in a residential low voltage distribution network are presented. The voltage imbalance at different locations along a feeder is investigated. In addition, the sensitivity analysis is performed for voltage imbalance in one feeder when PVs are installed in other feeders of the network. A stochastic evaluation based on Monte Carlo method is carried out to investigate the risk index of the non-standard voltage imbalance in the network in the presence of PVs. The network voltage imbalance characteristic based on different criteria of PV rating and location and network conditions is generalized. Improvement methods are proposed for voltage imbalance reduction and their efficacy is verified by comparing their risk index using Monte Carlo simulations.

3. Mahmoud M. Amin, Mohamed A. Elshaer, O. A. Mohammed
Florida International University
Poster Title: DC Bus Voltage Control for PV Sources in a DC Distribution System Infrastructure
Abstract: This paper proposes a design of a controlled voltage bus for a PV source to be used in a hybrid DC distribution system infrastructure. Load centers, boost converter, and distribution panels combine to link the solar collectors with multiple loads and Backup battery systems add to the complexity of a PV installation. The controlled voltage bus is constructed based on the design of a DC-DC boost converter. A Traditional DC-DC boost converter is limited to get a constant DC voltage as an input and boosting it to a certain voltage level as long as the load is fixed.

4. Benyamin Moradzadeh, Kevin Tomsovic
University of Tennessee
Poster Title: Mixed Integer Programming for Distribution System Reconfiguration and Restoration
Abstract: This work presents the application of mixed integer programming (MIP) in solving reconfiguration problem for a stressed distribution network or restoration following a fault. The objective is to minimize the number of switching operations with respect to operational constraints, such as, load balance, line flow limits, and radiality of the network. The latter is the most challenging issue in solving the problem by MIP. A novel approach is implemented in this study to maintain the radiality of the network during the reconfiguration process. Recent improvements in MIP algorithms and processor speed have dramatically improved computational time, thus, allowing the approach to be practical for online application. Numerical simulations of the proposed method on a realistic distribution system model demonstrate the feasibility of the proposed algorithm.

5. Sumit Paudyal, Claudio A. Caizares, Kankar Bhattacharya
   University of Waterloo
   Poster Title: Optimal Operation of Distribution Feeders in Smart Grids
   Abstract: This research proposes a generic three-phase Distribution Optimal Power Flow (DOPF) model that can be used by Local Distribution Companies to integrate their feeders into Smart Grids. In the DOPF model, a new distribution system operation objective is proposed which is based on the minimization of the energy drawn from the substation while limiting the number of switching operations of load tap changers and capacitors. A novel method for solving the DOPF model by transforming the mixed-integer non-linear programming problem to a non-linear programming problem using quadratic penalty function is proposed to reduce the computational burden and facilitate its practical implementation and application. Two practical case studies, including a real distribution feeder example, are carried out to demonstrate the features of the proposed methodology. The results illustrate the benefits of the proposed DOPF in terms of reducing energy losses while limiting the number of switching operations.

6. Peter Richardson, Damian Flynn, Andrew Keane
   University College Dublin
   Poster Title: Impact Assessment of Varying Penetrations of Electric Vehicles on Low Voltage Distribution Systems
   Abstract: Advances in the development of electric vehicles, along with policy incentives will see a wider uptake of this technology in the transport sector in future years. However, the widespread implementation of electric vehicles could lead to adverse effects on power system networks, especially existing distribution networks. This work investigates some of the potential impacts from various levels of uncontrolled electric vehicle charging on a test distribution network. The network is examined under worst case scenario conditions for residential electricity demand in an effort to assess the full impact from electric vehicles. The results demonstrate that even for relatively modest levels of electric vehicle charging, both the voltage and thermal loading levels can exceed safe operating limits. The results also indicate the importance of assessing each phase on the network separately in order to capture the full effects of uncontrolled electric vehicle charging on the network.

7. Iman Ziari, Gerard Ledwich, Arindam Ghosh, David Cornforth, Michael Wishart
Queensland University of Technology
Poster Title: Optimal Allocation and Sizing of DGs in Distribution Networks
Abstract: In this paper, the placement and sizing of Distributed Generators (DG) in distribution networks are determined using optimization. The objective is to minimize the loss and to improve the reliability at lowest cost. The constraints are the bus voltage, feeder current and the reactive power flowing back to the source side. The placement and size of DGs are optimized using a combination of Discrete Particle Swarm Optimization (DPSO) and Genetic Algorithm (GA). This increases the diversity of the optimizing variables in DPSO not to be trapped in a local minimum. To evaluate the proposed algorithm, the semi-urban 37-bus distribution system connected at bus 2 of the Roy Billinton Test System (RBTS), which is located at the secondary side of a 33/11 kV distribution substation, is used. The results illustrate the efficiency of the proposed method.

8. Yu Takamizawa, Keisuke Ueda, Shinichi Iwamoto, Yoshinori Kato, Masafumi Shimazu
Waseda University
Poster Title: Transmission Reinforcement Planning using Pareto Optimal Set
Abstract: With the period of high economic growth extending until the 1990s, the power demand has been increasing sharply year by year. Therefore, the electric power utilities have installed many electric power facilities to cope with the predicted demand. However, in recent years, fewer apparatuses have been installed because electric power demand growth is saturated due to low economic growth. Therefore, in electric power facility planning, it is necessary to form a rational reinforcement planning with multi-objective aspects. In this paper, we propose a new transmission reinforcement planning prioritization method using a Pareto optimal set as a multi-objective optimization method. Here, we evaluate the total heavy-loaded power flows, the power flow changes and the transmission losses. Finally we carry out simulations for the IEEJ EAST 10-machine -O/V model system and determine the transmission reinforcement planning priority to confirm the validity of the proposed method.

9. Valentina Cecchi, Karen Miu
   Drexel University
   Poster Title: System Impacts of Transmission Line Models Incorporating Ambient Temperature Variations
   Abstract: This work discusses system impacts of segmented transmission line models. These models are characterized by multiple non-uniform lumped segments and have been developed to capture a temperature gradient along the line. Given a set of ambient temperature measurements, a Matlab-based tool performs power flow analysis on a multi-bus system. The tool first determines, for each branch in the system, appropriate model segmentation and segment parameter values. Then, it executes power flow calculations. Preliminary results of the tool are presented for an example system.

10. Hao Chen, Dionysios Aliprantis
    Iowa State University
    Poster Title: Low-Frequency Transmission for Wind Power Plants
    Abstract: Geographic sites that are suitable for the wind power plant development are in remote land locations or offshore locations, far from the main transmission grid and major load centers. The transmission of wind power to the main grid is a major expenditure that adversely affects the economics of wind power generation systems. In order to decrease the cost of transmission and make the wind power plant a more reliable power source so that the capacity credit can increase, the low-frequency AC transmission is proposed. The comprehensive evaluation of the technical performance and economics of low-frequency AC transmission, in comparison to HVDC and power-frequency AC transmission will be performed.

11. Y.Pipelzadeh, B.Chaudhuri, T.C.Green
Imperial College London
Poster Title: System Impacts and Opportunities of HVDC Upgrades
Abstract: A case study on the Australian equivalent system - recently adopted as an IEEE benchmark for stability studies is presented here to illustrate power oscillation damping (POD) through HVDC links. Wide-area signals are used for supplementary modulation of the HVDC power order driven through a multi-variable controller. The test case is set up in DIgSILENT and benchmarked against the standard results. Linearized model around the nominal condition is obtained by using subspace identification on a set of measurements derived out of probing the system through the HVDC link. Modal analysis is carried out to identify a set of feedback signals for the controller. Pole-placement technique is used to design a MISO controller in two different frameworks i) observer driven state feedback and ii) optimized lead-lag compensators. The effectiveness of HVDC modulation for POD is validated through eigen-value analysis and non-linear simulation (in DIgSILENT) over a range of operating conditions.

12. Mahmoud Amin, Prof. Dr. Osama Mohammed
Florida International University
Poster Title: DC-Bus Voltage Control of Three-Phase PWM Converters connected to Wind Powered Induction Generators
Abstract: This paper presents a performance analysis of wind powered self-excited induction generator (SEIG) and a vector controlled PWM converter. The origin of difficulties in the control of the above converters is in their nonlinear nature. The PWM current control technique is used to derive the switching signals for the converter. Closed-loop control of the converter utilizes a conventional proportional integral (PI) controller. In order to examine the dynamic performance of the system, its model is simulated and results are analyzed. The simulation results and experimental results are presented. The experimental results were obtained using Dspace DS1104 R&D controller board which confirms good performance of the proposed control system and agree with the simulation results. The results verify the validity of the proposed model and show practical promise in renewable energy applications.

13. Yan Ma, George G. Karady, James R. Hunt
    Arizona State University
    Poster Title: Investigation of Electrical Substations Generated
    Abstract: To measure the magnetic field generated by SRPs urban substations and provide an independent and unbiased assessment of the magnetic field in nearby areas.

14. Mr. Donald Fentie, Dr. Rama Gokaraju, Dr. Sherif Faried
    University of Saskatchewan
    Poster Title: Transient Modeling of the 'Sen' Transformer
    Abstract: The Sen Transformer (ST) is a new Flexible AC Transmission Systems (FACTS) device that uses a number of magnetically-coupled, series windings to economically provide independent active and reactive power flow control in a transmission line. This is the first work addressing the transient model of the ST including: phase-to-phase coupling, zero sequence leakage impedance, and saturation effects. Two transient ST models were created and compared. The first model uses a hybrid transformer method where a fictitious transformer winding is attached to a topologically correct electric equivalent of the magnetic core. Simulations are performed with an ElectroMagnetic Transients Program (EMTP). The second model uses Finite Element Analysis (FEA) to achieve the most accurate results for comparison. The transient results from the two programs are compared for different types of faults in order to access the accuracy of the hybrid ST model.

15. Yaw Nyanteh, Chris Edrington, Sanjeev Srivastava, Touriah El-mezyani, David Cartes
Florida State University
Poster Title: Application of Artificial Intelligence to Fault Detection and Diagnosis of Electric Machines
Abstract: Experimental and computer simulation data have been analyzed for time domain and frequency domain information. Simulation data is used to create an Artificial Neural Network (ANN) for model based fault detection. Time domain analysis is carried out with data obtained from an actual experimental setup. The frequency domain analysis is obtained from a Finite Element Analysis (FEA) carried out in Magnet software. Fault conditions considered include internal short circuited windings, saturation and inrush conditions. Particle Swarm Optimization (PSO) is used to adjust the ANN weight and bias matrix for fast convergence. Work is ongoing to develop FEA models that balance computation speed and accuracy. The fast convergence of the ANN using PSO shows that this method can be applied to create adaptive ANN using Real Time PSO (RTPSO).

16. Xu Yang, Xiang Gong, Wei Qiao
University of Nebraska-Lincoln
Poster Title: Mechanical Sensorless Maximum Power Tracking Control for PMSG Wind Turbines
Abstract: Wind turbine generators (WTGs) are usually equipped with mechanical sensors to measure wind speed and rotor position for system control, monitoring, and protection. This poster presents a mechanical sensorless maximum power tracking control for wind turbines equipped with permanent magnetic synchronous generators (PMSGs). The PMSG rotor position is estimated from the measured stator voltages and currents by using a sliding mode observer. The turbine shaft speed is then determined from the estimated back EMF. An artificial neural network is designed to generate the optimal shaft speed reference in real time by using the estimated turbine shaft speed and measured PMSG electrical power. A control system is developed to continuously track the optimal shaft speed reference to generate the maximum power from the WTG without using any mechanical sensors. The control algorithm is validated by simulation and experimental results on a PMSG wind turbine.

17. Hung-Ming Chou
    Texas A&M University
    Poster Title: Modeling and Simulation of Propulsion System for Integrated Ship Power Systems in PSCAD
    Abstract: In the recent development of ship power systems, integrated power system (IPS) configurations have brought revolution, where a set of generators is used to supply power to ship service and combatant loads as well as propulsion systems. Since propulsion systems consume bulk amount of power, its impact on the ship power system, such as harmonics, transient dynamics, system stability, should be investigated. To model and control propulsion system, volt/Hz and field-oriented vector control techniques are implemented. A novel method of modeling the hydrodynamics of ships is implemented. PSCAD is used to simulate a simple IPS system. The performances of volt/Hz and field-oriented vector control are compared. The impact of the propulsion system on the ship power system is investigated. The result shows that field-oriented vector control has superior performance and some measures have to be implemented to reduce the undesirable impact of propulsion system on the ship power system.

18. Yanni Li
    Iowa State University
    Poster Title: Sculpting Electric Machines for Unidirectional Motion
    Abstract: The vast majority of generators and motors rotate in a single direction over the span of their lifetimes. With this operational characteristic taken into account, the objective of this research is to study the improvement in electric machine operation for unidirectional motion. The approach is precisely sculpting the stator and rotor surfaces, thus affecting the electromagnetic field in the air gap so that the production of electromechanical torque is increased. This research will result in lighter-weight, more efficient and more cost-effective solutions for electromechanical energy conversion for virtually all generation and motion applications.

