

# Technical Sessions



Wednesday August 25, 2010

WM1

LESCOPE Session







# Thursday August 26, 2010

TM1	Control Aspects I
TM2	Energy Management
TM3	Intelligent Systems
TM4	Power System Dynamics
TP1	Control Aspects II
TP2	Energy Storage Systems
TP3	Operational Scheduling
TP4	Renewable Energy
TE1	Design Aspects
TE2	HVDC
TE3	Power Electronics
TE4	Smart Grid



# TM1:Control Aspects I

Session Chair: Dr. Jason Gu and Dr. Hao Chen

Acadia A 10:20-12:20 Thursday, August 26

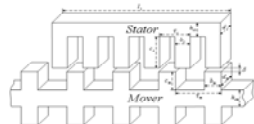
Acadia A (1) 10:20-10:44

## Design of Bilateral Switched Reluctance Linear Generator

H. Chen<sup>1,3</sup>, X. Wang<sup>1</sup>, J. J. Gu<sup>2</sup>, S. Lu<sup>1</sup>

<sup>1</sup>China University of Mining & Technology, Xuzhou 221116, China, hchen@cumt.edu.cn  
<sup>2</sup>Dalhousie University, Halifax, NS, Canada B3J 2X4, jason.gu@dal.ca  
<sup>3</sup>The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009 Australia

- The paper presented the design objective of three-phase 6/4 structure long-mover bilateral Switched Reluctance linear generator.
- The structure, the main design parameters are described.
- The design procedure and example of a developed prototype with rated output power 200 W, rated velocity 2 m/s, and output voltage for windings 24V are given.



Main structure dimensions diagram of long-mover bilateral Switched Reluctance linear generator

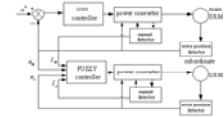
Acadia A (2) 10:44-11:08

## Simulation on Parallel Drive System of Double Switched Reluctance Motors Based on Sliding Mode & Fuzzy Controllers

H. Chen<sup>1,3</sup>, X. Wang<sup>1</sup>, J. J. Gu<sup>2</sup>, Q. Song<sup>1</sup>

<sup>1</sup>China University of Mining & Technology, Xuzhou 221116, China, hchen@cumt.edu.cn  
<sup>2</sup>Dalhousie University, Halifax, NS, Canada B3J 2X4, jason.gu@dal.ca  
<sup>3</sup>The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009 Australia

- The sliding mode control algorithm is adopted in the main controller for closed-loop rotor speed control of main motor. The fuzzy control algorithm is adopted in the subordinate controller for synchronized rotor speed and loads equilibrium distribution between main motor and subordinate motor.



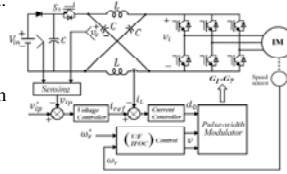
Block Diagram of Parallel Drive System and subordinate motor.

Acadia A (3) 11:08-11:32

## A new Closed Loop Speed Control of Induction Motor Fed by A High Performance Z-Source Inverter

Omar Ellabban, Joeri Van Mierlo and Philippe Lataire  
 Department of Electrical Engineering and Energy Technology  
 Vrije Universiteit Brussel

- The speed control is based on both: V/F and indirect field-oriented control strategies.
- The indirect field-oriented control based on PWM voltage modulation with voltage decoupling compensation
- A dual loop controller is designed to control the peak dc link voltage of the ZSI



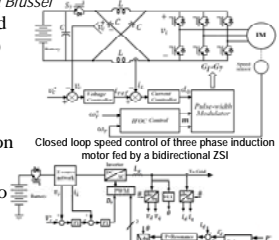
Closed loop speed control of three phase induction motor fed by high Performance ZSI

Acadia A (4) 11:32-11:56

## Control of a Bidirectional Z-Source Inverter for Hybrid Electric Vehicles in Motoring, Regenerative Braking and Grid Interface Operations

Omar Ellabban, Joeri Van Mierlo and Philippe Lataire  
 Department of Electrical Engineering and Energy Technology  
 Vrije Universiteit Brussel

- This paper presents a battery supplied bidirectional Z-Source Inverter (ZSI) fed a three phase induction motor
- The indirect field-oriented control based on PWM voltage modulation with voltage decoupling compensation
- In addition, this paper presents the grid interface mode with its control to charge or discharge the battery from the grid.



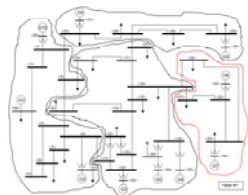
Control strategy of grid connected bidirectional ZSI

Acadia A (5) 11:56-12:20

## Wide-Area Frequency Control during Power System Restoration

Vahid Yari, Saber Nourizadeh, Ali Mohammad Ranjbar  
 Department of Electrical Engineering  
 Sharif University of Technology  
 Tehran, Iran

- A new method for frequency control is presented which determines the maximum load pickup within the allowable frequency ranges for stage of load restoration.
- A single-machine equivalent for each power system island is computed online using PMUs. Using this model the progression of frequency stability after a disturbance is predicted, so suitable amount of load pickup or generation increase can be determined for the supervised island of the power system.



New England 39 bus system after islanding

# TM2:Energy Management

Session Chair: Dr. Voicu Groza and Dr. Walid Morsi

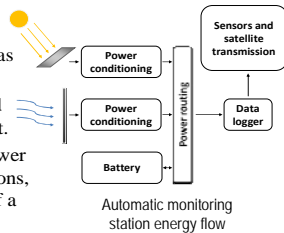
Acadia B 10:20-12:20 Thursday, August 26

Acadia B (1) 10:20-10:44

## Energy Harvesting Simulation for Automatic Arctic Monitoring Stations

D. Pimentel, P. Musilek, and A. Knight  
Electrical and Computer Engineering, University of Alberta  
Edmonton, Alberta, Canada T6G 2V4

- A multisource energy harvesting simulator is presented.
- Real climatological data is used as an input for the simulator.
- Simulation results show the need for advanced power management.
- Future research: sizing of the power source for different Arctic locations, development and optimization of a fuzzy power management algorithm, and case studies.

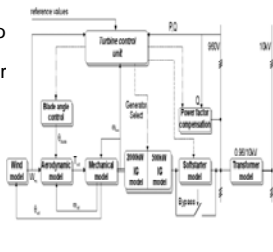


Acadia B (2) 10:44-11:08

## Modeling and Simulation of a Soft- Starter for a 2 MW Wind Turbine Generators

L. Mihet-Popa\* and V. Groza\*\*, *senior member IEEE*  
\* POLITEHNICA University/Electrical Machines and Drives, Timisoara, Romania;  
\*\* University of Ottawa/Dept. of Information Technology and Engineering, Canada

- A soft-starter model and its control strategy for connecting solutions to the grid of different operation modes for a wind turbine generator of 2/0.5 MW were evaluated;
- The thyristors switching for different functions of the firing angle has been discussed;
- A complete simulation model of a constant speed wind turbine with cage rotor and double stator windings induction generator has also been presented.



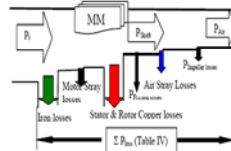
Simplified scheme of the wind turbine model

Acadia B (3) 11:08-11:32

## Using Global Efficiency Concept in Selection Decisions of Dedicated Equipments

Constantin D. Piliș<sup>1</sup> Voicu Z. Groza<sup>2</sup>  
1 # 900 - 4555 Kingsway, Burnaby, BC, V5H4T8, Canada  
2 800 King Edward Ave., Ottawa, ON, K1N 6N5, Canada

- The paper presents essentials of converter types (single and complex) and basics of the Global Efficiency (GEff) concept that has been promoted over the last few years in South African industries.
- Theoretical and technical aspects of GEff were substantiated with case studies.
- A case study of a single stage axial fan is presented.



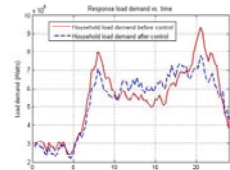
Schematic power flow diagram enables study of the power losses by using dedicated mathematical model

Acadia B (4) 11:32-11:56

## A Demand Side Management Program using Water Heaters and Particle Swarm Optimization

Araldo Sepulveda, Liam Paull, Walid G. Morsi, Howard Li, C. P. Diduch and Liuchen Chang  
Department of Electrical and Computer Engineering, University of New Brunswick  
Fredericton, New Brunswick, Canada

- Proposed method schedule water heaters operation using particle swarm optimization (PSO).
- Proposed method reduced the aggregated household peak load demand and filled valleys.
- Temperature of water heaters are accounted in the optimization algorithm to ensure customer satisfaction.



