**WELCOME!**

The Energy Systems Innovation Center (ESIC) and the School of Electrical Engineering and Computer Science (EECS) at Washington State University are honored to host the 46th North American Power Symposium (NAPS). On behalf of the organizing committee, it is our pleasure to welcome you to NAPS and to Pullman, Washington, in the Palouse region. This is a very special year in other ways as well because we debuted the first online professional master’s degree program in electrical power engineering and added two new faculty members, bringing the number of power faculty to 10.

WSU has one of the leading power engineering programs in the country with a rich history. The dams on the Columbia River system were modeled and designed at WSU, as were the development and testing of aluminum cables and conductors after WWII. The first microprocessor-based relays were successfully commercialized from WSU research and spawned the leading company in protection. The power engineering partnership (PEP) program started in 1970 has 12 industry members today. The WSU Energy Systems Innovation Center (ESIC) was established in 2012 with an emphasis on multidisciplinary research and has 10 members. In 2013, eight core faculty members of the ESIC had research expenditures of $4.3 million.

NAPS is held every year at a university in North America and provides an international open forum for participants from academia and industry to exchange innovative ideas and solutions. NAPS started as the Midwest Power Symposium (MPS) in 1969 with a strong focus on student participation to share their early-stage research—and that continues even after MPS changed its name to the North American Power Symposium in 1986.

This year, NAPS will continue the long tradition of encouraging students to present papers and recognizing their best efforts by awards at the end of the symposium. The symposium program highlights the role that power engineering plays in the society, and authors from many countries will be presenting papers on topics related to power and energy engineering.

This year’s technical program includes 4 panel sessions, 24 paper sessions, and undergraduate poster presentations. Dr. Christopher Keane, Vice President for Research at WSU, and Dr. Candis Claiborn, Dean of the Voiland College of Engineering and Architecture (VCEA), will welcome the attendees and open the symposium on Monday morning. Panel sessions will address important topics including cyber-physical systems, synchrophasors applications, northwest smart grid projects, and smart grid in a societal context. The symposium will provide opportunities for networking and will close with lunch on Tuesday featuring student paper awards. We hope that this NAPS will provide good opportunities for attendees to share new theoretical contributions and information on practical applications.

Social programs for this year’s NAPS will start with the ESIC lab tours and reception followed by a student activity on Sunday evening. Schweitzer Engineering Laboratories has graciously agreed to host a tour and banquet on Monday evening, featuring SEL Vice President Dave Whitehead as the speaker. On Tuesday afternoon, attendees will have options to choose between the ESIC lab tours or social tours. Social tours are planned to the Nez Perce National Park, Unicon town, Steptoe Butte, and local wine tasting.

We would like to thank the NAPS 2014 committee members and WSU Conference Management for helping with symposium organization and management. Special thanks go to all the authors, panelists, reviewers, session chairs, and attendees for contributing toward the symposium. Financial support from sponsors is critical for ensuring large student attendance and the success of this symposium. Special thanks to Jody Opheim for coordinating the financial support. We thank the following sponsors for making this symposium possible: Energy System Innovation Center, Voiland College of Engineering and Architecture, Schweitzer Engineering Laboratories, AVISTA, ITRON, and RTDS Inc. We have also been fortunate to receive funding from the IEEE Power and Energy Society and from the National Science Foundation (NSF) to support student participation. We are grateful to the symposium technical co-sponsor, the IEEE Power and Energy Society.

Welcome again and we hope you will have a productive symposium and an enjoyable visit to the unique landscape of the Palouse.

Anurag Srivastava and Anjan Bose, Symposium General Chairs

---

SYMPOSIUM ORGANIZERS

**Symposium Chairs:**
Professor Anurag K. Srivastava
Professor Anjan Bose

**Technical Program Chairs:**
Professor Chen-Ching Liu
Professor Vaithianathan Venkatasubramanian

**Student Program Chair:**
Professor Ali Mehrizi-Sani

**Committee Members:**
Professor Robert Olsen
Professor David Bakken
Professor Carl Hauser

**Corporate Relations Manager:**
Jody Opheim

**Conference Manager:**
Ian Norland

---

NORTH AMERICAN POWER SYMPOSIUM | 3
Compton Union Building (CUB), 2nd Floor
Washington State University campus
Pullman, WA 99164

Senior Ballroom

Access to L60 on the lower floor.

Compton Union (CUB)

Screened area represents WSU campus map
**SUNDAY, SEPTEMBER 7, 2014**
Residence Inn by Marriott
1255 NE North Fairway Rd., Pullman, WA

1:00–3:00 p.m.
NAPS Registration

3:00–4:00 p.m.
PEEC Meeting (Crimson and Gray Rooms)

4:00–5:00 p.m.
NAPS Steering Committee Meeting
(Crimson and Gray Rooms)

**MONDAY, SEPTEMBER 8, 2014**
WSU Compton Union Building (CUB)

7:30 a.m.–4:30 p.m.
NAPS Registration (CUB 2nd Floor Foyer)

8:00–8:30 a.m.
NAPS Welcome (CUB Senior Ballroom)

8:30–9:45 a.m.
Smart Grid in a Societal Context Panel (CUB 212)
Or
Northwest Smart Grid Projects Panel (CUB 210)

9:45–10:00 a.m.
Coffee Break (CUB 2nd Floor Foyer)

10:00–11:30 a.m.
Paper Sessions A1 (CUB 212, 210, 206, 204, L60)

11:30 a.m.–12:30 p.m.
Lunch (CUB Senior Ballroom)

12:30–1:00 p.m.
Networking Break

1:00–2:30 p.m.
Paper Sessions A2 (CUB 212, 210, 206, 204, L60)

2:30–2:45 p.m.
Coffee Break (CUB 2nd Floor Foyer)

2:45–4:15 p.m.
Paper Sessions A3 (CUB 212, 210, 206, 204, L60)

4:15–5:00 p.m.
Bus Transfer to SEL (leaves from NAPS registration)

5:15–6:15 p.m.
SEL Tours (SEL Events Center)

6:15–6:45 p.m.
SEL NAPS Reception (SEL Events Center Foyer)

6:45–8:15 p.m.
SEL Banquet (SEL Events Center)

8:15–9:00 p.m.
Bus Transfer to Residence Inn by Marriott (leaves from SEL Event Center Foyer)