19. Siyu Leng, II-Yop Chung, Chris S. Edrington, David A. Cartes
Florida State University
Poster Title: Real-Time Coordination of Multiple Reconfigurable Adjustable Speed Drives for Power Quality Improvement
Abstract: A new control strategy is proposed to coordinate multiple reconfigurable adjustable speed drives to compensate harmonic currents as well as reactive power generated by large nonlinear loads. Under the proposed control strategy, the power quality improvement task is distributed to multiple reconfigurable adjustable speed drives proportional to their instantaneous power margin. Therefore, the proposed control strategy can provide a flexible and economical solution for power quality improvement. In the meanwhile, the potential of the overall adjustable speed drive system is fully utilized and optimized. Simulation results verify the performance of the proposed coordination control strategy.

20. Prashant Kansal, Anjan Bose
Washington State University
Poster Title: Data and Communication Requirements for the Smart Grid Applications
Abstract: This research at Washington State University delves into the Data and Communication requirements of the various Smart Grid Applications. These requirements vary from application to application; for example Transient Stability Applications need small amount of fast sampled Data (30 samples/sec) with very short delay (100ms), Analysis Applications need huge amount of fast sampled Data (30 samples/sec) with any almost no delays requirements, Monitoring Applications need huge amount of slow sampled accurate Data (1 samples/sec) with 1-5 seconds of delay, Control Application needs small amount of fast sampled Data (30 samples/sec) with 1-5 seconds of delay and so on. In this research, we are trying to put all these requirements together and to determine the hardware requirements of the common scalable communication infrastructure that is needed to support all the future Smart Grid Applications.

21. Shaotong Guo
    Washington State University
    Poster Title: A New Data Communication Improvement in Power System
    Abstract: Our research is mainly focus on improving communication quality of power system. This topic is an interdisciplinary field associates with power system, network communication, distribution control. We have completed the first step for collect and analyze requirements of equipments and applications in distributed power system. It includes external and internal sampling rate, size and content of necessary data.The communication been discussed include:PMU-PDC, PMU-SCADA, DFR, SER, DPR, WAP, WAC, SPS, AGC,etc. The following step is to apply these requirements into system models, do relevant simulation, compare performance and provide suggestions to applications. In such way superfluous data will not stuck communication channel in emergencies and all necessary data are ready for use when disturbance happened, and more time are left for decisions for emergencies, which is critical for lower economic loss. The system would be more robust and stable and finally achieve Smart Grid.

22. Jie Yan, Chen-Ching Liu, Govindarasu Manimaran
    Iowa State University
    Poster Title: Cybersecurity for SCADA System of Wind Farms
    Abstract: Wind Power technology has reached a very reliable and sophisticated level, while the cybersecurity of wind farm has not been fully explored. Different types of cyber systems are implemented in todays wind farms. These cyber systems have vulnerabilities, which could be exploited by hackers to launch attacks and cause significant loss for wind farms. The goal of this project is to identify the vulnerabilities of the cyber systems of wind farms, study the consequences of attacks that exploit the vulnerabilities, and suggest appropriate mitigation method after cost/benefit analysis.

23. Soma Shekara Sreenadh Reddy Depuru, Lingfeng Wang, and Vijay Devabhaktuni
University of Toledo, Ohio
Poster Title: A Conceptual Design Using Harmonics to Reduce Pilfering of Electricity
Abstract: Electricity theft is a major problem in developing countries. This paper proposes an architectural design of smart meter, external control station, harmonic generator, and filter circuit, which can detect and chastise the appliances of people responsible for electricity theft. Motivation of this work is to deject the illegal consumption and conserve electricity. Total loss in the distribution feeder is computed by the external control station from the values of total load and technical losses in the distribution feeder. If considerable amount of non-technical losses are detected at any given feeder, harmonic generator is operated for introducing harmonics into the feeder for destroying the appliances of the illegal consumers. In addition, harmonic analysis of the distribution feeder and consumer appliances due to the presence of harmonics is carried out to estimate the effect of induced harmonics. Cost-benefit analysis for implementation of the proposed system for India is presented.

24. Krishna Prasad Bhat, Dr. Douglas C. Hopkins, Dr. Kwang Oh.
University at Buffalo (SUNY Buffalo)
Poster Title: Augmenting Buchholz Relay Using MEMS Gas Sensor
Abstract: The poster addresses the use of a MEMS sensor system to augment the Buchholz Relay, for protection of oil insulated Transformers. The proposed device is attached to the winding within the insulating oil, and primarily consists of multiple micro scale turbines centrally shafted to a MEMS generator. The device utilizes relative differences in velocity, pressure and flow rate, of gas emanating from stressed or degrading insulation. A differential electrical output is produced which can be RF coupled to a user interface.

25. Don Jacob
    The University of Texas at Arlington
    Poster Title: Nonlinear and Chaotic Phenomena in Power Converters with Nonlinear Loads.
    Abstract: The buck converter is essentially a DC/DC converter that steps down voltage just like a transformer which steps down voltage but in AC. Buck converters have several topologies; however in this paper the most common buck converter topology is used. . In this report control and operation of the buck power converter with constant power load is studied in detail. This buck converter is a nonlinear system. The presentation aims at providing an insight into appreciating the challenges involved in designing nonlinear controllers (using MATLAB SIMULINK) for a buck converter with nonlinear load.

26. Maren Kuschke, Prof. Kai Strunz
    TU Berlin
    Poster Title: Efficient Control of Tidal Energy Conversion Systems: Enhancing Knowledge from Wind Power Analogy
    Abstract: This poster presents an innovative grid integration concept of tidal energy conversion systems (TECS) with special regard to system efficiency and robustness. While underwater, TECS are based on a similar conversion principle as wind power systems. There are also significant differences. Tidal energy has an advantage in that tides can be predicted more accurately. But tidal energy has the disadvantage that its situation underwater makes maintenance more difficult. These observations are behind the proposed innovations. First, it is shown how maximum power point tracking can be made more fail safe. Second, it is demonstrated how fault ride through is supported. These methods are discussed and validated by simulation.

27. Amirhossein Hajimiragha, Claudio A. Canizares, Michael W. Fowler
University of Waterloo
Poster Title: Sustainable Convergence of Electricity and Transport Sectors in Ontario, Canada in View of Fuel Cell and Plug-in Hybrid Electric Vehicles
Abstract: Transportation is one of the sectors that directly touches the major challenges that energy utilities are faced with: significant increase of energy demand and environmental issues. In view of these considerations and the problems with the supply of oil, the issue of alternative fuels for meeting the future energy demand of the transport sector has gained much attention. Fuel cell vehicles (FCVs) and plug-in hybrid electric vehicles (PHEVs) are believed to be the future of transportation due to their technical and environmental benefits. The main idea presented in this poster is to demonstrate how the electricity network can be optimally exploited during off-peak hours for generating hydrogen for FCVs or charging the batteries in PHEVs. In order to do so, comprehensive robust optimization models for transition to these vehicles are developed, considering the constraints of both electricity grid and transport sector as well as the issue of data uncertainty.

28. Dingguo Lu, Wei Qiao
University of Nebraska-Lincoln
Poster Title: Wind Tunnel- An Advanced Platform for Wind Turbine Studies in a Laboratory Environment
Abstract: Wind tunnels offer an effective means to study wind turbines in a laboratory environment where natural wind sources are not available. This poster presents the development of a wind tunnel which provides environment close to natural environment for wind turbine testing. A suction wind tunnel is designed by using fluid dynamic software through which various airflow simulations are carried out to validate the design. A small prototype is then constructed with a 1:8 scale for further validation and optimization. According to the results from the prototype, a 6mx2.5mx2.5m wind tunnel is built where controllable airflows are generated by an adjustable-speed fan. Uniform airflow velocities are achieved in the testing area inside the wind tunnel and turbulences can be eliminated. The airflow parameters can be monitored while carrying out the experiments. The wind tunnel provides an all-weather condition, easy-access, efficient, and safe platform for study various issues of wind turbines.

29. Xiang Gong
University of Nebraska-Lincoln
Poster Title: Wind Turbine Shaft Imbalance Detection Using Electrical Signals
Abstract: This poster investigates the detection of wind turbine shaft imbalance by using electrical signals. Two types of shaft imbalance are studied, i.e., blade imbalance and aerodynamic asymmetry. Blade imbalance is studied by changing the mess density of one blade, which creates an uneven distribution of the rotor mess. Aerodynamic asymmetry is studied by setting different pitch angles for each blade, which creates an uneven torque on the rotor. The dynamics of a model wind turbine generator (WTG) are simulated using TurbSim, FAST, and Simulink under variable wind speed and various shaft imbalance conditions. A method based on power spectrum density (PSD) analysis is developed to detect these shaft imbalance faults using the output electrical power of the WTG. The results show that both the blade imbalance and the aerodynamic asymmetry create excitations in the output electrical power at the rotating frequency of the wind turbine and can be effectively detected by using the proposed method.

30. Juan C Jimenez, Chika O Nwankpa, Anawach Sangswang
Drexel University
Poster Title: DC-DC Buck-Boost Converter Parameter Space Design based on Regions of Operation
Abstract: DC-DC power converters have extensive industrial applications so it is essential for the design engineer to have a broad knowledge about the system behavior at different regions in the parameter space. Given that there are numerous inevitable sources of undesired nonlinearities in power electronic circuits, the complexity in the operation of power converters can be appreciated. This work presents the deterministic analysis of DC-DC converter stability under the influence of varying system parameters. The region of operation is obtained and quantified based on the occurrence of bifurcations of operating points. Simulation of a DC-DC buck-boost converter with voltage and current feedback control is presented and a graphical depiction of feasible regions of operation is shown.

31. Murali Bottu, Dr. Mariesa L. Crow
Missouri University of S&T
Poster Title: Design of a Conditioner for Smoothing Wind Turbine Output Power
Abstract: As a result of wind speed intermittency, highly variable wind power output can adversely impact local loads. We propose a conditioner to smooth the wind power by utilizing the energy of an ultracapacitor. The conditioner is based on a single phase voltage source inverter (VSI) connected between the grid interconnection point and the ultracapacitor. The shunt VSI injects or absorbs active power from the line to smooth the wind power by utilizing the short term storage capabilities of the ultracapacitor. The ultracapacitor is connected to the DC link through a DC-DC converter, which maintains the voltage of the DC link relatively constant to provide good controllability of the VSI. The control strategies for the conditioner are presented in this poster. The simulation results show that the conditioner is efficient in smoothing the wind power. The conditioner design and control will be validated on a Skystream3.7 wind turbine installed at Missouri University of Science & Technology.

32. Christopher Lohmeier, Doug Dietze, Wei Qiao
University of Nebraska-Lincoln
Poster Title: Highly Efficient MPPT and Voltage Control for PV Panels
Abstract: Maximum power point tracking circuits have been used to increase the efficiency of solar panels for many years. However, these circuits rarely have the ability to control the voltage output in one simple, cheap circuit design. What is being proposed here is a simple, efficient circuit design to be used between the output of a solar panel and storage batteries. The converter should be able to output a voltage higher than the electrical grid, so transferring power from the batteries to the electrical grid can also be done cheaply and efficiently.

33. Yuya Maruno, Satoshi Horiuchi, Shinichi Iwamoto
Waseda University
Poster Title: Load Frequency Control with a NAS Battery System Considering Large Penetration of Wind Power Generation
Abstract: Recently, some renewable energy sources such as wind power generators have been introduced because of environmental problems. However, the output variation of the wind power generators are so large that negative influences such as frequency deviations are of great concern. In this paper, we propose a method of suppressing the frequency deviations due to the wind power generators using a NAS battery system which is a kind of electric power-storage batteries. In order to verify the validity of the proposed method, numerical simulations are carried out using a two-area LFC model and we evaluate the installed capacity of the NAS battery system introduced into the power system.

34. Ashishkumar K Solanki, Dr. David Yu
University of Wisconsin - Milwaukee
Poster Title: Major Breakthrough in Wind Energy Cycloconverter Technology
Abstract: Wind can play a major role to meet increasing demand of energy. Wind Energy is important because wind exists everywhere on the earth. Secondly there is technological capacity in Wind. These two factors inspire us to use wind energy. But we also need to consider two more factors. A vision of a new way to use the wind power and government support is required to make it happen. Government from all over the world is encouraging use of wind energy. Introduction of Power electronics to Wind Energy gave us a new direction. The principle idea of the poster is to use Cycloconverter in Wind Energy System. In present scenario we are using Rectifier Inverter pair to connect the wind turbines to the grid. The poster proposes a scheme to use a single step converter instead of two step converter. This poster gives a comparison of back to back converter and cycloconverter. This poster is an attempt to identify the advantages and disadvantages of cycloconverter over the back to back converter.