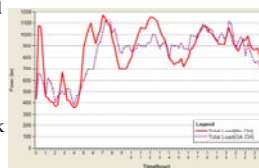
Aggregated load demand response simulation using PSO to control water heaters

Acadia B (5) 11:56-12:20

## A Centralized Genetic Algorithm Controller to Control Power Demands of Electric Water Heaters for Peak Shaving of Residential Consumers

M. Shaad, W. G. Morsi, C. P. Diduch, H. Li, L. Chang  
Sustainable Power Research Group, University of New Brunswick  
Fredericton, New Brunswick, Canada

- A centralized controller is proposed to control load demand of domestic electric water heaters (DEWH).
- This controller finds the best patterns of working for each individual DEWH to shave the peak of load demands.
- Simulation results show that this method can reduce the peak of demands up to 3%



Comparison between total power demands of 500 households with GA controller and without controller



# TM4:Power System Dynamics

Session Chair: Dr. Ferial El-Hawary and Dr. Aidan Foss

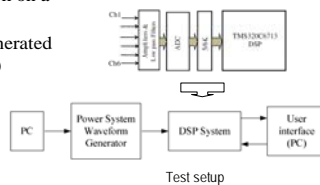
Tupper Room 10:20-12:20 Thursday, August 26

Tupper Room (1) 10:20-10:44

## Real-time Implementation of Discrete Wavelet Transform for Transient Type Protection Applications

Nuwan Perera, Athula D. Rajapakse and Aniruddha M. Gole  
Department of Electrical and Computer Engineering  
University of Manitoba

- Hardware module was implemented using a FIR filter based approach on a floating-point DSP platform.
- Tested using the waveforms generated by a Real Time Playback (RTP) generator.
- Accuracy was validated using MATLAB wavelet toolbox.
- Example case was presented to demonstrate the applicability.



Tupper Room (2) 10:44-11:08

## $H^\infty$ Loop Shaping Based Robust Power System Stabilizer for Multi Machine Power System

Jayapal R.  
Assistant Professor  
R.V.College of Engineering  
Bangalore, India.

Dr.J.K.Mendiratta  
Professor  
CMR Institute of technology  
Bangalore, India.

- A generalized multimachine power system model was developed.
- PSSs were located only at the machines where PSS is most essential, using participation factor technique.
- Robust PSS was developed using Glover-McFarlane  $H^\infty$  loop shaping design procedure.
- Method of selecting weighting functions were highlighted.
- The performance of the resulting Robust PSS(RPSS) was compared with Conventional PSS to show that RPSS is superior.
- Robustness of RPSS was justified by considering three different operating points.
- With RPSS the settling time is almost same for different operating points and settles around 4sec .

Tupper Room (3) 11:08-11:32

## Economical and Ecological Aspects of Renewable Energy Generation in Coal Fired Power Plant Supported with Geothermal Heat

Janusz Buchta and Andrzej Wawszczak  
Technical University of Lodz  
Lodz, Poland

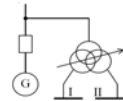
- The separation rule of renewable energy from conventional one at hybrid (fossil fuel-geothermal) power plant output was proposed
- An impact of cooling water temperature fluctuations, geothermal fluid temperature and its rate flow on renewable energy production within a year was discussed
- Payback period of the investment cost concerning conventional power plant transformation to a hybrid one was estimated

Tupper Room (4) 11:32-11:56

## Transient States Simulation in Power Plant Auxiliary Electrical System

Janusz Buchta  
Technical University of Lodz  
Lodz, Poland

- A mathematical model of large power induction motor to analyse multi-motor system supplied by auxiliary electrical system (AES) of power plant is presented
- Simulation of transients were done for motors supplied from an AES of 360 MWe rated lignite fired power unit – the start-up of the largest motor and the run-up of motor group as the result of switch over of supply system were considered
- The results of simulation were verified with experimental measurements



# TP1:Control Aspects II

Session Chair: Dr. Sheldon Williamson and Joy Brake

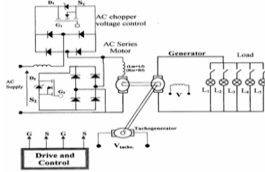
Acadia A 14:00-16:00 Thursday, August 26

Acadia A (1) 14:00-14:24

## Speed Control of AC Series Motor Using AC Chopper Voltage Control

M.M.R. Ahmed<sup>1</sup> and M. Soliman<sup>2</sup>  
Helwan University, Cairo  
University college of North Canada, Canada

- Speed control system of ac series motor fed from pulse width modulated ac chopper voltage control was proposed.
- The advantage of this system is its high power factor and less total harmonic distortion factor of the motor current.
- A laboratory set up has been built and experimentally tested to examine the proposed system.

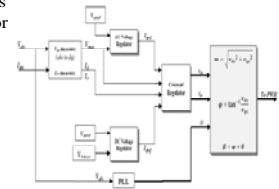


Acadia A (2) 14:24-14:48

## A Comparison of Conventional, Direct-Output-Voltage and Fuzzy-PI Control Strategies for D-STATCOM

Ms. Suchismita A. Chatterjee and Mr. K. D. Joshi  
Dept. of Electrical Engineering, G. H. Raisoni College of Engineering, Nagpur, India.

- This paper investigates and implements conventional and advanced methods for the control of DSTATCOM.
- The mathematical model of conventional double loop control, Direct-Output-Voltage (DOV) control, Decoupled DOV, Fuzzy-PI and Decoupled Fuzzy-PI based control is studied.
- The dynamic response of the models are presented and compared.



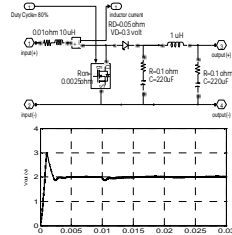
D-STATCOM Control System

Acadia A (3) 14:48-15:12

## A predictive voltage controller for stabilizing single fuel cell converter

A. Masoumzadeh, V.R. Nasirian, R. Roshandel, A.H. Fathi  
Energy Engineering Department, Sharif University of Technology  
Halifax, Nova Scotia, Canada

- One dimensional model for a single fuel cell is presented to investigate the cell's voltage and power characterizations
- Matlab/Simulink shows constant regulated voltage with admissible startup versus variations of converter reactant pressure and external load which was not achieved in previous works.

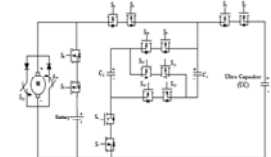


Acadia A (4) 15:12-15:36

## Novel Controller Design for a Luo Converter Electric Vehicle Energy Management System

Zahra Amjadi and Sheldon S. Williamson  
Power Electronics and Energy Research (PEER) Group, Concordia University  
Montreal, Quebec H3G 1M8, Canada

- The detailed analysis and novel hybrid controller design for bidirectional energy management solutions, using smart power electronic DC/DC converter solutions is presented.
- An intelligently designed novel digital control technique is presented for 4-quadrant switched-capacitor Luo DC/DC converters.
- A Features of voltage step-down, step-up, and bi-directional power flow are integrated into a single circuit.



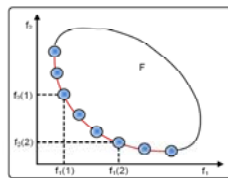
Circuit schematic with hybrid energy sources and traction motor

Acadia A (5) 15:36-16:00

## Optimal Drivetrain Component Sizing for a Plug-in Hybrid Electric Transit Bus Using Multi-Objective Genetic Algorithm

Chirag Desai, Florence Berthold, and Sheldon S. Williamson  
P. D. Ziogas Power Electronics Laboratory, Concordia University  
Montreal, Quebec H3G 1M8, Canada

- In this study we consider PHEV version of parallel hybrid NOVA transit bus model developed with the Powertrain System Analysis Toolkit (PSAT).
- A genetic based derivative free algorithm called Multi-Objective Genetic Algorithm (MOGA) is used.
- The AER, fuel economy, emissions and main performance constraints of the PHEVs will be compared.



Multi-Objective Genetic Algorithm

# TP2:Energy Storage Systems

Session Chair: Dr. Voicu Groza and Dr. Hao Chen

Acadia B 14:00-16:00 Thursday, August 26

Acadia B (1) 14:00-14:24

## Stationary Applications of Energy Storage Technologies for Transit Systems

Paul Radcliffe, James S. Wallace and Lily H. Shu  
Mechanical and Industrial Engineering, University of Toronto  
Toronto, Ontario, Canada

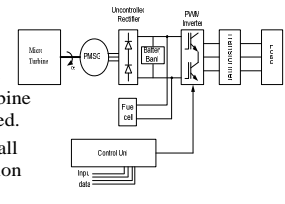
- Review of three different energy storage technology demonstrations in transit applications
- Sodium sulphide battery, flywheel and capacitor energy storage system demonstrations reviewed
- Systems were shown to improve energy efficiency of transit systems they supported

Acadia B (2) 14:24-14:48

## Modeling of Fuel Cell/Microturbine Generation Scheme with Battery Storage

M. Soliman<sup>1</sup>, M.M.R. Ahmed<sup>2</sup> and M. Safiuddin<sup>3</sup>  
<sup>1</sup>University College of the North, Canada.  
<sup>2</sup> Faculty of Industrial Education, Helwan University, Egypt .  
<sup>3</sup>State University of New York at Buffalo, USA.

- A distributed generation scheme comprising a Fuel cell/Microturbine with battery storage was proposed.
- Mathematical model of the overall system was derived and simulation results were presented.



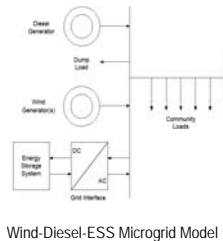
The Microturbine/ Fuel Cell generation system with battery storage.

Acadia B (3) 14:48-15:12

## Analysis of Energy Storage Sizing and Technologies

Michael Ross, Rodrigo Hildalgo, Chad Abbey and Geza Joos  
Power Engineering Research Laboratory, McGill University  
Montreal, Quebec, Canada

- A sensitivity analysis of sizes and technologies was performed on various energy storage systems.
- A Knowledge Based Expert System Controller was used to minimize the cost of energy.
- The minimized cost of energy of the wind-diesel-ESS microgrid was analyzed for various technologies.