**TUESDAY, SEPTEMBER 9, 2014**
WSU Compton Union Building (CUB)

8:00–9:15 a.m.
Synchrophasor Applications Panel (CUB 212)
Or
Cyber-Physical Systems Panel (CUB 210)

9:15–10:30 a.m.
Paper Sessions B1 (CUB 212, 210, 206, 204, L60)

10:30–10:45 a.m.
Coffee Break (CUB 2nd Floor Foyer)

10:45 a.m.–12:15 p.m.
Paper Sessions B2 (CUB 212, 210, 206, 204)

12:30–1:30 p.m.
NAPS 2014 Lunch and Closing (CUB Senior Ballroom)

2:00–3:00 p.m.
Energy Systems Innovation Center Lab Tours (leaves from NAPS registration)

2:00–6:30 p.m.
Student Social Outing (leaves from NAPS registration)

Hike and Sip: scenic views and a visit to a local winery
Or
History of the Palouse: Native American perspective and a visit to a local artist barn
NAPS WELCOME
Monday, September 8, 2014
Location: WSU Compton Union Building (CUB), Senior Ballroom

8:00–8:30 a.m.
Anurag Srivastava
Conference General Chair and Assistant Professor,
The School of Electrical Engineering and Computer Science, WSU
Christopher Keane
Vice President of Research, WSU
Candis Claiborn
Dean, The Voiland College of Engineering and Architecture, WSU

NAPS PANEL SESSIONS
Monday, September 8, 2014
Location: WSU Compton Union Building (CUB 212 and 210)

8:30–9:45 a.m.
Smart Grid in a Societal Context, CUB 212
Chair: Chen-Ching Liu
Christine Horne, Washington State University
Russ Vanos, ITRON
Josh DiLuciano, AVISTA
Jodi Obradovich, Pacific Northwest National Lab
Northwest Smart Grid Projects, CUB 210
Chair: Anjan Bose
Ron Melton, Pacific Northwest National Laboratory
Curt Kirkeby, AVISTA
Will Odell, Snohomish Public Utility District
Mani Venkata, ALSTOM

8:00–9:15 a.m.
Synchrophasor Applications, CUB 212
Chair: Vaithianathan Venkatasubramanian
James O’Brien, Peak Reliability
Juan Castaneda, Southern California Edition
Vincent Minden, Bonneville Power Administration
Greg Zweigle, Schweitzer Engineering Laboratories
Cyber-Physical Systems, CUB 210
Chair: David Bakken, WSU
Ryan Goodfellow, Information Sciences Institute (ISI), University of Southern California
Dennis Gammel, Schweitzer Engineering Laboratories
Adam Hahn, Washington State University
Peter Sauer, University of Illinois

NAPS PANEL SESSIONS
Tuesday, September 9, 2014
Location: WSU Compton Union Building (CUB 212 and 210)

8:00–9:15 a.m.
Synchrophasor Applications, CUB 212
Chair: Vaithianathan Venkatasubramanian
James O’Brien, Peak Reliability
Juan Castaneda, Southern California Edition
Vincent Minden, Bonneville Power Administration
Greg Zweigle, Schweitzer Engineering Laboratories
Cyber-Physical Systems, CUB 210
Chair: David Bakken, WSU
Ryan Goodfellow, Information Sciences Institute (ISI), University of Southern California
Dennis Gammel, Schweitzer Engineering Laboratories
Adam Hahn, Washington State University
Peter Sauer, University of Illinois
MONDAY, SEPTEMBER 8, 2014
Location: WSU Compton Union Building (CUB)

10:00-11:30 a.m.
Paper Sessions A1

Transmission Systems: A1-A
Cyber Physical Systems: A1-B
Power Electronics in Power Systems: A1-C
Distribution Systems I: A1-D
Computational Framework for the Power Grid: A1-E

TRANSMISSION SYSTEMS: A1-A
Location: Room 212
Chair: Matthew Varghese

Dynamic Analysis of an ePFC (Enhanced Power Flow Controller) with Conduction Angle Control
Alekhya Vaddiraj, Madhav Manjrekar

Application of Node Centrality in Transmission Expansion Planning Under Uncertainty
Fatou Thiam, Christopher L. DeMarco

The Three-Dimensional Electromagnetic Simulation Analysis of Power Transmission of Loosely Coupled Transformer Based on ANSYS
Jiang Li, Peng Zhang, Yiwei Wang, Chao Wei

Frequency Response Assessment of Eastern and Western Interconnections
Mark Lauby, Jessica Bian, Svetlana Ekisheva, Matthew Varghese

Frequency Response Assessment of ERCOT and Québec Interconnections
Mark Lauby, Jessica Bian, Svetlana Ekisheva, Matthew Varghese

Development of Software for Calculating Electromagnetic Fields Near Power Lines
Lei Xiao, Keith Holbert

CYBER PHYSICAL SYSTEMS: A1-B
Location: Room 210
Chair: Carl Hauser

On the Impact of Communication Delays on Power System Automatic Generation Control Performance
Jiangmeng Zhang, Alejandro Domínguez-García

Addressing Cyber Security for the Oil, Gas and Energy Sector
Rafat Rob, Tolga Tural, Gareth W. McLorn, Abdullah Sheikh, Ahmad Hassan

Implementing a Real-Time Cyber-Physical System Test Bed in RTDS and OPNET
Bo Chen, Karen L. Butler-Purry, Ana Goulart, Deepa Kundur

Game Theoretic Model of Energy Trading Strategies at Equilibrium in Microgrids
Mohammad Faqiry, Rupam Kundu, Rohan Mukherjee, Sanjoy Das, Anil Pahwa

Power Grid Cyber Security: Challenges and Impacts
Paul Kaster, Pankaj Sen

Quantifying the Economic Impacts of Attacks on Competitive Energy Markets
Rajes Rangarajan
POWER ELECTRONICS IN POWER SYSTEMS: A1-C
Location: Room 206
Chair: Herbert Hess

Modeling and Control of Grid-Connected Photovoltaic Power Plants Utilizing a Simplified Model of the Modular Multilevel Converter
Muhammad Alsadah, Fernando Mancilla-David

Modeling and Control of a Grid-Connected Small-Scale Windmill System Using a Pulse Width Modulated Modular Multilevel Converter
Ersin Canak, Miguel Carrasco, Fernando Mancilla-David