35. Andrew Tubesing, Kevin Wedeward
New Mexico Institute of Mining and Technology
Poster Title: Integrating a Solar Concentrator Photovoltaic Array with a Grid-Connected Commercial Building
Abstract: This project studies the integration of a solar concentrator photovoltaic array (CPV) with a grid-connected commercial building. Local solar radiation data and characterization of the CPV were used to determine a profile for its annual energy production. The annual load profile was projected using data from three years of historical monthly bills and a sample week of detailed real-time power consumption. This study quantifies, at one-minute resolution, the energy produced by the CPV, consumed by the building, and metered to and from the supply grid. The study concludes that the CPV system makes a significant energy contribution with substantial environmental benefit and can pay for itself in energy savings over a number of years. Financial viability is dependent upon a number of variables, including the panel quantity, buy/sell prices of grid energy, project lifetime, financing options, and renewable energy credit programs.

36. Haiping Yin
Univeristy of South Florida
Poster Title: On Active/Reactive Power Modulation of DFIG-based Wind Generation for Inter-area Oscillation Damping
Abstract: The objective of this paper is to compare two methods for DFIG-based wind generation for inter-area oscillation damping, namely, active power modulation and reactive power modulation through DFIGs rotor side converters. One major concern of active power modulation is its interaction with wind turbines torsional dynamics. The paper successfully demonstrates the interaction between active power modulation and torsional dynamics. On the other hand, reactive power modulation has no interaction problem as regards of wind turbine torsional dynamics. Linear system analysis and root loci diagrams are employed to demonstrate the analysis. Simulation results in MATLAB/Simulink verify the analysis. The major contributions of this paper are: i) the identification of wind generations active power modulations potential disadvantage, and ii) the identification of reactive power modulation in wind generation as an alternative for inter-area oscillation damping.

37. Chanxia Zhu, Lingling Fan, Minqiang Hu
University of South Florida
Poster Title: Control and Analysis of DFIG-Based Wind Turbines in a Series Compensated Network for SSR Damping
Abstract: With increasing wind power in power systems, impact of wind generator on subsynchronous resonance (SSR) is of interest. This paper presents the models of a double fed induction generator (DFIG)-Based Wind Turbine in a series compensated network for SSR study. Small-signal stability analysis is also conducted to study the impact of wind speeds, series compensation levels and torsional dynamics on SSR. Timedomain simulations are performed inMatlab/Simulink to confirm the analysis.

38. Taesic Kim, Wei Qiao
University of Nebraska-Lincoln
Poster Title: Series-Connected Fully Reconfigurable Multicell Battery: A Novel Design toward Smart Batteries
Abstract: The traditional multicell battery design usually employs a fixed configuration to connect multiple cells in series in order to achieve the required voltage level. This design has a low reliability and can only utilize a part of the total battery capacity if the cells have different usable capacities. Recently, several reconfigurable multicell battery topologies have been proposed. However, these topologies are complex and generally unrealistic for the battery systems.The proposed design can maximally utilize batterys capacity and is tolerant to failures of single or multiple cells, which prolong the operating time and lifespan and enhancing the reliability of the battery system. By using the proposed design, additional monitoring, control, protection, and optimization functions can be readily added to each cell and the battery system to produce a smart battery. The proposed design is validated by simulation and experimental studies for a six-cell lithium battery.

39. Michael Knauff, Dagmar Niebur, Chris Dafis
Drexel University
Poster Title: State of Charge Estimation using the Extended Kalman Filter
Abstract: Battery state of charge (SOC) is a quantity which describes the amount of remaining charge that can be extracted from a battery. SOC estimation methods using the extended Kalman filter (EKF) and other related methods have recently received attention due to their success in applications where frequent partial charges and discharges occur (e.g. hybrid electric vehicles). The authors have pursued this area due to the potential use of batteries in wind smoothing applications. This poster summarizes recent research efforts by the authors in improving the accuracy of EKF based SOC estimators and demonstrating their accuracy through experimental testing. The EKF depends on a state space representation of the system in question. A new battery model has therefore been developed and validated experimentally. Further, the resulting SOC estimator is compared to two other state of the art EKF based SOC estimators. The poster provides a brief overview of this work.

40. A.H. Shahirinia, D.C.Yu, A. Nasiri
University of Wisconsin - Milwaukee
Poster Title: Modeling and Software Development for Off-Grid Hybrid Power System
Abstract: This poster presents an optimized design of a stand-alone multisources hybrid power system. The power system includes such sources as wind turbines, photovoltaic array, diesel generator, and battery bank based on an evolutionary algorithm. In this work, the battery bank and diesel generator are used to cover the base loads. For this approach, economic aspects such as interest rate, inflation and capital recovery factor are expressed for each power sources, and then an objective function with the aim of minimizing of all system costs is defined. A genetic algorithm approach is employed to obtain the best cost value of hybrid power system construction. Simulation results show this method calculating the electrification costs (capital cost, replacement costs, operation and maintenance cost, and fuel cost) over a period of 20 years. Keywords: Hybrid Power Systems, Renewable Energy Sources, Optimization, Wind Turbines, PV array, Diesel Generator, Battery Bank

41. Shengnan Shao
Virginia Tech
Poster Title: Distributed Demand Response Strategy for PHEV and Household Load Control
Abstract: When Plug-in Hybrid Vehicles (PHEVs) take a greater share in the personal automobile market, their penetration may bring potential challenges to the electric utility distribution network. Our previous analysis indicated that charging PHEVs in a residential distribution network may create new load peaks for a distribution transformer. And allowing quick charge may even result in overloading of a distribution transformer when many PHEVs are plugged in.The focus of this paper is to present a distributed demand response strategy that can be used to mitigate the issues of transformer overloading due to high penetration of PHEVs in a residential distribution network. The proposed distributed demand response strategy is based on customers preferences and load priority. Unlike traditional centralized load control methods initiated by a utility, this approach respects customers privacy and allows customers to set their own load priority and preferences when operating under restricted supply. The simulation results show that the proposed demand response strategy reduces the load peak seen by the distribution transformer even with high penetration of PHEVs and its quick charge. At the same time, customer preferences are also satisfied.

42. Reza Arghandeh Jouneghani, Ramon Zamora, Anurag. K. Srivastava
Virginia Tech
Poster Title: Flywheel Energy Storage System (FESS) Dynamic Behavior Analysis in Microgrid Application
Abstract: This study aims at analyzing the dynamic behavior of a Flywheel Energy Storage System (FESS) for microgrid application. In this study, FESS consists of a flywheel, a lead-acid battery and a power electronic interface to connect storage system to the AC load. FESS combines high energy density of battery and unique features of flywheel – long life, compact, and low maintenance cost, making the FESS an outstanding choice for a microgrid storage system. This poster will present the development of FESS model in the MATLAB/Simulink environment, as well as the dynamic behavior of the FESS in power quality and load leveling applications in a microgrid.

43. Yingzhong Gu, Le Xie,
Texas A&M University
Poster Title: Fast Look-ahead Coordinated Control of Wind Power and Aggregated PHEVs
Abstract: In poster, we present a coordinated model predictive control (MPC)-based scheduling framework for variable wind generation and aggregated plug-in hybrid electric vehicles (PHEVs). By leveraging battery charging/discharging capacity against short-term wind power forecast errors, the proposed scheduling framework maximizes the joint economic profits of wind farm and aggregated PHEVs. By formulating the MPC as a quadratic programming problem, we discuss several numerically efficient algorithms to compute the optimal control strategy. Numerical examples in a standard IEEE RTS system have shown that (1) through coordination the combined profits of wind farm and PHEVs are higher than the case without coordination, and (2) the computational time is about 500 times faster than standard quadratic programming routine in MATLAB.

44. Niannian Cai, Joydeep Mitra
Michigan State University
Poster Title: A Centralized Multi-agent System's Architecture for Autonomous Microgrids Including Power Electronic Controls
Abstract: In this poster, we present an autonomous microgrid control architecture based on a multi-agent system (MAS). The proposed control strategy is centralized, and consists of a grid agent, a central control agent, and generation and load agents for individual generators and loads. The implementation includes controls for power electronic interfaces and is shown to be capable of establishing power balance and maintaining voltage within specified limits.

45. Darshit Shah
    Missouri S&T
    Poster Title: Intelligent Monitoring and Control of Microgrid
    Abstract: This poster proposes an intelligent strategy for monitoring and control of an islanded microgrid with multiple renewable and conventional energy resources and loads. The microgrid is islanded from main grid and is connected to multiple diesel generators for the reliability and quality of power. The other renewable energy sources connected to microgrid are photovoltaic panels, wind farms, plug-in vehicle parking lots (smart parks) and batteries, and fuel cells. Several goals act as drivers for intelligent monitoring and control of microgrid. One of the important goals is to minimize the operating cost of diesel generators and emissions, and maximize the use of available renewable energies and thus maximize the operational efficiency of microgrid. A fuzzy logic based coordination controller will be used to manage the real and reactive power flow optimally on the microgrid to reduce operating cost and emissions.

46. Laxman Subedi, Anil Pahwa, Sanjoy Das
    Kansas State University
    Poster Title: Trouble Call Analysis Supported by Intelligent Techniques
    Abstract: Outage Management is an important activity for an utility company. The first step of outage management is to know where the problem is.This part of outage management is usually called Trouble Call Analysis in the utility jargon. The utilities typically depend on the customers to call and inform them of the problem by entering their addresses. After sufficient calls are received, the utility is able to pinpoint the location of the outage. The biggest challenge is to determine the sufficient level of calls before declaring the location of outage. Incorrect location would lead to wasted crew time and delay in service restoration and waiting too long will also delay restoration of power to the customers. Since the number of calls received depends on the time of day and weather conditions, the algorithm should be adaptive. Therefore, a heuristic or an intelligent approach is most suitable for this application. In this paper, a method based on Idiotypic network will be presented.

47. Peng Zhao, Siddharth Suryanarayanan, Marcelo Simoes
CSM
Poster Title: Cyber Enabled Energy Management System towards Net Zero Energy Buildings: Optimization and Multi-agent Decision Making
Abstract: Aligned towards net zero energy building goals, building energy management system will consider cost reduction and renewable energy technology utilization to serve the local energy loads in building structures with dispersed resources. The optimization of energy flows in modern commercial buildings calls for advanced control techniques. This poster will present the optimization and multi-agent decision making models in heating, cooling and electrical energy zones of a commercial building aiming at minimizing energy cost.

48. Bipul Luitel, Ganesh K. Venayagamoorthy
Missouri University of Science and Technology
Poster Title: Smart Grid Applications of CSRN
Abstract: One important motivation behind cellular architecture of the neural networks is for scalability. Since repeated patterns of cells representing a part of the actual system can be implemented (in parallel) using cellular architecture, cellular simultaneous recurrent neural networks (CSRN) have the potential of being able to realize very large systems. However, training of CSRN is a challenging problem because of iterative feedback, parallel implementation of various cells that need to be trained simultaneously and the size of the network. In this study, CSRN is implemented in two smart grid applications. A wide area monitor (WAM) is implemented using a four-cells CSRN for predicting the speed deviation of generators in a two-area four-machine system. In another application, 11-cells CSRN is used for predicting the bus voltages in a 12-bus benchmark system with wind farm and parking lots.

49. Nadim H Kan'an, Lina Al Farouk, Hatem Zeineldin, Wei Lee Woon
MASDAR Institute of Science and Technology
Poster Title: Effect of DG Location on Multi-Parameter Passive Islanding Detection Methods
Abstract: Passive islanding detection methods are considered the simplest and cheapest approach for detecting an islanding condition of a Distributed Generator (DG). Passive methods, relying on one system parameter, suffer from large Non-Detection Zones (NDZ). To overcome this problem, new passive methods relying on more than one parameter and their combination have been recently proposed. These methods were tested for a specific DG location. In this poster, an approach is presented to investigate the effect of DG location on the choice of parameters. Consequently, 40 different possible parameters are extracted and ranked based on information gain to determine the most effective and robust parameters for passive islanding detection. This method is tested on synchronous based distributed generation connected to the IEEE 34 bus system.

50. Kai Yin Kenny Poon, Anjan Bose
Washington State University
Poster Title: Framework for a Hierarchical and Distributed State Estimator
Abstract: The research in my project concerns the investigation of implementation issues regarding hierarchical and distributed state estimators (HSE) and is significant in the framework for making such hierarchical and distributed SEs feasible. Historically, the feasibility of solving HSEs has mainly been from an algorithmic solution viewpoint. However, issues relevant to the actual implementation of such a hierarchical and distributed SEs, including time skew issues, accuracy of network data base and availability of raw data versus state estimated data have not been investigated yet and are performed in this project. Moreover, the effect of having a few PMUs in the external system on internal state estimation is also investigated. A algorithm is also proposed for determining important external system measurements to improve internal system state estimation. The objective of the project is to describe the requirements for the feasibility of a real time model of a large interconnection.

51. Mohammad Abdullah Nayeem, Ali Kashefi Kaviani
Florida International University
Poster Title: Development of Distributed Generation and Microgrid Platform for Power System Integration Studies
Abstract: A DG infrastructure comprised of alternate energy sources in addition to conventional sources, is developed as a test bed. The test bed is operated by synchronizing, wind, photovoltaic, fuel cell, micro generator and energy storage assets, in addition to standard AC generators. Connectivity of these DG assets is tested for viability and for their operational characteristics. The control and communication layers for dynamic operations are developed to improve the connectivity of alternates to the power system. A real time application for the operation of alternate sources in microgrids is developed. Multi agent approach is utilized to improve stability and sequences of actions for black start are implemented. Experiments for control and stability issues related to dynamic operation under load conditions have been conducted and verified.