Wind-Diesel-ESS Microgrid Model

Acadia B (4) 15:12-15:36

## Statistical Modeling of Energy Production by Photovoltaic Farms

Marek Brabec<sup>1</sup>, Emil Pelikán<sup>1</sup>, Pavel Krč<sup>1</sup>, Kryštof Eben<sup>1</sup>, Petr Musilek<sup>2</sup>  
<sup>1</sup> Department of nonlinear modeling, Institute of Computer Science, Praha, Czech Republic  
<sup>2</sup> Electrical and Computer Engineering, University of Alberta, Edmonton, AB, Canada

- Several strategies of statistical modeling of photovoltaic production are considered, discussed and compared.
- Our recommended statistical model is based on a generalization of flexible nonparametric regression (GAMLSS model).
- Statistical model uses numerical weather model output (short wave downward direct solar radiation in W/m<sup>2</sup>) as its input and calibrates it in order to predict electric energy generated (in kWh) for short time horizons.
- Our model allows for uncertainty (and even energy quantile) estimates besides the usual estimates of mean energy.

# TP3:Operational Scheduling

Session Chair: Dr. Jason Gu and Dr. Tim Little

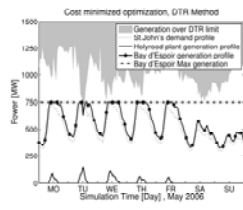
Acadia C 14:00-16:00 Thursday, August 26

Acadia C (1) 14:00-14:24

## Electric Power System Cost/Loss Optimization Using Dynamic Thermal Rating and Linear Programming

Milad Khaki, Petr Musilek, Jana Heckenbergerova, Don Koval  
Department of Electrical and Computer Engineering  
University of Alberta, Edmonton AB, Canada

- Describes an approach to optimization of power generation cost/transmission losses based on DTR of power transmission system.
- Results show that systems using DTR can transmit more power under most circumstances.
- A typical example of a thermal plan located in the vicinity of a load center, and a hydro plant located at much greater distance is analyzed an results are provided.



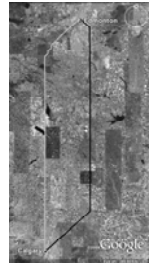
Hydro and thermal power generation for cost optimization with DTR

Acadia C (2) 14:24-14:48

## An Intelligent Weather-based System to Support Optimal Routing of Power Transmission Lines

Pawel Pytlak and Petr Musilek, *Senior Member, IEEE*  
Dept. of Electrical & Computer Engineering, University of Alberta  
Edmonton, Alberta, Canada

- A novel approach is proposed to allow the power industry to incorporate meteorological factors affecting power transmission lines in the construction planning process.
- The system selects waypoint coordinates for a transmission line using an algorithm that attempts to minimize the line temperature by avoiding locations that are prone to cause temperature hot-spots.
- The optimized routings provide an increase in the available transmission capacity for networks employing DTR technologies, or alternatively provide a decrease in the average line operating temperature.



Acadia C (3) 14:48-15:12

## A Framework for Compromising between Power Generation Cost and Power System Security in Regulated Market using MO-OPF

Amirsaman Arabali\*, Pedram Sotoodeh\*, Hamed Khosravi\*\*, and MahmoudReza Pishvaei\*\*\*  
\*Electrical Engineering Department, Sharif University of Technology, Tehran, Iran  
\*\*North Drilling Company, Iran Ministry of Oil, Tehran, Iran  
\*\*\*Chemical and Petroleum Department, Sharif University of Technology, Tehran, Iran

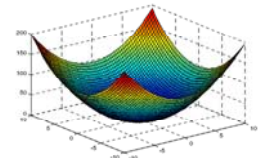
- A framework for compromising between social cost and security is suggested.
- The suggested algorithm uses Multi-Objective Optimal Power Flow conception.
- The algorithm selects the best decreased line flow from its allowed value subject to minimum cost.
- The proposed algorithm is simulated on the 14-Bus IEEE test system.

Acadia C (4) 15:12-15:36

## A New Meta-Heuristic Optimization Technique: A Sensory-Deprived Optimization Algorithm

F. S. Abu-Mouli, Student Member, IEEE, and M. E. El-Hawary, Fellow, IEEE

- A new and efficient metaheuristic optimization algorithm inspired by the intelligent behavior/survival of sensory-deprived human beings is presented.
- The proposed algorithm (SDOA) is a population-based with distinct features occurring at the semi-exploration and semi-exploitation tactical levels.
- The efficiency of the proposed SDOA is confirmed by the fact that the standard deviation of the results obtained for 30 independent runs is virtually zero.



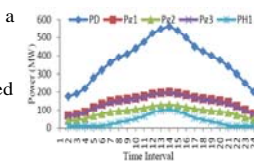
3D plot of the sphere function

Acadia C (5) 15:36-16:00

## Fixed-Head Hydro-Thermal Scheduling Using a Modified Bacterial Foraging Algorithm

I. A. Farhat, Student Member, IEEE, and M. E. El-Hawary, Fellow, IEEE

- The short-term hydro-thermal scheduling problem is solved using a modified bacterial foraging algorithm (MBFA).
- Critical modifications are introduced to the basic BFA. The algorithm presented is validated using two fixed-head test systems.
- Results show that the proposed algorithm is capable of solving the problem with good performance.



Load curve and optimal solution

# TP4:Renewable Energy

Session Chair: Dr. Branislav Djokic and Dr. Rachid Beguenane

Tupper Room 14:00-16:00 Thursday, August 26

Tupper Room (1) 14:00-14:20

## Neural Network Based Wind Speed Sensorless MPPT Controller for Variable Speed Wind Energy Conversion Systems

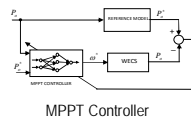
J. S.Thongam<sup>1</sup>, P. Bouchard<sup>1</sup>, R. Beguenane<sup>2</sup> and I. Fofana<sup>3</sup>

<sup>1</sup>Department of Renewable Energy Systems, STAS Inc., Chicoutimi, QC, Canada

<sup>2</sup>Department of ECE, Royal Military College, Kingston, ON, Canada

<sup>3</sup>Department of Appl. Sc., Univ of Quebec at Chicoutimi, Chicoutimi, QC, Canada

- A wind speed sensorless NN based MPPT controller for variable speed WECS is proposed.
- A Jordan type recurrent NN is used which is trained online using backpropagation.
- The concept is analyzed in a grid connected direct drive variable speed PMSG WECS with a back-to-back frequency converter.



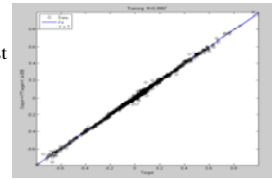
MPPT Controller

Tupper Room (2) 14:20-14:40

## Tidal Currents Forecasting Using a Hybrid of ANN and Least Squares Model

Hamed H. H. Aly, Student Member, IEEE, and M. E. El-Hawary, Fellow, IEEE

- In this study tidal currents models based on combining an artificial neural network (ANN) and the least squares method (LSM) were developed and evaluated for forecasting currents over a future month.
- A hybrid model of ANN and least squares is proposed and this model gives good results compared to either the ANN or LSM alone.



The regression line for the trained innovations of the direction data after using the hybrid model

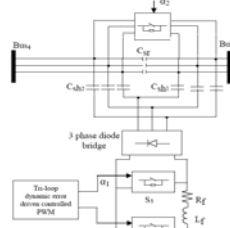
Tupper Room (3) 14:40-15:00

## A Novel Dynamic Voltage Regulator Compensation for a Stand Alone Tidal Energy Conversion Scheme

Tarek Aboul-Seoud & Adel M. Sharaf

Electrical & Computer Engineering Department, University of New Brunswick  
Fredericton, New Brunswick, Canada

- Tidal energy is an inexpensive, clean and abundant source of energy.
- This paper studies the improvement to power quality introduced by a FACTS device to a stand-alone rural load, fed from a tidal turbine.
- The proposed DVR is an inexpensive and robust FACTS based device.
- It is controlled via a tri-loop dynamic error-driven PI controller.
- This scheme proved its ability to introduce a significant improvement to power quality which is illustrated via comparing the simulation results of the studied network with and without the DVR.



The DVR layout

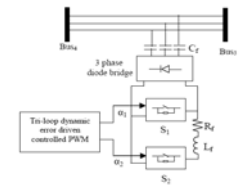
Tupper Room (4) 15:00-15:20

## Utilization of the Modulated Power Filter Compensator Scheme for a Grid Connected Rural Hybrid Wind/Tidal Energy Conversion Scheme

Tarek Aboul-Seoud & Adel M. Sharaf

Electrical & Computer Engineering Department, University of New Brunswick  
Fredericton, New Brunswick, Canada

- The effect of Modulated Power Filter Compensator (MPFC) to a rural Wind/Tidal ECS is studied.
- The MPFC is controlled via a tri-loop dynamic error-driven PI controller.
- The proposed MPFC is an inexpensive and robust FACTS based device.
- The FACTS based device establishes a significant improvement to the power quality.
- The improvement is illustrated via comparing the simulation results of the studied network with and without the MPFC.



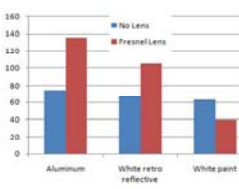
The MPFC layout

Tupper Room (5) 15:20-15:40

## Designs of Solar Collector for Hybrid Fiber Optic Lighting System

Patrick Couture, Mohammed Mostefa, and Abdul Al-Azzawi  
Algonquin College, Ottawa, Ontario, Canada

- The proposed system relies on the fact that light rays are free and can be harnessed without the use of expensive tracking systems equiring constant alignments.
- The system has to be robust to withstand all weather conditions and have an efficiency equivalent to that of standard lighting requirements.
- A control system to turn lighting on/off as needed would be advantageous.