Energy Function for a Grid-Tied, Droop-Controlled Inverter
Philip Hart, Bernard Lesieutre

A Simple Algorithm to Control Two-Phase Induction Motors Using a Two-Leg VSC
Younes Sangsefidi, Saleh Ziaeinejad, Ali Mehrizi-Sani, Abbass Shouloua

Dynamic Reactive Compensation Requirements at the Rectifier End of an LCC HVDC Link Connected to a Weak AC System
Abosalah ElMehdi, Ahmed Momen, Brian Johnson

Fault Detection and Compensation for a PV System Grid Tie Inverter
Ahmed Ebrahim, Tarek Youssef, Sherief M. Wasfy Ahmed, Saied E. Elmasey, Osama Mohammed

DISTRIBUTION SYSTEMS I: A1-D
Location: Room 204
Chair: Valentina Cecchi

Increasing Penetration of Distributed Generation with Meshed Operation of Distribution Systems
Masoud Davoudi, Valentina Cecchi, Julio Romero Agüero

Application of Minimum Spanning Tree Algorithm for Network Reduction of Distribution Systems
Adarsh Nagarajan, Raja Ayyanar

Distribution System Voltage Regulation by Distributed Energy Resources
Oguzhan Ceylan, Guodong Liu, Yan Xu, Kevin Tomsovic

A New Linearization Method of Unbalanced Electrical Distribution Networks
Guodong Liu, Yan Xu, Oguzhan Ceylan, Kevin Tomsovic

Dynamic Analysis of Distribution Systems with High Penetration of PV Generators Using Differential Algebraic Equations in Open DSS
Adarsh Nagarajan, Raja Ayyanar

Modeling Large Distribution Feeders for Transient Analysis Using Graph Search Algorithms
Adarsh Nagarajan, Raja Ayyanar

COMPUTATIONAL FRAMEWORK FOR THE POWER GRID: A1-E
Location: Room L60
Chair: Adam Hahn

Parallel Contingency Analysis Solution Based on Open MP
Feng Dong, Xiatian Xu, Xu Zhang

On Detailed Synchronous Generator Modeling for Massively Parallel Dynamic State Estimation
Hadis Karimipour, Venkata Dinavahi

Application of Null Space Method in Computing Electricity Prices with Voltage-Stability Constraints
Jeremy Lin, Mohammad Reza Hesamzadeh, Olga Galland

Hidden Markov Models for Nonintrusive Appliance Load Monitoring
Jacob Mueller, Anusha Sankara, Jonathan Kimball, Bruce McMillin

Detecting, Locating, & Quantifying False Data Injections Utilizing Grid Topology Through Optimized D-FACTS Device Placement
Kaci Kuntz, Michael Smith, Kevin Wedeward, Michael Collins

Robust Continuous-Discrete Kalman Filter for Time-Stamped Delay Mitigation in Networked Estimation and Control Systems
Bei Yan, Hanoch Lev-Ari, Aleksandar Stankovic
POWER SYSTEM COMPUTATION AND OPTIMIZATION: A2-A
Location: Room 212
Chair: Cosmin Safta

An Efficient Primal-Dual Approach to Chance-Constrained Economic Dispatch
Gabriela Martinez, Yu Zhang, Georgios Giannakis

Optimal Storage Sizing Using Two-Stage Stochastic Optimization for Intra-Hourly Dispatch
Kyri Baker, Gabriela Hug, Xin Li

Active/Reactive Power Decomposition Approaches to the AC Optimal Power Flow Problem
ByungKwon Park, Christopher L. DeMarco

Optimal Distributed Generation Allocation on Distribution Networks at Peak Load and the Analysis of the Impact of Volt/Var Control on the Improvement of the Voltage Profile
Insu Kim, Ronald Harley, Raeey Regassa

Optimal Location of Electrical Energy Storage Unit in a Power System with Wind Energy
Yi Xu, Ward Jewell, Chengzong Pang

Toward Using Surrogates to Accelerate Solution of Stochastic Electricity Grid Operations Problems
Cosmin Safta, Richard Chen, Habib Najm, Ali Pinar, Jean-Paul Watson

SYNCHROPHASOR APPLICATIONS: A2-B
Location: Room 210
Chair: Bharat Bhargava

Synchrophasor Monitoring of Single Line Outages via Area Angle and Susceptance
Atena Darvishi, Ian Dobson

Lyapunov Exponents Over Variable Window Sizes for Prediction of Rotor Angle Stability
Haosen Guo, Chen-Ching Liu, Guanqun Wang

User Interface for Situational Awareness of openPDC
Nick Gellerman, Prakash Ranganathan, Ranganath Vallakati, Anupam Mukhejjee

Synchrophasor Time Skew: Formulation, Detection and Correction
Qiang Zhang, Vaithianathan Venkatasubramanian

Stress Assessment in Power Systems and its Visualization Using Synchrophasor Based Metrics
Anamitra Pal, Iknoor Singh, Bharat Bhargava

Fast Fault Location in Power Transmission Networks Using Transient Signatures from Sparsely-Placed Synchrophasors
Justin Valdez, Xun Zhang, Jackeline Abad Torres, Sandip Roy
Sensitivity of Voltage Sag Based Fault Location in Distribution Network to Sub-Cycle Faults
Po-Chen Chen, Vuk Malbasa, Tatjana Dokic, Mladen Kezunovic, Yimai Dong

Evaluation of Fault Analysis Tool Under Power Swing and Out-of-Step Conditions
Ahad Esmaeilion, Mladen Kezunovic

Transmission Side Protection Performance with Type-IV Wind Turbine System Integration
Ankita Roy, Brian Johnson

Alternative Coordination Approaches for Implementation in Smart Grid
Meng Yen Shih, Arturo Conde Enriquez

Relieving the Pressure of Electric Vehicle Battery Charging on Distribution Transformer via Particle Swarm Optimization Method
Yin Yao, Wenzhong Gao

Minimization of Operating Time Gap Between Primary Relays at Near and Far Ends in Overcurrent Relay Coordination
Manohar Singh, B. K. Panigrahi

An Approach for Modeling Frequency-Dependent Apparent Resistance of Power Transmission Lines
Bikash Poudel, Valentina Cecchi