52. Mostafa Sahraei-Ardakani, Seth Blumsack, Andrew Kleit, Zhen Lei
Pennsylvania State University
Poster Title: Quantitative Assessment of Act 129's Effect on Demand Side Electricity Prices in Pennsylvania
Abstract: Pennsylvania recently passed Act 129, which requires that electric utilities in the state reduce overall annual electric load by one percent through load management programs. Utilities in Pennsylvania will also have to cut 4.5 percent of their load during their 100 highest (peak) load hours during a year. This will affect consumer electricity prices in Pennsylvania once the states deregulation of retail electricity markets is complete by the end of 2010. Here we develop an econometric model to project location-specific electricity price duration curves based on historical fuel prices and electricity price data from PJM. The model is trained using data from 2005 to 2009. Then it is used to estimate prices for 2010. We estimate our model for scenarios reflecting the policy goals of Act 129 for six utility territories in Pennsylvania. The model shows that Act 129 reduces total electricity expenditures by 4.5%, or $375 million in these six utility territories.

53. Chuan Fu, James D. McCalley
Iowa State University
Poster Title: Extended Object-Oriented Programming for Sequential and Parallel Numerical Algorithms of Time-Domain Simulation of Cascading
Abstract: Very fast on-line computational capability is one attribute of newly developed time-domain simulator, named high-speed extended term time domain simulator (HSET-TDS). Focusing on software programming in HSET-TDS, this poster introduces the application of extended object-oriented programming (OOP) to coding sequential and parallel numerical algorithms, such as explicit or implicated integration methods, nonlinear solver of waveform relaxation, and linear solver of SuperLU. There are two advantages of extended OOP with reference to fast simulation, i) much less time is needed to acquire Jacobian matrix during the simulation, ii) appropriate combination of numerical methods can deal with stiffness problem, and highly improve calculation efficiency. New England 39 and expanded 8775 buses systems, and PJM 13029 buses system with cascading are used to test the several integration methods, waveform relaxation and SuperLU by sequential and parallel computing in HSET-TDS.

54. Diogenes D. Molina, Ganesh K. Venayagamoorthy, Ronald G. Harley
Georgia Tech
Poster Title: Intelligent Global Dynamic Optimization of Large Power Systems
Abstract: The presence of non-linearities, the stochastic nature of the loads, the intermittency and unpredictability of renewable energy sources, often conflicting operating goals, etc, make controlling the power system in an optimal fashion a difficult task at best. A controller capable of learning and adapting to this ever-changing environment offers the possibility of providing more efficient and appropriate reactions to deal with all the aforementioned factors. Artificial Neural Network (ANN) based Adaptive Critic Neuro-Controllers have been shown to provide some measure of optimality while controlling non-linear, time-varying, complex dynamic systems. This project pursues the development of an ANN based controller architecture capable of optimally controlling a very large portion of a realistic power system. In addition to the main project idea, the poster will present some of the initial efforts in system simulations, as well as the ongoing and future research directions.

55. Qiang Fu, David Yu, Jugal Ghorai
University of Wisconsin - Milwaukee
Poster Title: Modeling Wind Speed Dependencies and Their Applications In Probabilistic Load Flow Analysis
Abstract: This poster proposes a method called 5 Point Estimation method (5PEM) for Probabilistic Load Flow (PLF) analysis in power networks, and test it by comparing with Monte Carlo method. Then we analyze and model the wind speed dependencies between two wind farms based on the Copula method, and apply it to PLF analysis. Finally, conditional load flow is introduced and shown. The result shows that if we consider spatiotemporal dependencies of power generation between wind farms (in this case Milwaukee and Madison), the PLF shows a significant difference when assuming dependent or not, that is why the dependent model is important to be introduced to PLF analysis.

56. Nikhil Gudi, Lingfeng Wang, and Vijay Devabhaktuni
University of Toledo, Ohio
Poster Title: A Simulation Tool to Demonstrate Active Demand-Side Management for Household Appliances
Abstract: Demand-Side Management (DSM) can be defined as the implementation of policies and measures to control, regulate, and reduce energy consumption. DSM offers a variety of solutions to reduce or transfer electricity consumption and demand. This paper introduces the architecture, design, and development of a simulation tool for demonstrating active DSM, which is an important element of the smart grid. The tool evaluates and provides an estimate for home electricity management using DSM. The tool presents two-way grid communication highlighting the importance of consumer participation in a smart grid framework. The tool can also be used as an educational platform for demonstrating DSM and its various functions.

57. Zhiyong Yuan, Mo-Yuen Chow
North Carolina State University
Poster Title: Microgrid Planning and Operation: Solar Energy and Wind Energy
Abstract: Economic, technology and environmental incentives are changing the features of electricity generation and transmission. Centralized power systems are giving way to local scale distributed generations. A large number of small-scale Microgrid components with their own characteristics are a big challenge for Microgrid modeling and planning. At present, there is a need to assess the effects of large numbers of distributed generators and short-term storage in Microgrid. To accommodate the high demand of renewable energy and the environment policy, the planning and operation of Micro-source generators has been studied using HOMER. Simulation results show a case study of an optimal Microgrid configuration on Ontario area in Canada. Sensitivity variables are specified to examine the effect of uncertainties (e.g. diesel price and average wind speed), especially in a long-term planning. The effect of air emission penalties on Microgrid planning is also well presented.

58. Yurong Wang, Fangxing Li, Qiulan Wan, Hao Chen
The University of Tennessee
Poster Title: Reactive Power Planning Based on Fuzzy Clustering and Simulated Annealing
Abstract: This research proposes a new approach for reactive power planning with two major steps. First, fuzzy clustering algorithm is employed to select candidate locations for installing new shunt VAR sources. Second, the reactive power optimization model is built and solved using simulated annealing (SA) method. Gray code is employed to represent new VAR capacity intervals at candidate buses, then a piecewise TTC(Qc) function is formulated with the linear regression algorithm and used as static voltage stability constraint in the VAR optimization model. To improve the efficiency of SA, a modified definition of the neighborhood selection is proposed, and a novel generation method for new random solutions is advanced by Students t-distribution. Fuzzy clustering method, SA and the Gray code were applied to the IEEE 30-bus system. Test results clearly demonstrate that the combination of the fuzzy clustering algorithm and the VAR optimization model is a promising method for Var planning.

59. Hui Zhang, George Karady, Seshank Malap, James Hunt
Arizona State University
Poster Title: Transient Analysis of Induced Voltage and Current Due to Inductive Coupling between Power Line and Nearby Pipeline
Abstract: A large amount of research has been conducted on the issues of AC interference between high voltage power line and nearby pipelines during the past half century. However, few of these studies analyzed the transient scenario. This paper proposes an analytical approach based on circuit model to calculate the transient inductive interferences. First the state space representation of the complete network for power line pipeline system is constructed, and then by solving the network differential equations, the induced current and voltage on the pipeline can be obtained. This proposed approach is easy to program and requires modest computer memory. The induced voltage and current in each section of the pipelines can be calculated in one step. Numerical example is given to show the transient induced voltage and current waveforms. Results show that the transient peak is much larger than that of steady state if the fault current is not removed in time.

60. Junhui Zhao, Caisheng Wang, Feng Lin
Wayne State University
Poster Title: Analysis of a Microgrid with HPEVs for Hybrid Safety Control
Abstract: Plug-in hybrid electric vehicles (PHEVs) will bring many benefits, such as higher fuel efficiency, lower trip cost, etc. However, they can cause great impacts over the grid, which need to be addressed before the widespread use of them. In this poster, a Microgrid, containing renewable energy sources, energy storage and PHEVs, will be considered to analyze the influence of PHEVs to the system in term of deviations of frequency and voltage. The influence formulas of different participants will be derived analytically. The influence will also be estimated through system estimation and compared with the analytical ones. The verified system estimation method will then be used for a large system with high adoption ratio of PHEVs. Based on the derived or estimated formulas, the hybrid control theory that deals with both discrete events and continuous variables will be applied to keep the system within its safety region, e.g. to maintain the frequency and voltage within the desired ranges.

61. Qun Zhou, Leigh Tesfatsion, Chen-Ching Liu
Iowa State University
Poster Title: Global Sensitivity Analysis for the Short-term Prediction of System Variables
Abstract: Short-term prediction of system variables with respect to load levels is highly important for market operations and demand response programs in wholesale power markets with congestion managed by locational marginal prices (LMPs). This study undertakes a more global analysis of system variable sensitivities when LMPs are derived from DC optimal power flow solutions for day-ahead energy markets. A 5-bus case study is used to illustrate the accuracy of the proposed prediction method.

62. Mohamed Zakaria Kamh, Reza Iravani
University of Toronto
Poster Title: The SMART GRID Initiative: Understanding the Potentials and Barriers
Abstract: This poster discusses the potentials and barriers of the smart grid initiative. The poster holds a comparison between today's grids and the smart grid vision. Several definitions of the smart grid are presented. Finally, the standard features, main driving factors, and key players of this initiative are addressed.

63. Amir Motamedi, Hamidreza Zareipour, William (Bill) Rosehart
University of Calgary
Poster Title: Electricity Price and Demand Forecasting in a Smart Grid Environment
Abstract: In a smart electricity grid, advanced metering, control and communication technologies are integrated into the electricity network, which in turn increases the significance of demand-side participation in electricity markets. In this context, demand-side customers are expected to play a bigger role in determining electricity market prices by offering a higher demand elesticity. Thus, accurate price and demand forecasts will become more dependent upon accurate electricity demand modeling and the behavior of consumers. In order to consider the interdependency of electricity demand and price, and enhance the performance of both demand and price forecasting, more advanced forecasting models are required. In this work, electricity demand and price forecasting challenges and models in a smart grid environment are discussed.

64. Bharadwaj R. Sathyanarayana, Dr. Gerald Heydt
Arizona State University
Poster Title: A Roadmap for Distribution Energy Management via Multiobjective Optimization
Abstract: Future distribution systems with increased deployment of distributed energy storage devices and distributed energy resources are being designed under the aegis of a number of sectors of the power engineering community. This includes the National Science Foundation supported Future Renewable Electric Energy Distribution Management (FREEDM) center. A technical roadmap for the FREEDM center distribution system is proposed that is based on multiobjective optimization. Diverse objectives in the optimal control of the distribution energy management system are handled through a Pareto optimal approach. The normal boundary intersection method is used to develop a Pareto optimal front and solving the multiobjective optimization subroutine has been approached through separable programming techniques. Uncertainty in load demand and distributed resource power output are incorporated in the test cases studied to formulate a robust algorithm for distribution energy management.

65. Che Guan
University of Connecticut
Poster Title: Hybrid Kalman Algorithms for Very Short-term Load Forecasting and Confidence Interval Estimation
Abstract: Very short-term load forecasting predicts the load over one hour into the future in five-minute steps and performs the moving forecast every five minutes. To quantify forecasting accuracy, the confidence interval is estimated in real-time. An effective prediction with a small associated confidence interval is important for area generation control and resource dispatch, and can help the operator further make good decisions. We previously presented a multi-level wavelet neural network method, but it cannot produce a good confidence interval due to the model itself. This paper presents a method of multiple wavelet neural networks trained by hybrid Kalman algorithms. The prediction, however, is difficult, since one effective model is not able to capture complex load features at different frequencies. Appropriate transformations on load components also result in a complicated derivation in order to estimate an accurate variance. The key idea is to use neural network trained by extended Kalman filter for the low frequency component which has a near linear input-output function relationship; and use neural networks trained by unscented Kalman filter for high frequency components which have nonlinear input-output function relationships. Forecasts for load components from individual networks are then transformed back and derived, and combined to form the final load prediction with the good confidence interval. Numerical testing demonstrates significant value for load component predictions via hybrid Kalman filter-based algorithms for training neural networks and the derivation for confidence interval, and shows that our method provides the accurate prediction.

66. Sasidharan Sreedharan, I. Made Warthana, Kittavit Buayai, Dr. J.G. Singh, Dr. Weerakorn Ongsakul
Asian Institute of Technology-AIT
Poster Title: Comparative Study for Maximizing the Wind Penetration of Various Types of Wind Turbines for Maximizing the Penetration
Abstract: In this paper, various types of wind turbines are compared for maximizing the wind penetration. Particle Swarm Optimization (PSO) based algorithm has been developed to obtain the maximum instantaneous penetration by the optimization of grid control parameters. Three types of wind turbines viz., variable speed synchronous, double fed induction and constant speed induction have been compared. The developed algorithm has been tested on modified IEEE 14-bus test system. The result shows the maximum instantaneous wind energy penetration level in percentage.