Light collected from different finishes

Tupper Room (6) 15:40-16:00

## Overview and Status of Hydrokinetic Technology in Canada

Ghanashyam Ranjithkar

CanmetENERGY, Natural Resources Canada

- In recent years, considerable advances have been made in developing hydrokinetic technology to capture energy from waves and tides, and flowing water currents. However, many waves and tidal devices, including river current technologies are still in the concept or prototype development stages. There are few hydrokinetic technologies that are close to pre-commercial stage. Canada has a tremendous potential for hydrokinetic resource, has an opportunity to maximize the advantages of these technologies to displace fossil fuel generated power with renewable energy, and potentially reduce the greenhouse gas (GHG) effects substantially.
- There are number of Canadian device developers that have invested significantly in hydrokinetic field to capture energy from flowing water currents and are leaders in this sector. CanmetENERGY of Natural Resources Canada had been actively supporting the Canadian technology developers by providing technical and financial support. This paper will present introduction on hydrokinetic technology, its resource potential and technology configuration with specific focus on flowing water current application. It will also cover the overview of the hydrokinetic technology for water current, development and status of the devices that CanmetENERGY had been supporting including details of some of the demonstration project.

# TE1:Design Aspects

Session Chair: Dr. Ferial El-Hawary and Prof. Hosein Marzi

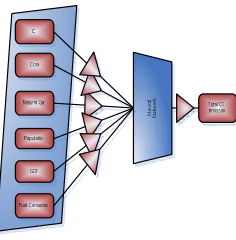
Acadia A 16:20-18:20 Thursday, August 26

## Acadia A (1) 16:20-16:44

### Achieving CO<sub>2</sub> Emission Targets for Energy Consumption at Canadian Manufacturing and beyond; using Hybrid Optimization Model

Arash Marzi<sup>1</sup>, Hosein Marzi<sup>2</sup> and Elham Marzi<sup>2</sup>  
<sup>1</sup>Dr. John Hugh Gillis Regional High School, Antigonish, NS Canada  
<sup>2</sup>Department of Information Systems, St. Francis Xavier University, Antigonish, NS, Canada

- Power and energy production and consumption, using coal, oil and natural gases, are the main sources of CO<sub>2</sub> emissions.
- Copenhagen Climate Change Protocol requires the reduction of Canadian CO<sub>2</sub> emissions levels by 2020.
- A Hybrid Model of Bees Algorithm and Artificial Neural Networks is developed to determine idealistic annual CO<sub>2</sub> reduction targets to meet Copenhagen Protocol goals by 2020 in Canada's Manufacturing industry.



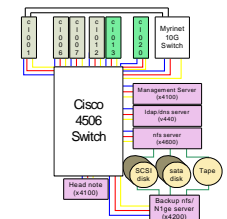
Training model for Artificial Neural Network

## Acadia A (2) 16:44-17:08

### BIO-INSPIRED SOLUTION TO ECONOMIC DISPATCH PROBLEM USING DISTRIBUTED COMPUTING

Arash Marzi<sup>1</sup>, Hosein Marzi<sup>2</sup> and Elham Marzi<sup>2</sup>  
<sup>1</sup>Dr. John Hugh Gillis Regional High School, Antigonish, NS Canada  
<sup>2</sup>Department of Information Systems, St. Francis Xavier University, Antigonish, NS, Canada

- The application area under investigation is multi-objective optimization scenario of Economic/Environment Power Dispatch Problem for a 30-Bus 6 Generators IEEE Standard Power System.
- The Bees Algorithm, bio-inspired optimization technique that simulates foraging of honey bees is executed on a High Performance Computing Grid to optimize power generation, while minimizing cost and NO<sub>x</sub> emissions.
- The results of the Bees Algorithm is compared to other benchmark algorithms. The Bees Algorithm shows significantly improved results for minimized cost and NO<sub>x</sub> emissions, and reduction in computational time.



Placentia High Performance Grid

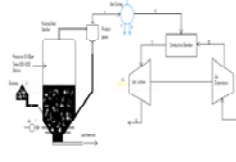
## Acadia A (3) 17:08-17:32

### Optimization of Biomass Waste Gasification Combined Heat and Power System

B. Fakhimghanbarzadeh<sup>1</sup>, Hosein Marzi<sup>2</sup>, and Hossein Abolghasem<sup>2</sup>

<sup>1</sup> School of Mechanical Engineering, Sharif University of Technology, Tehran, Iran  
<sup>2</sup> Department of Information Systems, St. Francis Xavier University, Antigonish, Canada

- The objective of the research done in this paper was to determine cost of the power and heat system with pressurized fluidized bed gasifier using exergoeconomic appraisal techniques.
- The Exergetic efficiency maximization was approached with use of multi-objective evolutionary optimization methods which were designed such that the costs were minimized in line with the exergoeconomic plans.



Combined heat and power system containing fluidized bed gasification

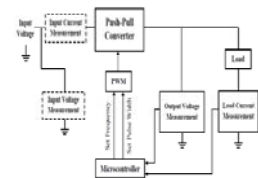
## Acadia A (4) 17:32-17:56

### Efficiency Improvement of a DC-DC Converter Used in Series-Connected Boost Converters

M. Mirsamadi<sup>1</sup> and M. Taherbaneh<sup>1,2</sup> and A. H. Rezaie<sup>3</sup>

<sup>1</sup> Department of Electrical Engineering, Amirkabir University of Technology, Tehran, Iran  
<sup>2</sup> Iranian Research Organization for Science and Technology, Tehran, Iran  
<sup>3</sup> Department of Electrical Engineering, Amirkabir University of Technology Tehran, Iran

- The practical implementation of a variable switching frequency scheme is discussed for a Push-Pull DC-DC converter used in a Series-Connected Boost Converter (SCBC).
- Various approaches to implement the technique are discussed, and experimental results are provided.
- Efficiency improvements up to 15% can be expected at light loads when using variable switching frequency.



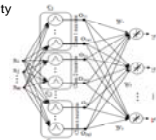
Block diagram of variable frequency switching converter

## Acadia A (5) 17:56-18:20

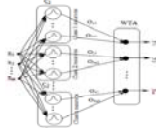
### Static Security Assessment Using Radial Basis Function Neural Networks Based on Growing and Pruning Method

D. S. Javan, H. Rajabi Mashhadi and M. Rouhani  
 Electrical Engineering, Ferdowsi University  
 Mashhad, Iran

- A novel method was proposed based on growing and pruning training algorithm using radial basis function neural network and winner-take-all neural network to examine whether the power system is secure under steady-state operating conditions.
- Hidden layer neurons have been selected with the proposed algorithm which has the advantage of being able to automatically choose optimal centers and distances.
- A feature selection technique-based class separability index and correlation coefficient has been employed to identify the inputs for the GPRBF network.



Structure of GPRBF neural network



GPRBF-based WTA technique.

# TE2:HVDC

Session Chair: Dr. Wahab Almuhtadi and Dr. Vijay Sood

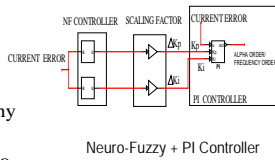
Acadia B 16:20-18:20 Thursday, August 26

## Acadia B (1) 16:20-16:44

### An Adaptive Neuro-Fuzzy (NF) PI Controller for HVDC System

Munish Multani, Vijay Sood and Jing Ren  
Department of Electrical & Computer Engineering, UOIT  
Oshawa, Ontario, Canada

- Neuro-Fuzzy (NF) PI controller to adapt PI gains of a conventional PI controller is presented.
- The proposed controller has the capability of finding accurate PI gains with changing system conditions without the need of any initial gain values.
- Simulation results are provided to illustrate the potential of the proposed controller.



## Acadia B (2) 16:44-17:08

### Modeling of Voltage Source Converter Based HVDC System in EMTP-RV

Hiteshkumar Patel and Vijay K. Sood  
Faculty of Engineering and Applied Science, University of Ontario Institute of Technology  
Oshawa, Ontario, Canada

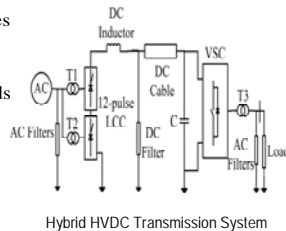
- A detailed model of a Voltage Source Converter (VSC) operated HVDC transmission system is simulated with EMTP-RV, in order to investigate its operational performance.
- The VSC control strategy is explained using direct and vector control.
- The effect of de-coupling between the control parameters is investigated by applying disturbances in the reference quantities of active and reactive power and DC voltage.

## Acadia B (3) 17:08-17:32

### A Hybrid HVDC Transmission System Supplying a Passive Load

Omar Kolb and Vijay K. Sood  
Department of Electrical and Computer Engineering, UOIT  
Oshawa, Ontario, Canada

- Presented a Hybrid HVDC transmission system that combines LCC and VSC technologies.
- System meant for unidirectional power feed to islands/remote loads
- Developed rectifier & inverter controllers.
- Additional control schemes that handle load shedding and AC network fault situations.