Equivalent Models for Implicitly-Coupled Electromechanical and Electromagnetic Transient Analysis
Xu Zhang, Alexander Flueck, Shrirang Abhyankar

Real Time Modeling and Simulation of Campus Microgrid for Voltage Analysis
Sayonsom Chanda, Venkatesh Venkataramanan, Anurag Srivastava

DFIG Based Wind Turbine System Modeling in the Real Time Digital Simulator
Rishabh Jain, Herbert Hess, Brian Johnson

Reduced Order Modeling of Wind Farms for Inclusion in Large Power System Simulations for Primary Frequency Response Application
Sudipta Ghosh, Nilanjan Senroy, Sukumar Kamalasadan

Digital Filter Realizations of a Phase Domain Transmission Line Model for Electromagnetic Transient Analysis
Martin Vega, Jose Luis Naredo, Octavio Ramos-Leãnos

Estimation of Lost Voltage Measurements in Distribution Networks
Andrés Argüello, Gustavo Valverde

Multi-Objective Optimization for Reconfiguration and Capacitor Allocation in Distribution Systems
Diana Paola Montoya Escobar, Juan Manuel Ramirez, Jean Rene Zuluaga

Dynamic Voltage Restorer with Active Disturbance Rejection Control
Looja Tuladhar, F. Eugenio Villaseca

Distribution System Reconfiguration Using Artificial Immune Systems
Francisco Ricardo Alonso, Denisson Q. Oliveira, Antonio C. Z. De Soza, Benedito Lopes

A Study of Harmonic Distortion Limit Changes During the Reconfiguration Process of the Smart Grid
Wenyue Yang, Daniel L. Geiger II, S. Mark Halpin

Stochastic Loss Minimization for Power Distribution Networks
Vassilis Kekatos, Gang Wang, Georgios Giannakis
DISTRIBUTED GENERATION: A3-A
Location: Room 212
Chair: Hashem Nehrir

Impacts of Distributed Generation on Power Quality
Ali Hariri, Omar Faruque

A Heuristic Power Optimization Method for Photovoltaic Systems
Joshua Icenhower, Mahyar Zarghami, Mohammad Vaziri

Optimizing Renewable Energy Control for Building Using Model Predictive Control
James A. Momoh, Feng Zhang, Wenzhong Gao

High Frequency Spectral Components in Distribution Voltages and Currents Due to Photovoltaic Resources
Titiksha Joshi, Gerald Heydt, Raja Ayyanar

Design and Implementation of a Low-Cost Solar Photovoltaic Experimental Station for Education Enhancement
Colin Young, Jashua Thelen, Hashem Nehrir

Size Reduction of Permanent Magnet Generators for Wind Turbines with Higher Energy Density Permanent Magnets
Helena Khazdozian, Ravi Hadimani, David Jiles

POWER SYSTEM SECURITY AND RELIABILITY I: A3-B
Location: Room 210
Chair: Sukumar Kamalasadan

A Network-Inclusive, Optimization-Based Approach to Power System Flexibility Evaluation
Kai Van Horn

Optimal TCSC Allocation in a Power System for Risk Minimization
Dmitry Shchetinin, Gabriela Hug

Optimal Power Flow with Primary and Secondary Frequency Constraint
Guangyuan Zhang, James McCalley

Multi-Agent System Algorithm for Preventing Cascading Failures in Smart Grid Systems
Rabie Belkacemi, Adeniyi Bababola, Sina Zarrabian, Robert Craven

Security Assessment and Enhancement Using RBFNN with Feature Selection
Namilakonda Srilatha, Guduri Yesuratnam

Dynamic Modeling and Filtering in Geomagnetically Induced Current Validation
Maryam Kazerooni, Hao Zhu, Thomas Overbye
A New Hybrid Optimization Algorithm for Solving Economic Load Dispatch Problem with Valve-Point Effect
Seyyed H. Elyas, Paras Mandal, Ashraf U. Haque, Annarita Giani, Tzu-Liang Tseng

Examining Some Prospect Scenarios for the Electricity Grid Infrastructure Modernization in Saudi Arabia
Turki Alaqeel, Siddharth Suryanarayanan

Using Distribution LMP and Time-of-Delivery Pricing to Promote Optimal Placement and Increased Profitability of Residential PV Systems
Matthew J. Reno, Kyle Coogan, Jouini Peppanen, Santiago Grijalva

Financial Storage Rights: Definition and Basic Properties
Daniel Muñoz-Álvarez, Eilyan Bitar

Financial Opportunities for LSE Under Scarcity Price Environment
Zhaohao Ding, Piampoom Sarikprueck, Lyndon Lee, Wei-Jen Lee, Jie Shi, Heng Lu

The Impact of Energy Storage on Long Term Transmission Planning in the North Sea Region
Delaram Azari, Shahab Shariat Torbaghan, Madeleine Gibescu, Mart van des Meijden

Modeling and Simulation of Hybrid Power Flow Controller Implemented on SMIB System
Lini Mathew, S Chatterji

Combined Tacs-Models for Footing Tower Resistance Considering Ground Ionization
John Morales, Eduardo Orduña, Roberto Cabral, Arturo Bretas

Wavelet and Multi-Rate Analysis for the Simulation of Electromagnetic Transients in Power Systems
Jean Rene Zuluaga, Jose Luis Naredo

Frequency-Domain Computation of Maximum Lightning Overvoltage Along a Cable Protected by Surge Arresters
Miguel Cervantes, Abner Ramirez

Frequency Domain Simulation of Fault Transients in Transmission Lines Including Measurement Transformers
Carlos Luna, Pablo Moreno, Julián Sotelo, Armando Guzmán

Steady-State Modeling and Simulation of a Distribution Feeder with Distributed Energy Resources in a Real-Time Digital Simulation Environment
Mayank Panwar, Siddharth Suryanarayanan, Sudipta Chakraborty

Investigation of Voltage Stability in Three-Phase Unbalanced Distribution Systems with DG Using Modal Analysis Technique
Hung-Ming Chou, Karen L. Butler-Purry

Dynamic Remedial Action Scheme Using Online Transient Stability Analysis
Arun Shrestha, Valentina Cecchi, Robert Cox

Stability Enhancement of Droop Controlled PV Based Microgrid with Frequency Dependent Load
Somesh Bhattacharya, Sukumar Mishra