67. Hugo Morais, Pedro Faria, Zita Vale
GECAD Knowledge Engineering and Decision Support Research Center - Institute of Engineering Polytechnic of Porto (ISEP/IPP)
Poster Title: Energy Resources Management in SmartGrid Context
Abstract: The Energy Resources Management allows the development of new strategies to assure the correct operation of power systems. The new concept of flexible and distributed SCADA systems allows the control and management of many resources of distribution network. The integration of Distributed Generation, Demand Response and storage in network operation allow more flexibility and a better resources management. A new methodology to manage the energy resources in SmatGrids context is developed. This methodology allows studying several scenarios considering many players. A case study that illustrates the use of the developed methodology will be presented. Let us consider a distribution network with 32 buses, from Baran & Wu. As our aim is to study the use of demand response in the context of intensive use of DG, we have included DG in this network, considering its evolution over time, since 2008 to 2040.

68. Scott Ghiocel, Joe H. Chow
Rensselaer Polytechnic Institute
Poster Title: Real-time Reactive Power Management for the Korean Power System
Abstract: Reactive power management is a crucial but often overlooked aspect of power systems; it has no tangible value to the consumer, but is required for active power transmission, and poor reactive power management can lead to voltage instability. In this poster, we present a real-time reactive power management system for the Korean electric power system, which encounters voltage stability issues due to high levels of active power transfer from distant coastal generator stations to the main load center, Seoul. We coordinate the dispatch of Flexible AC Transmission Systems (FACTS) controllers with shunt capacitor and reactor banks in the Seoul metropolitan region to improve voltage stability, reduce shunt switching action, and reduce system losses. The dispatch algorithm is implemented as a real-time system which takes input data from the EMS and state estimator, and outputs the dispatch for three FACTS controllers and numerous shunts in the Seoul metropolitan area.

69. Pinaki Mitra, Ganesh Kumar Venayagamoorthy
Missouri S&T
Poster Title: Wide-Area Monitoring and Control in a Smart Grid
Abstract: In this paper, wide area monitoring and control in smart grid using neural network and adaptive critic design is presented. The smart-grid model is developed by augmenting a wind farm and twelve plug-in vehicle parking lots (SmartParks) to the IEEE 12-bus system. SmartParks are capable of providing reactive power support to the grid and can improve the stability of the system. The wide-area controller coordinates the reactive power injection from the SmartParks and the grid side inverter of the wind farm and also provides the auxiliary control signals to the conventional generators excitation systems based on the voltage deviation of the weak buses and the speed deviation of the generators. The neurocontroller is based on heuristic dynamic programming (HDP) and it uses spiking neural network due to its scalability and faster response characteristics. The entire study is carried out on a Real-Time Digital Simulator (RTDS) platform with the HDP controller being implemented on a DSP.

70. Yingzhong Gu, Le Xie
Texas A&M University
Poster Title: Fast Look-ahead Coordinated Control of Wind Power and Aggregated PHEVs
Abstract: In poster, we present a coordinated model predictive control (MPC)-based scheduling framework for variable wind generation and aggregated plug-in hybrid electric vehicles (PHEVs). By leveraging battery charging/discharging capacity against short-term wind power forecast errors, the proposed scheduling framework maximizes the joint economic profits of wind farm and aggregated PHEVs. By formulating the MPC as a quadratic programming problem, we discuss several numerically efficient algorithms to compute the optimal control strategy. Numerical examples in a standard IEEE RTS system have shown that (1) through coordination the combined profits of wind farm and PHEVs are higher than the case without coordination, and (2) the computational time is about 500 times faster than standard quadratic programming routine in MATLAB.

71. Mei Li
    Iowa State University
    Poster Title: Optimal Utilization of Wind Turbine for System Frequency Control
    Abstract: With large amounts of wind power being integrated into power system, impact of wind power on system frequency control is of great concern. The system inertia is decreasing relatively with more thermal units displaced by wind turbines. It is necessary for wind units to contribute to system inertia and even participate in system frequency regulation. Two additional control blocks are added to traditional DFIG controller scheme, which makes wind units response to system frequency changes accordingly. The control strategy is tested by simulations on detailed models in MATLAB. The performance of DFIG under frequency disturbance shows that by new control strategy it is endowed with inertia response and frequency control ability like synchronous machine.

72. Ali Mehrizi-Sani, Reza Iravani
    University of Toronto
    Poster Title: Secondary Control of Microgrids Employing Potential Functions
    Abstract: In the smart grid, the envisioned future of power system, microgrids need to operate in islanded mode of operation in addition to the grid-connected mode. To ensure availability of the islanded mode, the microgrid should be provided with a set of set points tailored to its status and configuration. Devising such set points is called secondary control. In this work, a potential function based method is proposed for the secondary control of a communication-enabled microgrid. A potential function is defined for each controllable unit of the microgrid such that the minimum of the potential function corresponds to achieving the control goal. The set points are dynamic as the can be updated based on both system measurements and system configuration. The simulation results confirm viability of the method.

73. Chengrui Cai, Dionysios C. Aliprantis
Iowa State University
Poster Title: A Study of the Effect of Large Scale Roof-Top PV Generation System
Abstract: Solar energy conversion has many well known advantages, such as zero CO2 emission. It is believed that large scale employment of PV will take place when the cost decreases to a competitive level. So it is considerably important to investigate the effect resulting from large scale PV generation. The uncertainty of PV generation will bring some negative impacts to the distribution network and the transmission grid when it reaches certain penetration level. Our goal is to control distributed PV generation system and the responsive load with AMI data to maximize the power generation and at the same time minimize the negative effect of large scale roof-top PV generation.

74. S. K. Chaudhary, R. Teodorescu, P. Rodriguea, P. C. Kjr, A. M. Gole
Aalborg University
Poster Title: Negative Sequence Voltage Controllers in the VSC-HVDC to Reduce the Oscillations Due to Asymmetric Faults in the offshore Wind Power Plant Grid
Abstract: This poster shows the connection of a large and distant offshore wind power plant to the onshore grid using VSC-HVDC transmission. An offshore grid layout with 4 aggregated wind turbine generators, each with a full scale converter and connected to a separate collector bus and then to 3 winding step up transformer, has been considered. Zig-zag transformers are used for grounding of the collectors busses. VSC-HVDC provides the synchronizing reference voltage in the offshore grid. During an asymmetric fault, negative sequence voltage component appears in the the grid and produce power and DC voltage oscillations. A method of estimating the negative sequence components in the offshore grid voltage and subsequent control strategy to reduce the power and DC voltage oscillations has been described. Simulation results are shown for the two cases with and without the negative sequence controller in the VSC-HVDC.

75. Jing Dai, Ganesh K. Venayagamoorthy, Ronald G. Harley
Georgia Institute of Technology
Poster Title: Adaptive Control of an Active Power Filter using Echo State Networks
Abstract: A shunt active filter is a power electronic device used in a power system to reduce harmonic pollution . The performance of the shunt active filter is highly dependant on the effectiveness of the controller adopted. In this paper, an Echo State Network (ESN)-based system modeling technique for assisting model reference adaptive control approaches is proposed. Such system model can be used in any model reference adaptive control technique for improving the control of shunt active filters. The proposed scheme is implemented on a DSP and on Real-time Digital Simulator (RTDS) hardware to identify and control the load harmonics in a typical power system. The hardware-in-the-loop real-time simulation results show that the ESN is capable of providing fast and accurate control of the active filter under both minor and major system disturbances.

76. Baohua Dong, Sohrab Asgarpoor, Salman Kahrobaee
University of Nebraska-Lincoln
Poster Title: Artificial Neural Network Optimal Control of Wind Turbine with Doubly Fed Induction Generator
Abstract: In this project, the dynamic PI controllers are designed to improve DFIG transient performance. Particle swarm optimization is proposed to optimize parameters of PI controllers of DFIG with PSS at different operating points to maximize the damping ratio of the system eigenvalues in small signal stability analysis. Based on the calculated parameters values, an artificial neural network is designed and trained. ANN has the ability to forecast the optimal parameters values at each operating points and inputs them to the dynamic PI controllers. The controllers dynamically change values according to the different operating conditions to increase DFIG transient performance in a global operating range. This could be called real time optimization, smart controller, and global system optimization. The simulation will be done for a single machine connected to an infinite bus system and multi-machines system to prove the transient performance improvement in the overall power systems level.

77. Yi Du, Anish Prasai, Andrew Paquette, Ronald Harley, Deepak Divan
Georgia Institute of Technology
Poster Title: Multi-tiered Control Algorithm of Microgrid
Abstract: Microgrids are becoming attractive to consumers. However, there are technical problems since limited sources are required to supply all the power needed by loads while maintaining the voltage and frequency within limits. This poster proposes a multi-tiered control algorithm to improve power quality, efficiency and reliability of a meshed microgrid. The first tier is load control, by which non-critical loads are shed and motors are started sequentially if power quality is violated. The second tie is source control to maximize fuel efficiency with energy storage systems, generators operate at optimal point and the renewable resources are used as much as possible. The third tie is system control for higher reliability. The power flow is controlled by adjusting line impedance to prevent cascading failure and assist recovery. System level fault management will identify and isolate the faulted branch with minimal interruption. This algorithm is validated by PSCAD and Matlab simulations.

78. Xianyong Feng, Karen L. Butler-Purry, Takis Zourntos
Texas A&M University
Poster Title: Multi-Agent System-Based Real-Time Load Management for Next Generation Integrated Shipboard Power Systems
Abstract: Shipboard power systems have less generation capacity and include a large portion of dynamic loads and nonlinear loads relative to total power capacity. Therefore, the load demand and power generation of the system should be matched in real-time. In this paper, a multi-agent system-based real-time load management technique is proposed to balance the load demand and power generation in real-time without violating operating constraints of the system. The multi-agent system cooperative control protocol is developed based on the proposed reduced order agent model and artificial potential function of the agent system, which aims to maximize the energized loads in the shipboard power system without violating systems operating constraints in real-time. The stability of the proposed cooperative control protocol is analyzed using the Lyapunov approach. Moreover, the simulation results show that the system objectives are achieved in real-time.

79. Alexander C. Melhorn, Dr. Kevin Tomsovic
The University of Tennessee
Poster Title: Unit Commitment with High Penetration of Wind Generation
Abstract: Traditional unit commitment has been primarily formulated as a cost minimization with approximate but fixed security constraints. As wind generation increasingly penetrates the generation mix, adequate reserve constraints become more difficult to quantify external to the unit commitment process. This work takes into account the stochastic nature of the wind forecast and attempts to ensure adequate supply. The new approach uses longer term reliability as an added constraint. Specifically, the process attempts to maximize both the reliability of the units being committed as well as the cost . By considering the impact on reliability of the commitment mix, this method provides an approach for avoiding excessive reserve requirements.

80. Wei Sun, Chen-Ching Liu
Iowa State University
Poster Title: Generation Scheduling Problem Considering Carbon Dioxide Emission Allowance Cap-And-Trade Market
Abstract: The regulation of Carbon Dioxide (CO2) emission from electric power industry to mitigate global warming brings the challenge to generation companies (GENCOs). As an efficient market-based mechanism to regulate emission of CO2, CO2 emission allowance cap-and-trade market is formulated as the Cournot equilibrium model based on the market rules in Regional Greenhouse Gas Initiative. The sensitivity of GENCOs bidding price, electricity price and total amount of allowance to CO2 allowance price and dispatch are analyzed. Based on the proposed model, GENCOs will be able to determine their optimal mid-term operation planning and short-time operation schedules participating in both electricity market and CO2 allowance market.

81. Sarina Adhikari, Huijuan Li, Fangxing Li
The University of Tennessee
Poster Title: Voltage Control of Distribution System using Solar Photovoltaic (PV) based Distributed Energy Resources (DER)
Abstract: This poster presents the voltage control of a real distribution system of Catalina Island using the detailed actual model of Solar Photovoltaic (PV) technology based Distributed Energy Resources. A very detailed model of Solar PV considering the MPPT and the converter controls is developed in EMTP. This model of PV is used to regulate the voltage of weak buses of the distribution system under consideration. Various penetration levels of DER at different locations of the distribution system are considered for study.

82. Huijuan Li
The University of Tennessee
Poster Title: Adaptive Voltage Control with Multiple Distributed Energy Resources
Abstract: Distributed energy resources (DE) or distributed generators (DG) with power electronics interfaces and logic control using local measurements are capable of providing reactive power related ancillary system services. In particular, local voltage regulation has drawn much attention in regards to power system reliability and voltage stability, especially from past major cascading outages. This paper addresses the challenges of controlling DEs to regulate local voltage in distribution systems. An adaptive voltage control method has been proposed to dynamically modify control parameters to respond to system changes.Theoretical analysis shows that there exists a corresponding formulation of the dynamic control parameters; hence the adaptive control method is theoretically solid.

83. S. A. Pourmousavi, M. H. Nehrir, Advisor
Montana State University
Poster Title: Real-Time Energy Management of Microgrids Using Particle Swarm Optimization (PSO)
Abstract: Real-time energy management is a process of generation, storage and consumption control for components of a microgrid (MG) in real-time domain. The management essentially is a multi-objective, multi-constraint problem which has to be performed in a short time (few seconds to minutes). Therefore, the capability to make rapid and robust decisions regarding the dispatch of electrical power produced by generation assets is really important. In this poster, the application of particle swarm optimization (PSO), which is a biologically-inspired direct search method, to find real-time near-optimal energy management solutions for a stand-alone hybrid windmicroturbine energy system (a small MG) is presented. Results demonstrate that the PSO-based energy management algorithm can solve an extensive solution space very fast, while incorporating many other objectives.