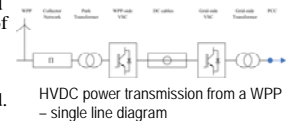


## Acadia B (4) 17:32-17:56

### Modular VSC Converter Based HVDC Power Transmission from Offshore Wind Power Plant: Compared to the Conventional HVAC System

R. Sharma<sup>1,2</sup>, T.W. Rasmussen<sup>2</sup>, K.H. Jensen<sup>1</sup> and V. Akhmatov<sup>1</sup>  
<sup>1</sup>Siemens Wind Power A/S, Denmark  
<sup>2</sup>Technical University of Denmark, Denmark

- Power transmission options for an offshore WPP are analyzed.
- The limitations of a HVAC cable transmission system are outlined.
- Transmission options are analyzed on the basis of energy efficiency of all the major components required for the power transmission.
- Comparison based on the total annual energy losses are presented.
- HVDC transmission provides better efficiency at high power and longer transmission distances.



# TE3:Power Electronics

Session Chair: Dr. Sheldon Williamson and Dr. Yang Zhao

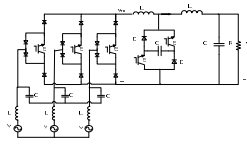
Acadia C 16:20-18:20 Thursday, August 26

Acadia C (1) 16:20-16:44

## A Soft Switching Three-Phase Three-Switch Buck Rectifier

Negar Noroozi, Mohammad Reza Zolghadri, Rasool Haghi  
Department of Electrical Engineering  
Sharif University of Technology, Tehran, Iran

- A novel soft switching three-phase pulse width modulation (PWM) rectifier was proposed.
- By using a zero current switching method, the system efficiency was increased.
- For the aim of soft switching, a simple auxiliary circuit with simple method of energy recovery has been applied in the converter



The proposed soft-switched PWM rectifier.

Acadia C (2) 16:44-17:08

## Simplified Series Active Power Filter (SAPF)

Mohamed Y. Tarnini  
Electric Eng. Department Hariri Canadian University  
Almechreef, Aldamour, Lebanon

- An Active Power Filter algorithm was proposed using direct control method by means of PIC controllers, to control the harmonic levels in residential and commercial areas
- It is characterized by simple control algorithms, reduced number of current transducers and a less price controller
- The Harmonic Rate meets the international recommendations standards



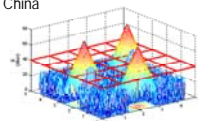
SAPF Overall Control Circuit

Acadia C (3) 17:08-17:32

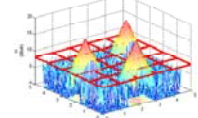
## Study on Multifunction GTEM Cell for Radiated EMI Measurement and Analysis

Yan Wei, Zhao Yang, Luo Yong-chao, Feng Zhi-min, ZHAO Bo, RONG Rong  
School of Electrical & Automation Engineering, Nanjing Normal University  
Nanjing, Jiangsu, China

- Structure of GTEM cell and structure of near field EMI diagnosis setup.
- The 3m chamber measurement results can be predicted by the suggested GTEM cell.
- The radiated EMI mechanism can be diagnosed by employing the GTEM cell.



3D radiated electric field distributed



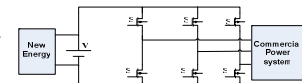
3D radiated magnetic field distributed

Acadia C (4) 17:32-17:56

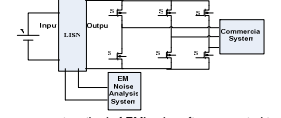
## Investigation on Electromagnetic Interference in New Energy Inverter System

QIU Xiaohui, DONG Yinghua, ZHAO Yang, YAN Wei, RONG Rong  
School of Information & Electrical Engineering, China University of Ming and Technology  
Xuzhou, Jiangsu, China

- EMI noise measurement on new energy inverter system.
- The principle of EMI noise suppression on new energy system. 1)Capacitor paralleled in DC side; 2) Inductance series in DC side.
- Test verification.



The principle of new energy inverter system



The measurement method of EMI noise after connected to commercial system

Acadia C (5) 17:56-18:20

## Conductive EMI Noise Analysis for Large Power Switched Reluctance Machine

Qiu Xiaohui, Lu Xiaoquan, ZHAO Yang, Dong Yinghua, Jiang Ningqiu, RONG Rong  
School of Information & Electrical Engineering, China University of Ming and Technology  
Xuzhou, Jiangsu, China

- EMI noise generated by the power converter circuit of a four-phase 8/6 pole structure SRM is analyzed in the paper.
- Noise suppression technique. 1) EMI Filter Design; 2) Radiators of Switch Transistor Ungrounded.
- Test verification.



Conductive EMI noise analysis test setup for SRM

# TE4:Smart Grid

Session Chair: Dr. Branislav Djokic and Dr. Melike Erol-Kantarci

Tupper Room 16:20-18:20 Thursday, August 26

Tupper Room (1) 16:20-16:44

## The Impact of Smart Grid Residential Energy Management Schemes on the Carbon Footprint of the Household Electricity Consumption

Melike Erol-Kantarci and Hussein T. Mouftah  
*School of Information Technology and Engineering  
University of Ottawa*

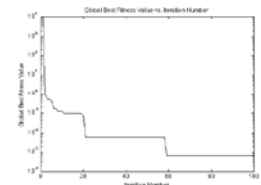
- The time of consumption affects the carbon footprint of the consumers
- In peak hours, utilities bring peaker plants online which use more expensive resources such as coal, natural gas, etc
- These resources have higher GreenHouse Gas (GHG) emissions
- In this paper, we investigate the impact of the residential energy management schemes on the carbon footprint of an household due to electricity consumption
- We show that energy management schemes decrease the peak hour usage of the appliances which consequently, decreases the carbon footprint of the consumers

Tupper Room (2) 16:44-17:08

## Voltage Collapse Detection Using Ant Colony Optimization for Smart Grid Applications

C. Church, Walid G. Morsi, Member IEEE, C. P. Diduch, Member IEEE, M. E. El-Hawary, Fellow IEEE, and L. Chang, Senior IEEE

- In this study Ant Colony Optimization is applied to detect voltage collapse conditions in power networks, to obtain faster computing time with the future goal of providing online detection and prediction for use in smart grids.
- Results and conclusions drawn from this study are also presented.



Global fitness function results

Tupper Room (3) 17:08-17:32

## Design of a Smart Meter Techno-Economic Model for Electric Utilities in Ontario

Elise Andrey and Jordan Morelli  
*Department of Physics, Engineering Physics & Astronomy, Queen's University  
Kingston, Ontario, Canada*

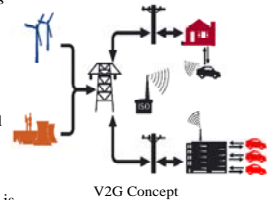
- A techno-economic model comparing various functionality levels of Smart Meters has been designed.
- Three levels of functionality were considered.
  - Minimum functionality smart meters,
  - Smart meters with in-home displays, and
  - Smart meters with a demand control unit.
- The functionality levels were compared based on the annual profit obtained and the overall reduction in energy consumption.
- Based on a number of case studies, minimum functionality smart meters were found to be the most profitable; however, smart meters with a demand control unit provided the greatest reduction in energy usage during peak demand times.

Tupper Room (4) 17:32-17:56

## Vehicle to Grid in Nova Scotia

Karen Pahlavan and Tim Little  
*Department of Electrical and Computer Engineering  
Dalhousie University, Halifax, Nova Scotia, Canada*

- Nova Scotia has high per capita emissions and needs a strategy like V2G in order to reduce its environmental footprint.
- V2G can be used to reduce emissions in both the power generation and transportation sectors.
- V2G also provides the energy storage and spinning reserve capacity needed to facilitate wind energy systems.
- V2G is shown to be beneficial to the province as its dependence on fossil fuels is reduced.



# Friday August 27, 2010

FP1	Wind Power I
FP2	System Dynamics I
FP3	Storage Technology
FP4	System Design
FE1	Wind Power II
FE2	System Dynamics II
FE3	Alternative Energy
FE4	Intelligent Systems



# FP1:Wind Power I

Session Chair: Tihomir Maricic and Dr. Liuchen Chang

Acadia A 14:00-16:00 Friday, August 27

Acadia A (1) 14:00-14:24

**A Study of the Reduction of the Regional Aggregated Wind Power Forecast Error by Spatial Smoothing Effects in the Maritimes Canada**  
 Yu Han and Liuchen Chang  
 Department of Electrical and Computer Engineering, University of New Brunswick  
 Fredericton, New Brunswick, Canada

- The accuracy of the prediction of aggregated wind power of planned wind farms distributed in the Maritimes Canada was studied.
- The spatial correlation function of prediction error is applied to calculate the ensemble wind forecast error based on arbitrary configurations of wind farms and wind generations in the Maritimes.
- The spatial smoothing effects is validated in the Maritimes Canada.
- This approval provides local utilities an alternative method to reduce the regional aggregated wind power forecast errors.




Fig. 1 Planned wind site locations of the NBSO wind project

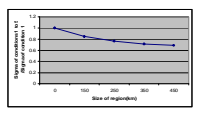
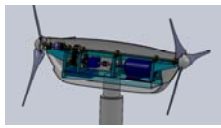


Fig. 4 Spatial smoothing effects

Acadia A (2) 14:24-14:48

**Performance Optimization of a Dual-Rotor Wind Turbine System**  
 Riyadh W. Y. Habash<sup>1</sup>, Voicu Groza<sup>1</sup>, and Pierre Guillemette<sup>2</sup>  
<sup>1</sup> School of Information Technology and Engineering, University of Ottawa, Ottawa, Ontario, Canada; <sup>2</sup> TRIAS Innovations, Ottawa, Ontario, Canada

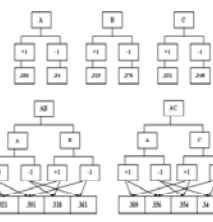
- This project focuses on the methodology to analyze the power flow performance of a dual-rotor wind turbine system with a new efficient induction generator.
- Wind tunnel test indicates that a scaled-down version of the system may produce up to 60% more power than a single-rotor system.