Performance Analysis of a New Synchrophasor Based Real Time Voltage Stability Monitoring (RT-VSM) Tool
Saugata Biswas, Tushar Tushar, Anurag Srivastava

PMU Based Real-Time Short Term Voltage Stability Monitoring-Analysis and Implementation on a Real-Time Test Bed
Amarsagar Reddy, Kerem Ekmen, Venkataramana Ajjarapu, Umesh Vaidya

A Comparative Study of Measurement-Based Thevenin Equivalents Identification Methods
Haoyu Yuan, Fangxing Li
TUESDAY, SEPTEMBER 9, 2014
Location: WSU Compton Union Building (CUB)

9:15-10:30 a.m.
Paper Sessions B1

Power System Dynamics: B1-A
Power System Analysis and Computation I: B1-B
Forecasting and Electricity Markets: B1-C
Modeling and Simulation III: B1-D
Microgrids: B1-E

POWER SYSTEM DYNAMICS: B1-A
Location: Room 212
Chair: Peter Sauer

Evaluation and Mitigation of Power System Oscillations Arising from High Solar Penetration with Low Conventional Generation
Anushree Pethe, Vijay Vittal, Gerald Heydt

Power Oscillation Damping Controller for the Power System with High Wind Power Penetration Level
Ataollah Arvani, Vittal S Rao

Fuzzy Logic PSS Assisted by Neighboring Signals to Mitigate the Electromechanical Wave Propagation in Power Systems
Mahmoud Ali

Damping Tie Line Oscillation Using Permanent Magnet Wind Generators in the Libyan Power System
Emad Elhaji, Constantine Hatziadoniu

Distributed Control with Local and Wide-Area Measurements for Mitigation of Cascading Outages
Greg Zweigle, Ellery Blood

POWER SYSTEM ANALYSIS AND COMPUTATION I: B1-B
Location: Room 210
Chair: Gerald Heydt

Generalized Injection Shift Factors and Application to Estimation of Power Flow Transients
Yu Christine Chen, Alejandro Domínguez-García, Peter Sauer

Generation of Simulated Wind Data Using an Intelligent Algorithm
Robert Weissbach, Wen-Li Wang, Bri-Mathias Hodge, Mei-Huei Tang, James Sonnenmerer

Performance Characterization of a Solar Panel: a Case Study
Haneen Aburub, Mohammad Heidari-Kapourchali, Ward Jewell, Visvakumas Ajavinthan

A Novel Integrated Optimal Battery Energy Management Control Architecture Considering Multiple Storage Functions
Sherif Abdelrazek, Sukumar Kamalasadan

Evaluating Correlations Between Interharmonics and Voltage Fluctuations
Brandon Eidson, S. Mark Halpin
FORECASTING AND ELECTRICITY MARKETS: B1-C
Location: Room 206
Chair: Sarika Khushalani-Solanki

On Comparison of Two Strategies in Net Demand Forecasting Using Wavelet Neural Network
Hamid Shaker, Hamed Chitsaz, Hamidreza Zareipour, David Wood

Forecasting Solar Photovoltaic Power Production at the Aggregated System Level
Yue Zhang, Marc Beaudin, Hamidreza Zareipour, David Wood

Short Term Electrical Load Forecasting Using Back Propagation Neural Networks
Surender Reddy Salkuti, James A. Momoh

An Improved Simultaneous Feasibility Test to Alleviate Revenue Inadequacy in FTR Markets
Rajes Rangarajan, Zongfei Wang

Advanced Models and Algorithms for Demand Participation in Electricity Markets
José Iria, Filipe Soares, André Madureira

MODELING AND SIMULATION III: B1-D
Location: Room 204
Chair: Ali Mehrizi-Sani

An Optimization Based Generator Placement Strategy in Network Reduction
Yujia Zhu, Daniel Tylavsky

A Modified CIGRE HVDC Benchmark Model for 60 Hz Applications
James Schwartz, Ebrahim Rahimi, Hamidreza Zareipour

Improved DC Network Model for Contingency Analysis
Puneet Sood, Daniel Tylavsky, Yingying Qi

Frequency-Domain Approach to Calculate Steady-State of a Stand-Alone Photovoltaic System
Jesus Morales, Abner Ramirez

Aggregated Inflows on Stochastic Dynamic Programming for Long Term Hydropower Scheduling
Ricardo Scarcelli, Mônica Zambelli, Secundino Soares Filho, Adriano A. Carneiro

MICROGRIDS: B1-E
Location: Room L60
Chair: Ali Mehrizi-Sani

A Hybrid Approach to Improve the Resiliency of the Power Distribution System
Kaveh Rahimi, Badrul Chowdhury

Day-Ahead Battery Scheduling in Microgrid Considering Wind Power Uncertainty Using Ordinal Optimization
Qianyao Xu, Ning Zhang, Chongqing Kang, Ruoyang Wang, Jiangran Wang

Prony Analysis of Damping Characteristic for Micro-Grid with Energy Storage System
Jiang Li, James A. Momoh, Surender Reddy

Power Management of Shipboard Power Systems Using Interaction Balance Principle
Ranjit Amgai, Sherif Abdelwahed

Optimal Real-Time Integration Control of a Virtual Power Plant
Brook Abegaz, Satish Mahajan
DEMAND RESPONSE AND ENERGY EFFICIENCY: B2-A
Location: Room 212
Chair: Mariesa Crow

- Clustering-Based Methodology for Optimal Residential Time of Use Design Structure
  Fnu Maigha, Mariesa L. Crow

- Analysis of Coupon Incentive-Based Demand Response with Bounded Consumer Rationality
  Hao Ming, Le Xie

- Thermal Energy Storage for Air Conditioning as an Enabler of Residential Demand Response
  Jouni Peppanen, Matthew J. Reno, Santiago Grijalva

- Optimization of Electric Vehicle Movement for Efficient Energy Consumption
  Qin Yan, Bei Zhang, Mladen Kezunovic

- Investigation on Volt-Var Control Using CVR at Various Photovoltaic Penetration Levels
  Ali Rahimi, Anna Cloninger, Mahyar Zarghami, Mohammad Vaziri

POWER SYSTEM SECURITY AND RELIABILITY II: B2-B
Location: Room 210
Chair: Mahyar Zarghami