84. Dipendra Rai, Ramakrishna Gokaraju, Sherif O. Faried
University of Saskatchewan
Poster Title: Model Reference Adaptive Control for FACTS.
Abstract: In this paper, the investigation of an adaptive pole-shift control technique for FACTS devices under large disturbances is presented. Adaptive pole shifting techniques have been successfully implemented in power system stabilizer applications in the past. One of the essential parts of a real-time adaptive control implementation is the system identification using a suitable recursive identification algorithm. The practical implementation of such algorithm suffers from the inability to identify correct parameters during the large disturbances such as three-phase faults. In order to overcome this problem, some ad-hoc solutions: moving average parameter boundaries and random walk have been suggested. This work presents the use of a robust RLS technique to deal with large disturbances. The effectiveness of the proposed method has been demonstrated in single-machine infinite bus and two-area multi-machine system to damp power oscillations using the adaptive TCSC control.

85. Chuan Yan, Ganesh K. Venayagamoorthy, Keith A. Corzine
Missouri S&T
Poster Title: AIS-based Coordinated and Adaptive Control of Generator Excitation Systems for an Electric Ship
Abstract: An artificial immune system (AIS) based control of generator excitation systems for the Navys electric ship is presented to solve power quality problems caused by high-energy loads such as direct energy weapons. The coordinated development of the AIS controllers mainly consists of two parts an innate immunity (optimal) and adaptive immunity. The parameters of the controllers for the first part, to provide optimal performance, are tuned simultaneously using particle swarm optimization. For dramatic changes in the ship power system, an adaptive control based on the immune system feedback law is developed. The feedback law adapts the controllers parameters only during transient disturbances. Post-disturbance, the controllers parameters are restored to their innate values. A real-time ship power system and the proposed AIS control of all excitation systems have been implemented on a real-time digital simulator (RTDS) and DSP, respectively.

86. Ramon Zamora, Anurag K. Srivastava
Mississippi State University
Poster Title: Design of Microgrid Controllers
Abstract: A microgrid can operate as a subsystem of the main grid or a stand-alone system separated from the main grid. In normal operation, a microgrid operates in grid-connected mode of operation, while in abnormal operation, it operates in islanded mode of operation. Microgrids may automatically disconnect from the main grid during disturbances or intentionally operate in islanded mode when the power quality of the main grid decreases below certain standards. Inherent characteristic differences caused by the operation and control of diverse distributed energy resources and the switching processes from grid-connected operation to islanded operation create several challenges. Microgrids must be equipped by an intelligent controller to efficiently manage the power flow in normal and abnormal conditions. Several types of microgrid controllers along with the microgrid modeling will be discussed in this poster. The Matlab models and simulation results are included to verify the systems.

87. Farshid Shariatzadeh, Anrag K. Srivastava
Mississippi State University
Poster Title: Real-Time Implementation of Binary PSO Reconfiguration Algorithm for Electric Ship Power System
Abstract: Reconfiguration is the process of altering the power systems topological structures by changing the status (open/closed) of connecting devices, such as circuit breakers and switches. Reconfiguration is critical to maintain the availability of energy to the connected loads and to interrupt the smallest portion of the system under any abnormal conditions either to restore service to a section or to meet some operational requirements. A large number of technical papers have been published on reconfiguration of distribution networks. Numerous researchers reported theoretical work on reconfiguration of distribution system by using mathematical programming or artificial intelligence approaches. These developed algorithms need to be validated in real time before implementation. This work relates to developing a reconfiguration algorithm for distribution power system using soft computing method and implementing it in real-time using real time digital simulator (RTDS) and dSPACE controller.

88. Yen-Yu Lee, Ross Baldick, Jin Hur
University of Texas
Poster Title: Firm-Based Measurements of Market Power in Transmission-Constrained Electricity Markets
Abstract: In this poster, two different approaches to analyzing firm-based market power considering transmission constraints are presented. The market power indices estimate the average price-cost markup and transfer of wealth of a firm using residual demand Jacobian. The other approach, the transmission constrained residual supply index (TCRSI), measures whether a supplier is necessary to meet all the demand in the presence of transmission constraints. These two approaches provide complementary evaluations of market power. Large scale system examples are provided to demonstrate computational efficiency, and both approaches could be applied to real-world electricity markets.

89. Yang Gu, James McCalley
Iowa State University
Poster Title: Market-Based Transmission Expansion Planning
Abstract: This paper presents a market-based transmission expansion planning model, which seeks to find investment opportunities that will bring more economic benefits than the costs. Benders decomposition method is used to decompose the whole planning problem into a master problem, which make investment decisions, and a slave problem, which simulate the operation of the electric market. Uncertainties appearing in the planning process are analyzed systematically and classified into random and non-random uncertainties. Monte Carlo simulation method is applied to simulate random uncertainties, while robustness testing method is employed to incorporate non-random uncertainties. The case study illustrates the application of the proposed model in a competitive electricity market with double-sided auctions.

90. Anita Ann Jose, Dr.Anil Pahwa, Dr.Ruth Douglas Miller
Kansas State University
Poster Title: Economic Evaluation of Small Wind Generation Ownership under Different Electricity Pricing Scenarios
Abstract: With Time of Day (TOD) pricing becoming a reality, intelligent dispatching systems that utilize Energy Storage Devices (ESD), such as batteries, to optimize the use of renewable resources and grid energy while determining the most economical dispatch schedule could play an important role for both the customer and the utility. An optimization algorithm based on linear programming for various cases has already been developed as the initial part of this research. Including the option of curtailing the load in the house in response to electricity- rate changes in the optimal schedule is the focus of, the proposed research. A comparison of the Critical Peak Pricing (CPP) and Time of Use (TOU) demand response schemes will be shown. The economic evaluation of owning a wind generator with the two pricing schemes in effect will be considered. This research will help utilities decide upon electricity rates to be applied as well as help customers decide upon the pricing scheme to opt for.

91. Fangxing Li, Yanli Wei, Sarina Adhikari
The University of Tennessee
Poster Title: Improving an Unjustified Common Practice in Ex Post LMP Calculation
Abstract: A common practice for the Ex Post LMP calculation at a number of US ISOs uses a small constant range, typically from -2.0 to +0.1 MW, as each generators lower and upper bounds. This paper shows that this is an unjustified practice as the marginal units and LMP may change if the bounds are changed. A simple yet effective improvement is proposed.

92. Ali Al Awami, Mohamed El-Sharkawi
University of Washington
Poster Title: Combining Wind and Thermal Bids in Short-Term Electricity Markets
Abstract: In this work, combined trading of wind and thermal units in short-term electricity markets is considered. The objective is to maximize the expected profits of the wind owner. The thermal unit is used to hedge against wind forecast uncertainty. The uncertainty associated with the wind power output given the forecast is modeled using conditional probability density functions (CPDF). Simulation results shows the benefits of using a combined bidding strategy for wind and thermal units.

93. Niamh Troy, Mark O'Malley
University College Dublin
Poster Title: Wind as a Price-maker and Ancillary Services Provider in Competitive Electricity Markets
Abstract: As power systems evolve to incorporate greater penetrations of variable renewables, the demand for flexibility within the system is increased. Combined Cycle Gas Turbines (CCGTs) are traditionally considered as inflexible units but those which incorporate a steam bypass stack are capable of open-cycle operation. Facilitating these units to operate in open-cycle mode is shown to improve system reliability and reduce emissions. It also yields benefits for the generators themselves via increased revenues (in some circumstances) and reduced cycling.

94. Chanwit Boonchuay, Kevin Tomsovic, Fangxing Li, Weerakorn Ongsakul
University of Tennessee
Poster Title: Locational Marginal Price Based Load Frequency Control for Rapid Demand Fluctuations
Abstract: In the new environment of energy deregulation, locational marginal prices (LMPs) have become the primary basis for congestion management issues; however, it requires proper coordination with ancillary services to deliver system needs. Load frequency control (LFC) maintains the system frequency in the face of constantly fluctuating loads and the variable output of wind generation. Here, an efficient LFC approach using an adaptive participation factor is proposed for the LMP-based market. The concept of a critical load level is used to determine when price change is likely. The proposed approach modifies the LFC signal as it seeks to avoid price volatility.

95. David Pozo, Javier Contreras
University of Castilla - La Mancha
Poster Title: LongTerm Nash Equilibria in Electricity Markets
Abstract: In competitive electricity markets, companies simultaneously offer their productions to obtain the maximum profits on a daily basis. In the long run, the strategies utilized by the electric companies lead to various longterm equilibria that can be analyzed with the appropriate tools. We present a methodology to find plausible longterm Nash equilibria in poolbased electricity markets. The methodology is based on an iterative market Nash equilibrium model in which the companies can decide upon their offer strategies. An exponential smoothing of the bids submitted by the companies is applied to facilitate the convergence of the iterative procedure. In each iteration of the model the companies face residual demand curves that are accurately modeled by Hermite interpolating polynomials. We introduce the concept of metagame equilibrium strategies to allow companies to have a range of offer strategies where several pure and mixed metagame Nash equilibria are possible.

96. Yi Sun, Felix F. Wu, Hui Zhou
The University of Hong Kong
Poster Title: Power Portfolio Optimization with Traded Contract Products
Abstract: A clarification is made on commonly traded power contracts in the market, followed by a discussion of their pricing schemes. It is emphasized that actively traded electricity futures/forwards and options actually belong to commodity swaps and swaptions respectively. A power portfolio is then constructed for a generation company with these basic power contracts and the spot transaction as well. An optimization model is formulated to solve the asset allocation with Conditional Value at Risk (CVaR) as the risk measure. The viability of the model is tested through a numerical study.

97. Yan Yang, Fangxing Li
The University of Tennessee
Poster Title: Analyzing Market Equilibrium with Complicated Constraints Using Coevolutionary Computation
Abstract: This paper proposes a new model to compute electricity market equilibrium based on a model similar to the Linear Supply Function Equilibrium model. In the proposed model, transmission constraints in addition to generation constraints and consumers bidding behavior are considered. A coevolutionary computation approach is proposed to solve for market equilibrium. Several cases from two sample systems are tested to verify the effectiveness of the proposed method which avoids being trapped in local optimum when searching for Nash Equilibrium. Simulation results indicate that the proposed approach rapidly converges to the pure strategy Nash Equilibrium if it exists.

98. Nanpeng Yu, Leigh Tesfatsion and Chen-Ching Liu
Iowa State University AND University College Dublin
Poster Title: Financial Risk Management in Restructured Wholesale Power Markets: Concepts and Tools
Abstract: Recently a variety of new tools have been proposed for managing financial risk management in Wholesale Power Markets. New modeling approaches have also been explored, such as agent-based modeling (ABM), the computational modeling of real-world phenomena as systems of autonomous interacting units. This poster provides a summary overview of these developments.

99. Shan Jin, Sarah M. Ryan
Iowa State University
Poster Title: Capacity Expansion in the Integrated Supply Network for an Electricity Market
Abstract: Constraints in fuel supply, electricity generation and transmission interact to affect the welfare of strategic generators and price-sensitive consumers. We consider a mixed integer bilevel programming model in which the leader makes capacity expansion decisions in each level of the electricity supply network. Based on the leader's expansion decisions, the multiple followers including the fuel dispatchers, ISO and generation companies optimize their respective objectives of cost, social welfare, and profit at the same time. The problem is solved as a mathematical program with complementarity constraints. Challenges posed by the discreteness of transmission expansions are mitigated using bounds obtained from a relaxed centrally-coordinated version of the problem.

100. WenHao Zhang, Umar Rosadi, SeungYong Seo, SeungJae Lee, MyeonSong Choi
Myongji University
Poster Title: Distribution Factor-based Fault Location Algorithm for Double Circuit Transmission Line
Abstract: This study proposes an enhanced algorithm for fault location on double-circuit transmission line for a case of single line-to-ground (SLG) fault. The proposed algorithm uses a one-end data and does not require adjacent circuit current data although it considers the mutual coupling effect. The final fault location equation is given as a simple second order polynomial equation. Its effectiveness has been testified on a simple double-circuit transmission system through various simulations using MATLAB. Tests results of the proposed algorithm have shown its accuracy of the fault location.

101. Ning Kang, Yuan Liao
University of Kentucky
Poster Title: Fault Location Estimation For Transmission Lines Using Voltage Sag Data
Abstract: This poster presents a general approach to locate any type of fault on either a single-circuit or a double-circuit transmission line when only voltage sag data are available. The voltage measurements employed can be from one bus, two buses, or more buses, which are not restricted to those of the faulted section. It is assumed that the network data are available and the fault type is known. Quite encouraging results have been obtained based on EMTP simulation studies.