Acadia A (3) 14:48-15:12

**Modeling and Optimization of Power Coefficient Using 2<sup>K</sup> Factorial Methodology**  
 Md. Arifujaman  
 Faculty of Engineering and Applied Science, Memorial University of Newfoundland  
 St. John's, Newfoundland, Canada

- A modeling approach for the wind turbine power coefficient was proposed.
- Dependence of power coefficient on chord and twist distribution, number of blades and blade angle was developed
- Design of Experiment (DOE) was used to validate the model.

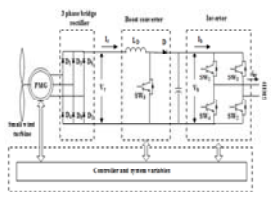


Power coefficient values for different factors and their interactions

Acadia A (4) 15:12-15:36

**Modeling, Simulation and Control of Grid Connected Permanent Magnet Generator (PMG)-based Small Wind Energy Conversion System.**  
 Md. Arifujaman  
 Faculty of Engineering and Applied Science, Memorial University of Newfoundland  
 St. John's, Newfoundland, Canada

- A PMG-based small wind energy conversion system was modeled
- Maximum power extraction controller as well as maximum power flow controller was developed
- Simulation results show acceptable performance



A grid connected PMG-based small wind turbine system

Acadia A (5) 15:36-16:00

**Efficiency Comparison of Two Possible Grid Connected Small Wind Turbine Systems.**  
 Md. Arifujaman, M.T. Iqbal and J.E. Qualicoe  
 Faculty of Engineering and Applied Science, Memorial University of Newfoundland  
 St. John's, Newfoundland, Canada

- Efficiency of a permanent magnet generator (PMG) and wound rotor induction generator (WRIG)-based small wind turbine system was presented
- Test benches for both systems were developed with maximum power point control strategy
- A procedure to calculate the system power loss and energy was developed
- Energy capture, energy loss and efficiency for eight sites of Newfoundland and Labrador were presented
- Experimental results show that a WRIG-based system could be an optimum alternative in small wind energy domain

Region	Annual average wind speed (m/s)	Annual energy loss as a percentage of the annual energy capture				Efficiency (%)
		PMG	WRIG	PMG	WRIG	
MB	3.13	1.20	2.81	1.30	19.30	79.30
FW	3.03	1.20	2.78	1.28	19.30	79.30
AW	3.03	1.20	2.78	1.28	19.30	79.30
SL	2.93	1.20	2.75	1.27	19.30	79.30
NS	2.83	1.20	2.72	1.26	19.30	79.30
LB	2.73	1.20	2.69	1.25	19.30	79.30
NP	2.63	1.20	2.66	1.24	19.30	79.30

Efficiency characteristic of a PMG-based (upper) and WRIG-based (lower) system

# FP2: System Dynamics I

Session Chair: Dr. Wahab Almuhtadi and Dr. Walid G. Morsi

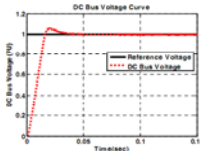
Acadia B 14:00-16:00 Friday, August 27

## Acadia B (1) 14:00-14:24

### A Novel Efficient PSO-Self Regulating PID A Novel GA-Self Regulating VSC-SMC Controller for Common AC-DC PV-FC-Diesel-Battery Green Energy Utilization Scheme

Adel M. Sharaf and Adel A. A. El-Gammal  
Centre for Energy Systems, University of Trinidad and Tobago UTT

A novel application of Multi Objective Genetic search Algorithms MOGA to optimally tune the gains of the variable structure sliding mode dynamic controller (VSC-SM) to control the 6-pulse controlled rectifier converter, dynamic filter/capacitor compensation DFC and the Green Power Filter GPF AC and DC schemes using real time dynamic self regulating error tracking.



DC bus voltage plot obtained with GA based tuned variable structure sliding mode dynamic controller.

## Acadia B (2) 14:24-14:48

### A Novel Efficient PSO-Self Regulating PID Controller for Hybrid PV-FC-Diesel-Battery Micro Grid Scheme for Village/Resort Electricity Utilization

Adel M. Sharaf and Adel A. A. El-Gammal  
Centre for Energy Systems, University of Trinidad and Tobago UTT

The paper presents a novel application of Multi Objective Particle Swarm Optimization MOPSO for PID controller parameters tuning to control the 6-pulse controlled rectifier converter, dynamic filter/capacitor compensation DFC and the Green Power Filter GPF AC and DC schemes using real time dynamic self regulating error tracking.



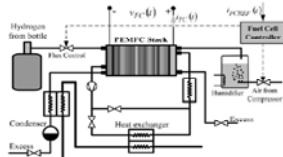
Tri-loop error driven self tuned variable structure sliding mode dynamic controller the AC side DFC filter compensator scheme

## Acadia B (3) 14:48-15:12

### Optimal PID-Self Regulating Controller for Micro Hydro-Fuel Cell Green Energy Management Scheme

Adel M. Sharaf and Adel A. A. El-Gammal  
Centre for Energy Systems, University of Trinidad and Tobago UTT

This paper presents a novel Electric Energy Management compensator based on Multi Objective Particle Swarm Optimization search technique OPSO for use in hydrogen and island electricity generation. It combines a fuel cell power source and a micro hydro water turbine. The novel control strategy is designed to achieve the high-efficiency coordinated operation of the two individual power sources and to regulate current and voltage for maximum utilization, without compromising the power quality and performance of the overall system.



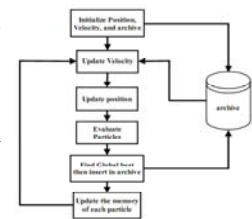
Simplified diagram of the PEMF-C system

## Acadia B (4) 15:12-15:36

### Optimal Selection of Capacitors in Distribution Networks for Voltage Stabilization and Loss Reduction

Adel M. Sharaf and Adel A. A. El-Gammal  
Centre for Energy Systems, University of Trinidad and Tobago UTT

- A novel discrete optimization approach to optimally solve the sizing problem of capacitor for the voltage stability enhancement in radial distribution networks using Discrete Multi Objective Particle Swarm Optimization MOPSO technique.
- The novel optimization approach using MOPSO is implemented to tackle a number of conflicting goals that define the complex optimality problem.



Flow chart of the MOPSO optimization search algorithm

# FP3:Storage Technology

Session Chair: Dr. Branislav Djokic and Prof. Hosseini

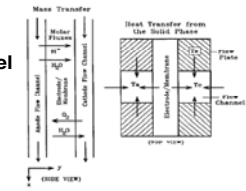
Acadia C 14:00-16:00 Friday, August 27

Acadia C (1) 14:00-14:24

## Dynamic Relaxation: A New Optimization Method for PEM Fuel Cell Analysis

Shirin Espiari and Majid Aleyaasin  
King's College, University of Aberdeen, Aberdeen, United Kingdom

- In this paper a dynamic relaxation method is proposed which provides a fictitious nonlinear dynamic system model for the fuel cell. Thereafter, by assuming appropriate initial conditions, the steady state solution can be obtained.
- For any current density, the corresponding temperature in cathode and anode, output voltage of the cell and stack temperature are determined.



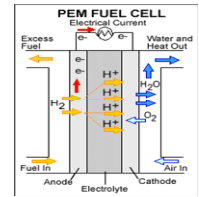
Schematic of model regions

Acadia C (2) 14:24-14:48

## Evaluating one of Renewable Electricity Generation Technologies: PEM Fuel Cells

Sajad Hoseinnia, S. M. Sadeghzadeh, Amir H. Fathi, Mojtaba Nasiri  
Robotics and Control Research Group, Dalhousie University  
Shahed University, Tehran, Iran

- A model of PEM fuel cell will be presented and the sensitivity of the fuel cell's parameters will be analyzed. Multi Parameters Sensitivity Analysis is used next to examine the relative importance of the influential parameters on the PEM fuel cell operation.

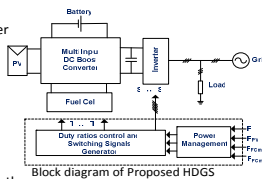


Acadia C (3) 14:48-15:12

## Multi-Input DC Boost Converter for Grid Connected Hybrid PV/FC/Battery Power System

S. H. Hosseini, S. Danyali, F. Nejabatkah, S.A.KH. Mozafari Niapoor  
Faculty of Electrical & Computer Engineering, University of Tabriz  
Tabriz, Iran

- Multi-input dc boost converter for grid-connected hybrid Photovoltaic (PV)/Fuel cell (FC)/Battery power system was proposed supplying a residential load.
- This structure provides five different duty ratios.
- Adjusting the duty ratios, maximum power point tracking of PV array, FC optimal operation, battery charging and discharging are possible
- Power management algorithm is realized to attain the DG sources and grid contribution in supplying the load
- The proposed system is considered to inject desired reactive power to the load and grid.