- A Risk Sensitivity-Based Approach to Hardening Power Systems Against Catastrophic Failures
  Mohammed Benidris, Salem Elsaiah, Joydeep Mitra

- Consideration of the Effects of Voltage and Reactive Power Constraints on Composite System Reliability
  Mohammed Benidris, Joydeep Mitra

- A Zonotope-Based Method for Capturing the Effect of Variable Generation on the Power Flow
  Xichen Jiang, Alejandro Domínguez-García

- A Method to Model the Output Power of Wind Farms in Composite System Reliability Assessment
  Samer Sulaeman, Mohammed Benidris, Joydeep Mitra

- A New Algorithm for Reliability Evaluation of Radial Distribution Networks
  Mojtaba Sepehry, Mohammad Heidari-Kapourchali, Avinash Banajiger, Visvakvmar Asavinthan
POWER SYSTEM COMPONENTS
ANALYSIS: B2-C
Location: Room 206
Chair: Robert Olsen

Age Estimation of Electrographite Brush in Generator System for Optimized Maintenance Planning of Sirikit Hydro Power Plant
Witcha Kate-Singnoy, Suttichai Premrudeepreechacharn

Methods to Detect Incorrect Fan Status for Transformer Thermal Models
Shruti Dwarkanath Rao, Daniel Tylavsky, Ken Alteneder, Kenneth Brown, Jason Gunawardina, Thomas LaRose

Circuit Breaker Operational Health Assessment via Condition Monitoring Data
Payman Dehghanian, Tomo Popovic, Mladen Kezunovic

Rectangular Representation of FACTS Devices in the ACOPF Problem
Omar Urquidez, Le Xie

POWER SYSTEM ANALYSIS AND COMPUTATION II: B2-D
Location: Room 204
Chair: Javier Guerrero

Decentralized Synergetic Controller Using Static Var Compensator
Rehan Fazal, Muhammad Akram Choudhry

Experimental Time Domain Harmonic State Estimation Using Partial Measurements
Ismail Molina-Moreno, Aurelio Medina, Rafael Cisneros-Magaña

Software Development of Optimal Substation Ground Grid Design Based on Genetic Algorithm and Pattern Search
Qianzhi Zhang, Xuan Wu

Smart Grid Implications for Power Quality Standardization
Daniel L. Geiger II, S. Mark Halpin

Distribution High Impedance Fault Location Using Localized Voltage Magnitude Measurements
Shamina Hossain, Hao Zhu, Thomas Overbye
HISTORY OF MPS/NAPS

MIDWEST POWER SYMPOSIUM (MPS)

1969
University of Minnesota
Minneapolis, Minnesota
V. Albertson, Chair

1970
Iowa State University
Ames, Iowa
P. Anderson, Chair

1971
University of Michigan
Ann Arbor, Michigan
M. Enns, Chair

1972
University of Missouri-Columbia
Columbia, Missouri
L. Walker, Chair

1973
University of Cincinnati
Cincinnati, Ohio
C. Evert, Chair

1974
University of Missouri-Rolla
Rolla, Missouri
M. Anderson and E. Richards,
Co-chairs

1975
University of Akron
Akron, Ohio
R. Grumbach, Chair

1976
Kansas State University
Manhattan, Kansas
F. Harris, Chair

1977
West Virginia University
Morgantown, West Virginia
E. Stanek and S. Venkata, Co-chairs

1978
University of Nebraska
Lincoln, Nebraska
H. Chung, Chair

1979
Ohio State University
Columbus, Ohio
S. Sebo, Chair

1980
Purdue University
West Lafayette, Indiana
A. El-Abiad and G. Heydt, Co-chairs

1981
University of Illinois at Urbana-Champaign
Urbana, Illinois
P. Sauer, Chair

1982
University of Wisconsin
Madison, Wisconsin
F. Alvarado, Chair

1983
Iowa State University
Ames, Iowa
K. Kruempel and A. Day, Co-chairs

1984
Drexel University
Philadelphia, Pennsylvania
R. Fischl, Chair

1985
Michigan Technical University
Houghton, Michigan
E. Stanek and D. Wiitanen, Co-chairs

1986
Cornell University
Ithaca, New York
R. Thomas, Chair

1987
University of Alberta
Edmonton, Alberta, Canada
D. Kelley and D. Koval, Co-chairs

1988
Purdue University
West Lafayette, Indiana
G. Heydt, Chair

1989
University of Missouri-Rolla
Rolla, Missouri
M. Anderson and E. Richards,
Co-chairs

1990
Auburn University
Auburn, Alabama
C. Gross and G. Sheblé, Co-chairs

NORTH AMERICAN POWER SYMPOSIUM (NAPS)