102. Hua Lin, Shravan Garlapati, Santhosh Sambamoorthy, Sandeep K. Shukla, James Thorp
Virginia Polytechnic and State University
Poster Title: Agent Based Supervision of Zone 3 Relays to Prevent Hidden Failure Tripping
Abstract: When power network is under stressed operating conditions, the role of protective switchgears becomes crucial. However, it has been shown that hidden failure based zone 3 relay unintended tripping could cause costly cascading failures and pose great threat to system stability. In this study possible blackout scenarios are simulated in PSLF based on a statistical model for hidden failure estimation. An agent based hierarchical Zone 3 supervisory scheme is further proposed which benefit from sufficient communication between protection relays to prevent Zone 3 relay misoperation and improve system reliability. A master agent is required in locale to monitor relay and breaker settings and coordinate their actions when faults are observed by Zone 3 relays. The underlying network infrastructure for this scheme is investigated to satisfy relay latency requirements. Combinations of different network topologies, protocols and link bandwidths are simulated and compared in Network Simulator 2.

103. Seung-Yong Seo, wenhao Zhang, Myeon-Song Choi, Seung-Jae Lee
Myongji University
Poster Title: A New Channel-Aided Protection Coordination Scheme for the Closed Loop Distribution System
Abstract: With the development of technologies, in order to obtain high power supply reliability, the closed loop structure is adopted for the distribution system. However, this closed loop structure will bring difficulty to the protection coordination. The protection coordination adopted in the radial distribution system is not suitable for this closed loop system, so the features of this closed loop system must be considered and its voltages and current changes under fault conditions need to be analyzed. In this paper, A new protection coordination scheme is proposed for the closed loop distribution system based on the channel-aided OCRs. This scheme is accomplished by transferring blocking signal and breaker failure signal. In addition to the validation of the proposed scheme, a sample system was built by Matlab Simulink and the protection coordination was applied in this sample system. The performance of the proposed scheme could be verified by the simulation results.

104. Trevor Chow-Sawatzky, Dr. Ramakrishna Gokaraju, Dr. Sherif Faried
University of Saskatchewan
Poster Title: Application of Support Vector Machines to Identify a Loss of Excitation Condition on a Power System with STATCOM
Abstract: The focus of this research is to show how a STATCOM affects generator protection during a power swing or loss of excitation condition. The project also uses a method of fault detection that incorporates pattern recognition instead of the traditional use of mho relays and multiple zones with delays. A support vector machine is used to compare patterns within the P-Q and R-X planes. This method has shown to detect a fault faster and more reliably than the traditional counterpart.

105. Mariya Babiy, Rama Gokaraju
University of Saskatchewan
Poster Title: Detecting Internal Turn-to-Turn Faults in Transformers Using Negative Sequence Currents
Abstract: A turn-to-turn fault is the most difficult type of fault to detect within the transformer. This research presents a new, simple and efficient protection technique which is based on negative sequence currents. Using this protection technique, it is possible to detect minor internal turn- to-turn faults in transformers. Also, it can discriminate between internal and external faults. The discrimination is achieved by comparing the phase shift between two phasors of the total negative sequence current. The new protected technique is being studied via an extensive simulation study using PSCAD software in a three-phase power system and is also being compared with a traditional differential algorithm. The results indicate that the new technique can provide a fast and sensitive approach for identifying minor internal turn-to-turn faults in transformers.

106. Binod Shrestha, Dr. Ramakrishna Gokaraju, Dr. Mohindar Singh Sachdev
University of Saskatchewan
Poster Title: Out of Step Protection using State Plane Analysis
Abstract: This work proposes a relaying scheme to protect power systems (PS) from out-of-step condition using State Plane Analysis (SPA). Power system dynamics can be represented by trajectories followed by system variables so that its mathematical model is replaced by a simple graphical plot. Using SPA in PS gives information on critical clearing angle and critical clearing time simultaneously which reduces the computation time as well as the decision time. An algorithm based on SPA is proposed and classification of stable and OST swings is done using the available information. The proposed algorithm will be tested in single machine infinite bus system and multi-machine system such as New England system. Test results will be compared with available data. A digital prototype of the relay will also be implemented in hardware and its performance will be accessed in a closed loop mode using Real-Time Digital Simulator (RTDSTM).

107. Hanif Livani, Cansin Yaman Evrenosoglu
University of Nevada Reno
Poster Title: A Traveling Wave Based Single-Ended Fault Location Algorithm using DWT for Overhead Lines Combined with Underground Cables
Abstract: This research presents a single-ended traveling wave based fault location method for power transmission systems where overhead lines are combined with underground cables. Bewley diagrams are used to determine the traveling wave patterns. The proposed method utilizes Discrete Wavelet Transform (DWT) to extract the transient information from the recorded voltage signals. The squares of the wavelet transform coefficients (WTC2) are calculated in order to determine the energy of the signal which is used to identify the faulted section (underground cable or overhead line) and subsequently to locate the fault

108. Robert C. Green II, Lingfeng Wang, Chanan Singh
University of Toledo
Poster Title: State Space Pruning for Reliability Evaluation Using Population-based Intelligent Search
Abstract: One methodology that has been previously developed to improve the computational efficiency and convergence of Monte Carlo Simulation (MCS) when computing the reliability indices of power systems is a technique known as state space pruning. This technique works by pruning the state space in such a way that the MCS samples a state space that has a higher density of failure states than the original state space. This poster presents a new approach to limiting the state space sampled when calculating reliability indices by pruning the state space through the use of Population-based Intelligent Search (PIS). The preliminary results indicate that this technique is promising to improve the convergence performance of MCS when calculating reliability indices. This is tested using an IEEE Reliability Test System at different levels.

109. John MacCormack, W.D. Rosehart, H. Zareipour
University of Calgary
Poster Title: Expected Reliability of Supply in Energy Only Electricity Markets Considering Strategic Behavior of Suppliers
Abstract: In deregulated electricity markets, electricity prices, reliability of supply, and generation development are no longer planned but emerge from the interplay between market participants operating under various conditions and constraints. Accurate forecasts of these quantities must consider future generator behavior in the context of a market. Variation in demand and supply gives rise to changing opportunities for suppliers to profitably raise prices by economically withholding supply. However, over time the ability of generators or other suppliers to raise prices is limited by the threat of entry of new generators or supplies. The emergent reliability of supply is related to the actual available capacity in relation to demand. This poster will show recent research into the expected emergent reliability in an energy only electricity market when competitive suppliers operating under constraints are expected to act strategically.

110. Sara Eftekharnejad, Gerald T. Heydt, Vijay Vittal
Arizona State University
Poster Title: Implications of Smart Grid Technology on Transmission System Reliability
Abstract: Condition monitoring using real time measurements is a smart grid technology that is proposed for increased system reliability. Self healing and resiliency are the main characteristics of the smart grid that equip the grid with proper tools to deal with contingencies and unpredicted operating conditions. This research investigates the effect of smart grid on improving system reliability while there are impending component failures. The signals received from the automatic condition monitoring systems are analyzed and in case that a failure is detected, a corrective action is taken by the smart module, and the operator is advised accordingly. Contingency ranking methods are used to identify the critical components of the system that result in overloads or voltage violations. N-1 contingency analysis is conducted based on actual system data to find the corrective action that needs to be taken to alleviate the effect of the contingency.

111. Maryam Hassani Variani, Benyamin Moradzadeh,Kevin Tomsovic
University of Tennessee
Poster Title: Damping of Inter-area Oscillations with DFIG Wind Units
Abstract: The penetration of wind generation is increasing rapidly in power system networks. Currently following system faults, wind energy conversion systems (WECs) may have to be tripped; thus, providing no support to the grid during a critical time period. With high penetration of wind energy, WECs must remain in service to support stable operation following faults. In this work, a new strategy is implemented for a doubly-fed induction generator (DFIG) control system to provide damping for local and inter-area oscillations. The approach is tested on a two-area system with a wind farm connected to the power exporting area.

112. Padmavathy Kankanala, Anil Pahwa, Sanjoy Das
Kansas State University
Poster Title: Regression Models for Outages due to Wind and Lightning on Overhead Distribution Feeders
Abstract: The reliability of power distribution system has become the important issue in the power industry. The utilities are concerned about providing customers electrical energy as economically as possible with a high degree of reliability. The reliability assessment relates to the system performance and it is greatly affected by outages caused by different environmental factors like weather, trees, animals and human factors. Wind and lighting continues to be the major causes of outages on overhead power distribution lines. To improve the system reliability, utilities use historical outage data to compute the reliability indices. This paper present a method based on a regression models to study and analyze outage due to wind and lightning on overhead distribution feeders in different districts in Kansas from 2005 to 2009.

113. Pedram Jahangiri, Anurag K. Srivastava
Mississippi State University
Poster Title: Reconfiguration of MVDC Shipboard Power System with Security Constraints
Abstract: One of the distribution architectures that Navy has proposed for their future shipboard power systems is MVDC. This architecture is based on paralleling V.S. Converters to form Multi-Terminal MVDC. The MVDC grid includes N VSCs at their dc terminals to form a Multi-Terminal MVDC system. In the event of losing each VSC, it will be isolated via protection system, whereupon the power flow of the dc network is changed and the DC bus voltages will be decreased or increased. As the surviving converters can be destroyed by over-voltage or being over modulated through under voltage, within a fraction of a time, there is no time for the controllers to reset power settings of power dispatcher VSCs. For this reason power settings should be predetermined to meet the voltage constraints in different situations. This poster at first introduces N-2 SC then shows the output of a computer program that has been developed based on GA to optimize the VSCs power control settings of MVDC notional SPS model

114. Sudipta Lahiri, Ren Kang, Dagmar Niebur, Harry Kwatny
Drexel University
Poster Title: A Software Test-bed for Supervisory Power Management of Islanded Power Systems
Abstract: Low inertia, self-contained power systems such as micro-grids are highly susceptible to system failure from component loss. A minimally restrictive power system supervision tool, based on the hybrid systems paradigm provides optimal strategies to mitigate damage and maintain system integrity in case of disturbances. A component based software test-bed has been developed for validation and verification of supervisory action. The test-bed supports simulation of continuous time differential algebraic equations as well as discrete events, and is integrated with symbolic and numerical analysis tools for controller design. A modular system design allows for great flexibility in incorporating multiple component and network models under a highly scalable environment. Faster than real time simulation speeds allows for real time control processor implementation and hardware-in-the-loop testing of controller capabilities.

115. Salman Kahrobaee, Sohrab Asgarpoor, Eric Harmon, Baohua Dong
University of Nebraska-Lincoln
Poster Title: Reliability, Availability, Maintainability, and Safety of Wind Energy Systems
Abstract: As the world is getting more interested in renewable energy and number of wind turbines increases, one important objective is to operate these wind turbines efficiently. So the goal of this research is to find an optimum maintenance policy to maximize wind farm availability while maintain each individual wind turbine work safely. There are bunch of studies needed to be conducted here which are explained within this poster.

116. Caixia Wang, James D. McCalley
Iowa State University
Poster Title: Impact of Wind Power on Control Performance Standards
Abstract: As larger wind power components are integrated into power systems, the impact of wind power on system active power and frequency control has become an issue of increasing concern. Control Performance Standards (CPS1, CPS2) are currently used to evaluate the effectiveness of each control areas control performance on active power balance and frequency deviation. As wind power output varies all the time and the control characteristics of wind turbines are different from those of conventional generators, the control areas compliance with CPS may also be influenced with wind power penetration increases. This research studies the impact of wind power on CPS compliance of control areas. and possible measures to mitigate the problem.

117. Emil Johansson, Agnes Nybø, Gerd Kjølle, Kjetil Uhlen, Oddbjørn Gjerde
Norwegian University of Science and Technology
Poster Title: Blackout: Understanding Sequence, Causes, & Remedies of Extraordinary Events
Abstract: Increased understanding of extraordinary events in the power system is vital in order to develop and assign appropriate remedies to limit the presence and consequences of such events in the future. In this paper, extraordinary events are analysed in order to identify general patterns in the sequence of event, causes, and potential remedies. The generalised discussion is supported by a case study of historical events from the U.S.-Canadian and continental European power systems. Results show that there are correlating factors between the proposed generalised structure of events and the events analysed in the case study, supporting the generalisation of extraordinary events. Improvements of monitoring systems and controlled islanding schemes are remedial actions identified to have high potentials for decreasing vulnerability of extraordinary events. Such actions may lead to increased situational awareness and limitation of disturbance propagation and consequences of extraordinary events.

118. Hao Huang, Fangxing Li
The University of Tennessee
Poster Title: Ensuring Security with Controllable Loads under Market Operation
Abstract: Currently, with the controllable loads added into the grid, it becomes more and more smart. Thus, it is wise for us to put more attention to improve demand side management that uses advanced metering technology to better control the load through price incentives. However, until now we are still lack of understanding of the behavior, especially, the dynamic behavior, of controllable loads under the LMP market operation. This poster gives a framework of the relationship between load changes and LMP, which also helps the power system to be more stable.