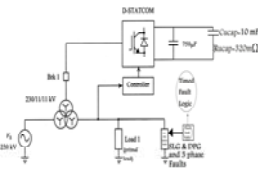


Acadia C (4) 15:12-15:36

## Application of D-STATCOM to Improve Distribution System Performance with Balanced and Unbalanced Fault Conditions

Seyed Hossein Hosseini, Ebrahim Babael and Amin Nazarloo  
Faculty of Electrical and Computer Engineering, University of Tabriz  
Tabriz, Iran

In this paper, a new control method for mitigating the voltage sags, caused by balanced and unbalanced faults, at the PCC has been proposed. The proposed method has been made up of two factors. The first factor was "Integrating D-STATCOM and super-capacitor energy storage system" and the second factor was "Lookup Table application in determining a suitable proportional gain for each different voltage disturbance". This proposed control scheme was tested under a wide range of operating conditions (under all types of fault), and it was observed that the proposed method is very robust and intelligent in every case.



Distribution system with D-STATCOM integrated with UCAP and controller

# FP4: System Design

Session Chair: Dr. Sheldon Williamson and Dr. Hao Chen

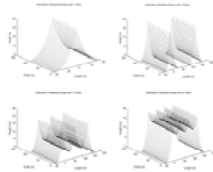
Tupper Room 14:00-16:00 Friday, August 27

Tupper Room (1) 14:00-14:24

## Lightning Risk Assessment of Power Systems

Riadh W. Y. Habash and Voicu Groza  
School of Information Technology and Engineering, University of Ottawa, Ottawa, Ontario, Canada

- This work focus on developing materials on lightning risk analysis aimed at teaching power systems.
- It describes series of case studies involving lightning effects on substations, transmission lines, and wind turbine systems.
- Case studies use various simulation tools such as Simulink, CADFEKO, and LABView.



Tupper Room (2) 14:24-14:48

## Distribution System Efficiency Improvement by Reconfiguration and Capacitor Placement Using a Modified Particle Swarm Optimization Algorithm

Pooya Rezaei and Mehdi Vakilian  
Electrical Engineering Department, Sharif University of Technology  
Tehran, Iran

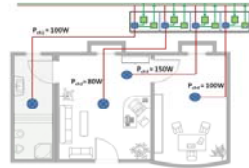
- Capacitor Placement/setting and Reconfiguration are used to minimize two objective functions including total costs and total losses.
- PSO is utilized to solve the above combinatorial non-linear problems because of its robustness and searching efficiency in the search space.
- Reconfiguration is also considered as a means for modifying the base network structure in capacitor placement problem.
- Two targets are achieved including energy efficiency and cost-effective capacitor investment.

Tupper Room (3) 14:48-15:12

## Metering of Energy Used for Lighting: a Practical Indirect Method

Luigi Martirano\*, Massimo Aliberti#, Ferdinando Massarella+  
\*Electrical Engineering Department University of Roma "La Sapienza"  
#Istituto di Scienza e Tecnologie dell'Informazione "A. Faedo" Consiglio Nazionale delle Ricerche  
+ Massarella Engineering ing.massarella@gmail.com

- A simple method was proposed for metering of energy used for lighting.
- The method adopts ordinary actuators and a basic supervisory system with a low cost impact.
- Smart metering exploits the capacity of BACS to quantify energy consumption and provide appropriate information to consumers.



Synthesized Grips on Different Objects

Tupper Room (4) 15:12-15:36

## Modeling of Optimal Electricity Supply Problem in Iran's Power Network by Using Hierarchical Planning Approach

R. Tanha Aminloei and S. F. Ghaderi, Jr.

Department of Industrial Engineering, University of Tehran, Iran

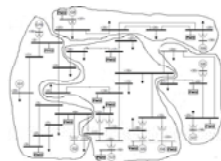
- A modeling by selecting a Fuzzy Hierarchical Production Planning (FHPP) technique with zone covering in the mid-term and long-term time horizons electricity supply modeling in the Iran global compact network with spotting 15 zone electricity study is proposed.
- Capacity, Max development, Max energy product of each production unit, reliability and autonomy constraints are considered.
- Other objective functions include parameters that minimize production, development and security costs of the system considering capital recovery factor, interest rate that maximize total preference weights of power plants.

Tupper Room (5) 15:36-16:00

## A Sectionalizing Method in Power System Restoration Based on Wide Area Measurement Systems

S. A. Nezam-Sarmadi, A. Salehi, S. Azizi, A. M. Ranjbar and S. Nouri-Zadeh  
Department of Electrical Engineering, Sharif University of Technology  
Tehran, Iran

- A Sectionalizing method was proposed to build-up a power system for restoration purpose.
- The proposed method made the New-England 39 bus system to four islands that could be restored simultaneously.



Sectionalized Network of New-England 39 bus system.

# FE1:Wind Power II

Session Chair: Joy Brake and Dr. Adel Merabet

Acadia A 16:20-18:20 Friday, August 27

Acadia A (1) 16:20-16:44

## Techno-Economic Assessment of Integrating Wind Farms into Power Generation System

Mohamed A. H. El-Sayed  
Utilities Engineering Egyptian  
University of Trinidad and Tobago

Effat A. Mouss  
Electricity Holding Co  
Nasr City, Egypt

- A hybrid reliability approach was proposed based on deterministic and probabilistic system characteristics to define the capacity credit of WECS taking into consideration the effect of the system dynamic behavior due to either of sudden loss of large generating units or loads.
- An economic technique to evaluate the feasibility of integrating WECS was presented to select their optimal size taking into account the environmental concerns.
- Sensitivity cost analysis is carried out to validate the feasibility of implementing WECS.

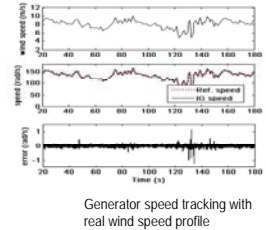
Acadia A (2) 16:44-17:08

## Predictive Tracking Controller for Induction Generator in Variable Speed Wind Energy Conversion Systems

Adel Merabet<sup>1</sup> and Jogendra S. Thongam<sup>2</sup>

<sup>1</sup> Division of Engineering, Saint Mary's University, Halifax, Nova Scotia, Canada  
<sup>2</sup> Department of Renewable Energy Systems, STAS Inc., Chicoutimi, Quebec, Canada

- In this paper, the problem of tracking control for variable speed wind induction generator (IG) energy conversion system (WECS) is investigated using nonlinear predictive control.
- A rotor speed predictive control algorithm has been designed to control the angular speed of the machine in order to allow the WECS operate with maximum power extraction.

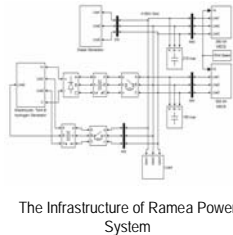


Acadia A (3) 17:08-17:32

## Dynamic Modeling and Simulation of a Remote Wind-Diesel-Hydrogen Hybrid Power System

Md. Maruf-ul-Karim and M. T. Iqbal  
Faculty of Engineering and Applied Science, Memorial University of Newfoundland  
St. John's, Newfoundland, Canada

- ❖ Dynamic model of Wind-Diesel-Hydrogen based Ramea power system has been developed.
- ❖ Hydrogen as a storage medium is a novel approach adopted in this system.
- ❖ Introducing of new WECS is aiming at increasing the penetration level.
- ❖ The dump load used in this system played an important role in maintaining stability.

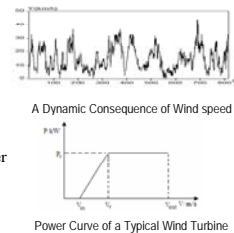


Acadia A (4) 17:32-17:56

## Wind Power Forecasting based on Econometrics Theory

Hui Zhou and Jiangxiao Fang  
School of Electrical Engineering, Beijing Jiaotong University  
Beijing, China

- ARCH effect exists in the fluctuated wind speed sequences.
- Based on econometrics theory, ARCH model and GARCH model of wind speed are established, both models have better forecasting precision than ARIMA.
- Plenty of numerical calculation demonstrates that GARCH model has better applicability.
- Based on wind power curve of a typical wind turbine, forecasted wind power of next day is gotten.

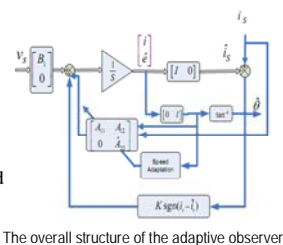


Acadia A (5) 17:56-18:20

## Direct Torque and Flux Control of the Converters for a Permanent Magnet Wind Power Generation System

Z. Xu, P. Ge, Dianguo Xu and C.H.Zhang  
Harbin Institute of Technology, 150001Harbin, China

- This paper presents a Space-Vector Modulated (SVM) Direct-Torque-Control (DTC) scheme for a direct-drive permanent magnet synchronous generator (PMSG) and a grid converter for wind energy without any position sensor.
- SVM-DTC can also be implemented into the grid converter in which nearly sinusoidal input current and fast dc link voltage regulation can be achieved.