1986
Cornell University
Ithaca, New York
R. Thomas, Chair

1987
University of Alberta
Edmonton, Alberta, Canada
D. Kelley and D. Koval, Co-chairs

1988
Purdue University
West Lafayette, Indiana
G. Heydt, Chair

1989
University of Missouri-Rolla
Rolla, Missouri
M. Anderson and E. Richards,
Co-chairs

1990
Auburn University
Auburn, Alabama
C. Gross and G. Sheblé, Co-chairs
<table>
<thead>
<tr>
<th>Year</th>
<th>Institution</th>
<th>Location</th>
<th>Chair(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>Southern Illinois University</td>
<td>Carbondale, Illinois</td>
<td>M. Daneshdoost, Chair</td>
</tr>
<tr>
<td>1992</td>
<td>University of Nevada, Reno</td>
<td>Reno, Nevada</td>
<td>M. Etezadi-Amoli, Chair</td>
</tr>
<tr>
<td>1993</td>
<td>Howard University</td>
<td>Washington, D.C.</td>
<td>J. Momoh, Chair</td>
</tr>
<tr>
<td>1994</td>
<td>Kansas State University</td>
<td>Manhattan, Kansas</td>
<td>A. Pahwa and M. Morcos, Co-chairs</td>
</tr>
<tr>
<td>1995</td>
<td>Montana State University</td>
<td>Bozeman, Montana</td>
<td>H. Nehrir, Chair</td>
</tr>
<tr>
<td>1996</td>
<td>MIT</td>
<td>Cambridge, Massachusetts</td>
<td>B. Lesieutre, Chair</td>
</tr>
<tr>
<td>1997</td>
<td>University of Wyoming</td>
<td>Laramie, Wyoming</td>
<td>B. Chowdhury, Chair</td>
</tr>
<tr>
<td>1998</td>
<td>Cleveland State University</td>
<td>Cleveland, Ohio</td>
<td>E. Villaseca, Chair</td>
</tr>
<tr>
<td>1999</td>
<td>Cal Poly State University</td>
<td>San Luis Obispo, California</td>
<td>A. Shaban, Chair</td>
</tr>
<tr>
<td>2000</td>
<td>University of Waterloo</td>
<td>Waterloo, Ontario, Canada</td>
<td>C. Cañizares, Chair</td>
</tr>
<tr>
<td>2001</td>
<td>Texas A&amp;M University</td>
<td>College Station, Texas</td>
<td>K. Butler-Purry, Chair</td>
</tr>
<tr>
<td>2002</td>
<td>Arizona State University</td>
<td>Tempe, Arizona</td>
<td>G. Heydt, Chair</td>
</tr>
<tr>
<td>2003</td>
<td>University of Missouri-Rolla</td>
<td>Rolla, Missouri</td>
<td>B. Chowdhury and M. Crow, Co-chairs</td>
</tr>
<tr>
<td>2004</td>
<td>University of Idaho</td>
<td>Moscow, Idaho</td>
<td>B. Johnson and H. Hess, Co-chairs</td>
</tr>
<tr>
<td>2005</td>
<td>Iowa State University</td>
<td>Ames, Iowa</td>
<td>V. Ajjarapu, Chair</td>
</tr>
<tr>
<td>2006</td>
<td>Southern Illinois University</td>
<td>Carbondale, Illinois</td>
<td>M. Daneshdoost, Chair</td>
</tr>
<tr>
<td>2007</td>
<td>New Mexico State University</td>
<td>Las Cruces, New Mexico</td>
<td>S. Ranade and J. Mitra, Co-chairs</td>
</tr>
<tr>
<td>2008</td>
<td>University of Calgary</td>
<td>Calgary, Alberta, Canada</td>
<td>W. Rosehart, H. Zareipour, and O. Malik, Co-chairs</td>
</tr>
<tr>
<td>2009</td>
<td>Mississippi State University</td>
<td>Starkville, Mississippi</td>
<td>N. Schulz, H. Ginn, A. Srivastava, and S. Grzybowski, Co-chairs</td>
</tr>
<tr>
<td>2010</td>
<td>University of Texas at Arlington</td>
<td>Arlington, Texas</td>
<td>Wei-Jen Lee and R. Shoultz, Co-chairs</td>
</tr>
<tr>
<td>2011</td>
<td>Northeastern University</td>
<td>Boston, Massachusetts</td>
<td>A. Abur and A. Stankovic, Co-chairs</td>
</tr>
<tr>
<td>2012</td>
<td>University of Illinois at Urbana-Champaign</td>
<td>Urbana, Illinois</td>
<td>A. Domínguez-García, Chair</td>
</tr>
<tr>
<td>2013</td>
<td>Kansas State University</td>
<td>Manhattan, Kansas</td>
<td>A. Pahwa, Chair</td>
</tr>
<tr>
<td>2014</td>
<td>Washington State University</td>
<td>Pullman, Washington</td>
<td>A. Srivastava, A. Bose, C. C. Liu, and V. Venkatasubramanian, Co-chairs</td>
</tr>
</tbody>
</table>
CHAIRS AND AUTHORS INDEX

A
Abdelrazek, S. 14
Abdelwahed, S. 15
Abegaz, B. 15
Abhyankar, S. 11
Aburub, H. 14
Agüero, J. R. 9
Ajavinthan, V. 14
Ajjarapu, V. 13
Alaqeel, T. 13
Ali, M. 14
Alonso, F. R. 11
Alsadah, M. 9
Alteneder, K. 17
Amgai, R. 15
Argüello, A. 11
Arvani, A. 14
Asavinthan, V. 16
Ayyanar, R. 9, 12
Azari, D. 13

B
Bababola, A. 12
Baker, K. 10
Banajiger, A. 16
Beaudin, M. 15
Belkacemi, R. 12
Benidris, M. 16
Bhargava, B. 10
Bhattacharya, S. 13
Bian, J. 8
Biswa, S. 13
Bitar, E. 13
Blood, E. 14, 15
Bretas, A. 13
Brown, K. 17
Butler-Purry, K. L. 8, 13

C
Cabral, R. 13
Canak, E. 9
Carneiro, A.A. 15
Carrasco, M. 9
Cecchi, V. 9, 11, 13
Cervantes, M. 13
Ceylan, O. 9
Chakraborty, S. 13
Chanda, S. 11
Chatterji, S. 13
Chen, B. 8
Chen, P. 11
Chen, R. 10
Chen, Y. C. 14
Chitsaz, H. 15
Chou, H. 13
Choudhry, M. A. 17
Chowdhury, B. 15
Cisneros-Magaña, R. 17
Cloninger, A. 16
Collins, M. 9
Coogan, K. 13
Cox, R. 13
Craven, R. 12
Crow, M. L. 16

D
Darvishi, A. 10
Das, S. 8
Davoudi, M. 9
De Soza, A. C. Z. 11
Dehghanian, P. 17
DeMarco, C. L. 8, 10
Dinavahi, V. 9
Ding, Z. 13
Dobson, I. 10
Dokic, T. 11
Domínguez-García, A. 8, 14, 16
Dong, F. 9
Dong, Y. 11

E
Ebrahim, A. 9
Eidson, B. 14
Ekisheva, S. 8
Ekmen, K. 13
Elhaji, E. 14
Elmasey, S. E. 9
ElMehdi, A. 9
Elsaih, S. 16
Elyas, S. H. 13
Enríquez, A. C. 11
Esmaeilian, A. 11

F
Faqiry, M. 8
Faruque, O. 12
Fazal, R. 17
Filho, S. S. 15
Flueck, A. 11

G
Galland, O. 9
Gao, W. 11, 12
Geiger II, D. L. 11, 17
Gellerman, N. 10
Ghosh, S. 11
Giani, A. 13
Giannakis, G. 10, 11
Gibescu, M. 13
Goulart, A. 8
Grijalva, S. 13, 16
Guarnerina, J. 17
Guo, H. 10
Guzmán, A. 13