119. Lei Tang, Siddhartha Kumar Khaitan, James McCalley
Iowa State University
Poster Title: Next Generation On-line Dynamic Security Assessment
Abstract: To get a more inside view of the power system dynamics and enhance the efficiency of existing on-line Dynamic Security Assessment (DSA) tools, existing numerical methods are improved to obtain trajectory sensitivities, and then sensitivity information is utilized for (1) contingency screening, (2) system limit determination, (3) operating condition selection, and (4) design of preventive and corrective control. Meanwhile, strategies are proposed to improve the accuracy of the sensitivities within acceptable increase of computation, which include (1) second order sensitivity, and (2) switching operating states based calculation.

120. Y. Yare, G. K. Venayagamoorthy
Missouri S&T
Poster Title: Wind-Hydrothermal GMS of a Modern Power System with Uncertainty in Wind Generation
Abstract: This work is aimed at enhancing the smart grid initiative, and presents an optimal preventive generator maintenance scheduling (GMS) in a modern power system comprising wind-hydrothermal energy resources. GMS problem is solved with the aim of maximizing economic benefits subject to satisfying system constraints. This GMS formulation becomes a challenging problem because of the variability and intermittency of wind speed and the incorporation of uncertainty in wind generation. The objective is to perform preventive GMS in such a manner that the annual generation cost is minimized, the annual cost saving is increased while all operating constraints are satisfied in the presence of uncertainty in wind generation. Discrete modified particle swarm optimization (MPSO-D) algorithm is used to solve this problem. The results show the benefits obtainable from increasing wind power penetration. The potential for practical application of this approach in modern power system is demonstrated.

121. Guodong Liu, Kevin Tomsovic
University of Tennessee
Poster Title: Quantifying Spinning Reserve Requirements in Systems With Significant Wind Power Penetration
Abstract: With increasing wind power penetration in the power system, determining reasonable spinning reserve requirements is becoming an important issue and directly relates to the reliability and economy of the power system. Load forecast error, wind forecast error and generator reliability all contribute to a need for reserves. In this paper, a new method is proposed to quantify the system adequate reserve levels. The method considers the joint probability distributions of forecast errors of wind and load, as well as generator forced outage rate by using the Expectation of Demand Not Served (EDNS) as an evaluation index. The proposed method is then applied to the IEEE reliability test system. Results illustrate the relationships of uncertainties with the system reserve requirements level.

122. Yuichi Morishita, Takuya Fukuoka, Shiniti Iwamoto
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Poster Title: An Adaptive PSS Design Method using H-infinity Control Theory and Particle Swarm Optimization
Abstract: The conventional PSS is generally designed for being effective in a linearized model at a certain operating point. In the power system, when the state of the system configuration and power flow change, the performance and stability of PSS are not guaranteed theoretically. In recent years, design methods of PSS which have a robustness of two or more operating points have been investigated. In this paper, we propose a design method of a generator control using the H∞ control theory for high robustness, and the Particle Swarm Optimization method for automatic tuning of the weight functions. As a result, we can make an improvement in the control performance. The validity of the proposed method is demonstrated using a 3 machine 9 bus system.

123. Jimmy Peng
University of Auckland
Poster Title: Adaptive Power System Stabilizer Tuning Technique for Damping Inter-Area Oscillations
Abstract: The adaptive Power System Stabilizer (PSS) tuning method for damping inter-area oscillation is presented in this poster. The primary focus is to adaptively improve the observability of the PSS reflecting the changing operating conditions in order to achieve effective damping towards Inter-Area oscillations. The proposed design approach is considered to be an indirect approach since the PSS parameters are not altered. Instead, the algorithm modulates the PSS input signal by mixing local and remote generator rotor speeds. Simulations are conducted in DIgSILENT and PSS/E to verify the performance of the proposed method.

124. Felix Rafael Segundo Sevilla, Balarko Chaudhuri, Imad Jaimoukha, Petr Korba
Imperial College London
Poster Title: Fault-Tolerant Wide-Area Control of Power Systems
Abstract: Despite effectiveness of wide-area control for power oscillation damping (POD), most utilities are still reluctant to deploy it for improving their system dynamic performance. One of their major concerns is the consequences of problems in communication channels leading to loss of signals in the worst case. In this poster, a fault-tolerant control scheme is proposed to guard against potential loss of one or more, but not all, remote signals. The controller is designed to ensure stringent specifications for the fault free nominal plant and minimal specifications for asset on off-nominal plants mimicking potential loss of signals. The control design problem is solved in a linear matrix inequality (LMI) framework. Effectiveness of such a fault-tolerant controller in the face of loss of feedback signals is demonstrated through a case study on the reduced equivalent of the Nordic system. Also the conservativeness of the controller is compared against a conventional one.

125. Jiakun Fang, Haishun Sun, Lin Cui, Xiaotao Peng, Jinyu Wen, Lin Jiang, Shijie Cheng
Huazhong University of Science and Technology
Poster Title: Study on a 35kJ/7.5kW High-Temperature Super-Conducting Magnetic Energy Storage Prototype: Development, Modeling and Application
Abstract: This paper presents development, modeling and application of a 35kJ/7.5kw High-Temperature Superconducting Magnetic Energy Storage (HT-SMES) system for improvement of power system stability. The development of the HT-SMES is introduced at first. Physical experiments that the SMES installs in a single machine infinite bus system has been carried out for the improvement of power system stability. A detailed model with a Pulse Width Modulation (PWM) control is built and simulated in PSCAD/EMTDC. Comparison between simulation and physical experiment results demonstrates that the effectiveness of the model developed. Since the model can fully reflect the operational characteristics of the practical device, it is used to suppress a 120kW generator power swing to demonstrate the efficiency of the SMES. Simulation results carried out by PSCAD/EMTDC are given.

126. Jawad Arif, Nilanjan Ray Chaudhuri, Swakshar Ray, Balarko Chaudhuri
Imperial College London
Poster Title: Self-tuning Feedback Linearization Control for Power Oscillation Damping
Abstract: Power systems exhibit highly nonlinear behavior especially under large disturbances, necessitating application of nonlinear control techniques. Nonlinear estimation and control of power oscillations through FACTS devices is illustrated. A special form of nonlinear neural network compatible with the feedback linearization framework is used. Levenberg-Marquardt (LM) algorithm is adapted to work in sliding window batch mode for online estimation of system oscillatory behavior. At each sampling interval the estimated neural network parameters are used to derive appropriate control using the feedback linearization technique. Use of LM is shown to yield better closed-loop performance compared to conventional recursive least square (RLS) approach. A case study is presented to demonstrate the effectiveness of feedback linearization controller (FBLC), especially, under stressed operating conditions. Its performance is compared against pole-shifting controller (PSC) under different scenarios.

127. Zhiqiang Jin
The University of Tennessee
Poster Title: Adaptive Control of a DFIG Based Wind Power System
Abstract: This poster focues on improving small signal stability in a grid connected doubly-fed induction generator (DFIG). Since different wind speeds will affect DFIGs operation status, an adaptive control method is used to dynamically change the control parameters such that the DFIG system always works well under different wind speeds. Examples and theoretical analysis show that this adaptive control method works. And the improvement of the small signal stability is also demonstrated.

128. Theresa Odun-Ayo, Mariesa Crow
Missouri University of S&T
Poster Title: An Analysis of Power System Transient Stability Using Stochastic Energy Functions
Abstract: This poster shows the development of an approach to analyze the impact of stochasticity on the transient stability of a power system. The stochastic power system stability was analyzed both through the stochastic Lyapunov function and numerically using the Euler-Maruyama method. It was shown that increasing either (or both) the variance and the magnitude of the applied noise can have a destabilizing effect on the power system. This could potentially cause difficulties as more randomness is introduced into the power system through renewable energy sources and plug-in-hybrid vehicles.

129. Joseph Makasa, Ganesh K. Venayagamoorthy
Missouri S&T
Poster Title: Prediction of Power System Voltage Stability Margin Using PMU Measurements
Abstract: Abstract: In this paper, a cellular neural network (CNN) based approach for prediction of power system voltage stability margin using synchrophasor measurements is presented. The method uses voltage and current phasors from phasor measurement units (PMUs) to predict the voltage stability margin. Real-time simulation of two test power system with PMUs is carried out on the Real-Time Digital Simulator (RTDS) platform. The CNN predicted output voltage stability margin can be used as feedback signals for voltage control in a power system. Results for the proposed approach on IEEE 14 bus and IEEE 68 bus systems under varying operating conditions show successful prediction of voltage stability margins. The results on 68 bus test system demonstrate the scalability of the CNN approach, and show the potential of the CNN based approach for practical power systems with large number of buses.

130. Jonathan Berardino, Chika Nwankpa
Drexel University
Poster Title: Development of a Reconfigurable Higher Order Generator Model for Analog Power System Analysis
Abstract: This work focuses on the development of a reconfigurable higher order generator model designed for a previously proposed method of analog power flow computations. Prior work in this area has developed static generator models which yielded accurate steady state results quickly, but did not include higher order dynamics. We have developed an analog generator model based on the generator two-axis equations. This will allow us to use exploit the advantages of analog emulation techniques when studying the dynamic behavior of generators.

131. Atsushi Enomoto, Shingo Sakaeda, Shinichi Iwamoto, Mashi Tatsuno, Daigo Hirano, Hisanori Ito
Waseda University
Poster Title: Voltage Stability Preventive Control using VMPI for Renewable Energy Generation Penetration
Abstract: Recently, New energy generations such as photovoltaic power generation and wind power generation keep penetrating into power systems in Japan after the renewables portfolio standard law is enforced. When bus voltages with new energy generations are fluctuated rapidly by a certain transmission line fault, the new energy generation might not be able to be connected to the system. However, there are some cases in which the bus voltage exceeds the lower voltage limit when preventive voltage controls are conducted in the system with new energy generations. Therefore, in this paper, we develop a new voltage stability preventive control scheme which calculates the penetration limits of the new energy generations in advance. Simulations are run using the IEEJ WEST 30 machine 115 bus system to verify the effectiveness of the proposed method.

132. Anshuman Vaidya, Ganesh K. Venayagamoorthy
Missouri S&T
Poster Title: SRN Based Real-Time Analysis of Power System Oscillations Using Hilbert-Huang Algorithm.
Abstract: In this paper, a Simultaneous Neural Network (SRN) based approach for prediction of power system oscillations for reducing the end effects caused due to application of Hilbert-Huang algorithm used for the analysis. The method uses neural network model to predict the oscillations for a few time steps ahead so that the end effects are only observed on the predicted signal and accurate instantaneous frequency information is retrieved from the HHT algorithm. The analysis is carried out on a DSP for a two area four machine system simulated on a Real-Time Digital Simulator (RTDS) platform.

133. Yunfei Wang, Jin Hao, Wilsun Xu
University of Alberta
Poster Title: Critical Technical Issues Associated with Impedance Match Based Voltage Stability Monitoring Techniques
Abstract: Impedance match based voltage stability monitoring techniques could lead to simple load shedding schemes, which are the ultimate measures for power system voltage collapse prevention. Due to the simplicity, the impedance match techniques that depend only on the local phasor measurements have attracted many interests in recent years. However, there are some main problems both in the practical implementation and the theoretical aspects. Furthermore, the impedance match theorem is easy to be verified on one-load systems. Conversely, the real power systems are all multi-load systems nowadays. Therefore, the applicability of impedance match (Z-match) techniques on those practical multi-load systems needs to be investigated. Instead of investigating on the problems with the practical implementations, this paper mainly focuses on the theoretical issues.

134. Yasser Wehbe, Lingling Fan
University of South Florida
Poster Title: Estimation of the Power Systems Dynamic Parameters Using Phasor Measurement Units (PMU) Data
Abstract: The research focuses on estimating interconnected power systems' dynamic parameters such as inertia H given synchronized phasor measurement units data (e.g. voltage magnitude and phase, current) based on Joe H. Chow's previous work on dynamic parameter estimation. Our research will develop an algorithm to find oscillation modes and compute the dynamic parameters using Matlab/Simulink. The work will also find the same the oscillation modes and dynamic parameters using prony analysis applied on real PMU data. The two methods will be compared for their computing time. The bandwidth requirement for dynamic estimation via PMUs will be investigated and compared with those for fault location and state estimation.

135. Ralph Wilson, Sanjeev Srivastava, Chris Edrington
Florida State University
Poster Title: A Measure of Complex Dynamics in Power Systems
Abstract: In order to begin the long task of accounting formally for the complexity of power systems from the perspective of Complexity Science, we introduce the use of a non-linear time series technique to detect and quantify complex dynamics in a time series signal. Using the methods of Time Delay Embedding to reconstruct an abstract state space, we make the correspondence between the dynamic complexity in the temporal behavior of a component, and the structural complexity of reconstructed trajectories in state space. The technique involves a significant reinterpretation of the Approximate Entropy (ApEn) which was introduced by Pincus, as a simplified computation of the Eckmann-Ruelle entropy. The methods are examined on numerical time series, system fault scenario measurements, as well as on the nonlinear dynamics of a buck converter when coupled with spurious noise. Results suggest that we are able to quantify the presence of nonlinear structure in time series measurements.