H
Hadimani, R. 12
Hahn, A. 9
Halpin, S. M. 11, 14, 17
Haque, A. U. 13
Hariri, A. 12
Harley, R. 10
Hart, P. 9
Hassan, A. 8
Hatziadoniu, C. 14
Hauser, C. 8
Heidari-Kapourchali, M. 14, 16
Hesamzadeh, M. R. 9
Hess, H. 9, 11
Heydt, G. 12, 14
Hodge, B. 14
Holbert, K. 8
Hossain, S. 17
Hug, G. 10, 12
I
Icenhower, J. 12
Iria, J. 15
J
Jain, R. 11
Jewell, W. 10, 14
Jiang, X. 16
Jiles, D. 12
Johnson, B. 9, 11, 13
Joshi, T. 12
K
Kamalasadan, S. 11, 12, 14
Kang, C. 15
Karimipour, H. 9
Kaster, P. 8
Kate-Singnoy, W. 17
Kazerouni, M. 12
Kekatos, V. 11
Kezunovic, M. 11, 16, 17
Khazdozian, H. 12
Khushalani-Solanki, S. 15
Kim, I. 10
Kimball, J. 9
Kundu, R. 8
Kundur, D. 8
Kuntz, K. 9
L
LaRose, T. 17
Lauby, M. 8
Lee, L. 13
Lee, W. 13
Lesieur, B. 9
Lev-Ari, H. 9
Li, F. 13
Li, J. 8, 15
Li, X. 10
Lin, J. 9
Lin, J. 13
Liu, C. 10
Liu, G. 9
Liu, G. 9
Lopes, B. 11
Lotfifard, S. 11
Lu, H. 13
Luna, C. 13
M
Madureira, A. 15
Mahajan, S. 15
Maigha, F. 16
Malbasa, V. 11
Mancilla-David, F. 9
Mandal, P. 13
Manjrekar, M. 8
Martinez, G. 10
Mathew, L. 13
McCalley, J. 12
McLorn, G. W. 8
McMillin, B. 9
CHAIRS AND AUTHORS INDEX

Medina, A.  17
Mehrizi-Sani, A.  9, 15
Ming, H.  16
Mishra, S.  13
Mitra, J.  16
Mohammed, O.  9
Molina-Moreno, I.  17
Momoh, J. A.  12, 15
Montoya Escobar, D. P.  11
Morales, J.  13, 15
Moreno, P.  13
Mueller, J.  9
Mukhejjee, A.  10
Mukherjee, R.  8
Muñoz-Álvarez, D.  13
Nagarajan, A.  9
Najm, H.  10
Naredo, J. L.  11, 13
Nehrir, H.  12
Oliveira, D. Q.  11
Olsen, R.  15, 17
Orduña, E.  13
Overbye, T.  12, 17
Pal, A.  10
Pang, C.  10
Panigrahi, B. K.  11
Panwar, M.  13
Park, B.  10
Peppanen, J.  13, 16
Pethe, A.  14
Pinar, A.  10
Popovic, T.  17
Poudel, B.  11
Premrudeepreechacharn, S.  17
Qi, Y.  15
Rahimi, A.  16
Rahimi, E.  15
Rahimi, K.  15
Ramirez, A.  13, 15
Ramirez, J. M.  11
Ramos-Leaños, O.  11
Ranganathan, P.  10
Rangarajan, R.  8, 15
Rao, S. D.  17
Rao, V. S.  14
Reddy, A.  13
Reddy, S.  15
Regassa, R.  10
Reno, M. J.  13, 16
Rob, R.  8
Roy, A.  11
Roy, S.  10
Safta, C.  10
Salkuti, S. R.  15
Sangsefidi, Y.  9
Sankara, A.  9
Sarikpruek, P.  13
Sauer, P.  14
Scarcelli, R.  15
Schwartz, J.  15
Sen, P.  8
Senroy, N.  11
Sepehry, M.  16
Shaker, H.  15
Shchetinin, D.  12
Shi, J.  13
Shih, M. Y.  11
Shoulaie, A.  9
Shrestha, A.  13
Singh, I.  10
Singh, M.  11
Smith, M.  9
Soares, F.  15
Sonnenmerer, J.  14
Sood, P.  15
Sotelo, J.  13
Srilatha, N.  12
Srivastava, A.  11, 13
Stankovic, A.  9
Sulaeman, S.  16
Suryanarayanan, S.  13
T
Tang, M. 14
Thelen, J. 12
Thiam, F. 8
Tomsovic, K. 9
Torbaghan, S. S. 13
Torres, J. A. 10
Tseng, T. 13
Tuladhar, L. 11
Tural, T. 8
Tushar, T. 13
Tylavsky, D. 15, 17

U
Urquidez, O. 17

V
Vaddiraj, A. 8
Vaidya, U. 13
Valdez, J. 10
Valakati, R. 10
Valverde, G. 11
van des Meijden, M. 13
Van Horn, K. 12
Varghese, M. 8

W
Vaziri, M. 12, 16
Vega, M. 11
Venkataramanan, V. 11
Venkatasubramanian, V. 10
Villaseca, F. E. 11
Vittal, V. 14

X
Wang, Gang 11
Wang, Guanqun 10
Wang, J. 15
Wang, R. 15
Wang, W. 14
Wang, Y. 8
Wang, Z. 15
Wasfy Ahmed, S. M. 9
Watson, J. 10
Wedeward, K. 9
Wei, C. 8
Weissbach, R. 14
Wood, D. 15
Wu, X. 17

Y
Xiao, L. 8
Xie, L. 16, 17
Xu, Q. 15
Xu, X. 9
Xu, Yan 9
Xu, Yi 10
Xu, Yin 11

Z
Zambelli, M. 15
Zareipour, H. 15
Zarghami, M. 12, 16
Zarrabian, S. 12

Zhang, B. 16
Zhang, F. 12
Zhang, G. 12
Zhang, J. 8
Zhang, N. 15
Zhang, P. 8
Zhang, Qiang 10
Zhang, Qianzhi 17
Zhang, Xu 9, 11
Zhang, Xun 10
Zhang, Yu 10
Zhang, Yue 15
Zhu, H. 12, 17
Zhu, Y. 15
Ziaenejad, S. 9
Zuluaga, J. R. 11, 13
Zweigle, G. 11, 14