# FE2: System Dynamics II

Session Chair: Dr. Jason Gu and Dr. Sheldon Williamson

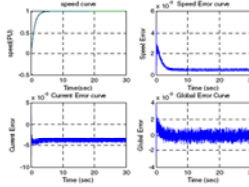
Acadia B 16:20-18:20 Friday, August 27

Acadia B (1) 16:20-16:44

## A Novel GA-Based Tri Loop Multi-Stage Incremental Action Drive Controller for Hybrid PV-FC-Diesel-Battery Electric Vehicle

Adel M. Sharaf, Senior Member IEEE and Adel A. A. El-Gammal, IEEE Member  
Centre for Energy Studies, University of Trinidad and Tobago UTT

- A novel self regulating tri loop self tuned multi-Stage incremental action controller for a hybrid PV-FC-Diesel-Battery powered all-wheel drive electric vehicle using four Permanent Magnet DC (PMDC) motors is presented.
- A Tri Loop dynamic error driven scheme is proposed to regulate motor current against high inrush currents and motor overloading conditions.
- The integrated scheme is fully stabilized using a novel FACTS based green filter compensators.



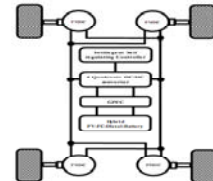
EV-PMDC Motor Speed response for the third speed track using GA based tuned Tri-Loop Multi-Stage Incremental Action Controller

Acadia B (2) 16:44-17:08

## A Novel PSO-Based Hybrid PV-FC-Diesel-Battery Electric PID-Controller Drive System for Electric Vehicle Traction

Adel M. Sharaf and Adel A. A. Elgammal  
Centre for Energy Studies, University of Trinidad and Tobago UTT

- A novel PID self regulating tri loop controller for a hybrid PV-FC-Diesel-Battery powered all-wheel drive electric vehicle using four Permanent Magnet DC (PMDC) motors, which are modeled to include existing nonlinearities in motor plus load inertia (J) and viscous friction (B).



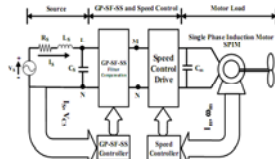
Schematic diagram of a prototype all-wheel drive electric vehicle using four PMDC motors

Acadia B (3) 17:08-17:32

## Novel Green Plug Switched Filter Schemes Based On Multi Objective Genetic Algorithm MOGA for Single Phase Induction Motors

Adel M. Sharaf and Adel A. A. Elgammal  
Centre for Energy Studies, University of Trinidad and Tobago UTT

- The paper presents a family of novel switched smart filter compensated devices using Green Plug Smart Filter Soft Starter GP-SF-SS devices for small single phase induction motors.
- The outcome is improved power quality, efficient utilization and reduced KWh energy consumption.



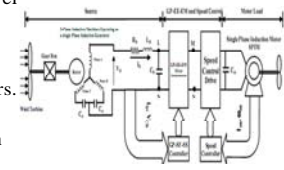
The proposed Green Plug-Smart Filter-Soft Starter GP-SF-SS for Single Phase Induction Motor SPIM drive system

Acadia B (4) 17:32-17:56

## Power Efficient PID Controller of Wind Driven Induction Generation Single-Phase Induction Motors for Electric Energy Saving Applications

Adel M. Sharaf and Adel A. A. Elgammal  
Centre for Energy Studies, University of Trinidad and Tobago UTT

- The paper presents a family of novel switched smart filter compensated devices using Green Plug Filter Compensator GPFC devices for small single phase induction motors.
- The GPFC devices are equipped with a dynamic online error driven optimally tuned controller that ensures improved power factor, reduced feeder losses, stabilized voltage, minimal current ripples and efficient energy utilization



Using Green Plug Filter Compensator GPFC devices for Single Phase Induction Motor SPIM drive system

# FE3:Alternative Energy

Session Chair: Glen Rocket and Dr. Tim Little

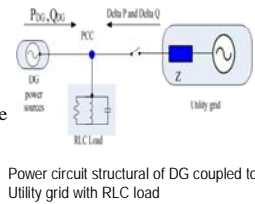
Acadia C 16:20-18:20 Friday, August 27

## Acadia C (1) 16:20-16:44

### Passive Method-Based Islanding Detection of Renewable-Based Distributed Generation: The Issues

A. S. Aljankawey, Walid G. Morsi, L. Chang and C. P. Diduch

- This paper presents a comprehensive survey of passive-based islanding protection schemes that have been proposed in the literature.
- The paper investigates the performance of the islanding detection schemes in the context of degraded power quality that will occur with the increased penetration of RDGs into the electric grid.



## Acadia C (2) 16:44-17:08

### Battery recharging and delivery service

Alfredo Herrera  
IEEE, Canada

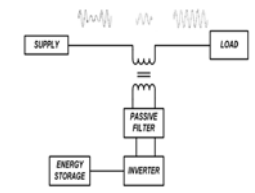
- The IEEE has recently become very proactive in humanitarian causes; notably by increasing efforts to be universally recognized for the contributions of technology and of technical professionals in improving global conditions." One ongoing initiative is the IEEE Humanitarian Technology Challenge's Reliable Electricity project (HTC-RE) [1]. This paper describe a workshop that will illustrate a use model for an electricity supply and management system in the context of developing countries.

## Acadia C (3) 17:08-17:32

### The Multi Functional Dynamic Voltage Restorer Based on SVPWM Control

S.H. Hosseini, S.Khani, M. Sadeghi and H.Afsharirad  
Faculty of Electrical and Computer Engineering  
University of Tabriz, Tabriz, Iran

- Dynamic Voltage Restorer (DVR) is a power electronic converter based device which can protect sensitive loads from supply side disturbances.
- If DVR has not been controlled properly, it might contribute to the PCC voltage sag in the process of compensating the missing voltage and worsening the faultsituation.
- To improve the capability of DVR, a downstream fault limiting function has been added to the DVR operation.

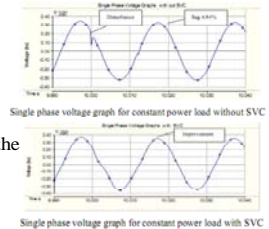


## Acadia C (4) 17:32-17:56

### Mitigation of Voltage Sag in Wind Generated Deregulated Distribution System by SVC

S.B. Warathe  
Department of Electrical Engineering,  
Govt. Polytechnic College Durg (C.G.) India

- This paper specifically deals with the wind farms.
- The FACT device SVC is used to enhance the performance of the deregulated distribution system.
- The PSCAD/EMTDC is used for the simulation studies.



# FE4: Intelligent Systems

Session Chair: Richard Itiveh and Dr. Adel Merabet

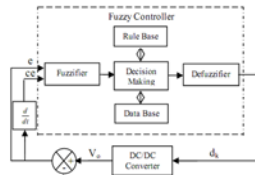
Tupper Room 16:20-18:20 Friday, August 27

## Tupper Room (1) 16:20-16:44

### Comparative Study of Fuzzy Logic Controller and Proportional Integral Derivative Controller on DC-DC Buck Converter

Muhammad Jamhuri Yusoff and Nik Fasdî Nik Ismail  
Universiti Teknologi MARA

- The main objective of this paper is to compare the performance between Fuzzy Logic controller (FLC) and Proportional Integral Derivative controller (PIDC) in improving the performance of DC/DC Buck Converters.
- Fuzzy logic controller has been implemented to the system by developing fuzzy logic control algorithm.



Basic configuration of FL controller

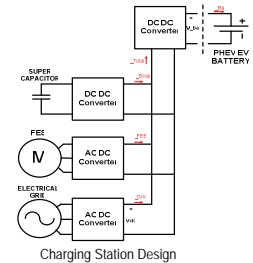
## Tupper Room (2) 16:44-17:08

### Design and Simulation of a Fast Charging Station for PHEV/EV Batteries

G. Joos and M. de Freige  
Department of Electrical Engineering  
McGill University  
Montreal, Quebec, Canada

M. Dubois  
Department of Electrical Engineering  
Laval University  
Sainte-Foy, Quebec, Canada

- The design and simulation of a fast charging station using a **flywheel** and a **supercapacitor** is proposed
- A typical PHEV battery has been charged from **20% to 95% state of charge in 13.25 min** while remaining within equipment technical specifications



Charging Station Design

## Tupper Room (3) 17:08-17:32

### Multi-Objective OPF Using Fuzzy LP

B.Venkatesh and Narayana Prasad Padhy

- This paper presents a Multi-objective Fuzzy Linear Programming (MFLP) method of solution in the Successive Linear Programming (SLP) framework and finding out the best generation settings such that both transmission losses and the system generation cost are minimized simultaneously.
- It has also been observed that the proposed algorithm can easily be applied to larger practical utilities and do not suffer with computational difficulties.

Control Objectives Model	Single Objective				Multi-Objective	
	AC OPF	Fuzzy LP OPF	Min. Cost	Min. Loss	Min. Cost & Loss	
$V_1$	1.082	1.077	1.082	1.082	1.079	
$V_2$	1.087	1.059	1.067	1.062	1.062	
$V_3$	1.061	1.057	1.051	1.062		
$V_4$	1.068	1.064	1.067	1.067		
$V_{11}$	1.087	1.068	1.072	1.070		
$V_{12}$	1.077	1.076	1.081	1.077		
$P_{G1}$	80.00	101.44	80.00	87.34		
$P_{G2}$	57.78	25.00	45.51	37.76		
$P_{G3}$	17.63	20.65	20.65	26.10		
$P_{G4}$	20.00	20.65	20.65	26.96		
$P_{G11}$	100.00	100.00	100.34	101.50		
$P_{G12}$	8.00	20.65	20.65	8.22		
$\sum P_{G_i}$ (MW)	288.42	288.41	287.82	287.91		
$\sum P_{loss}$ (MW)	5.820	5.009	4.425	4.519		
$\sum Cost$ (\$/hr)	4831.2	4839	4908.4	4879.4		

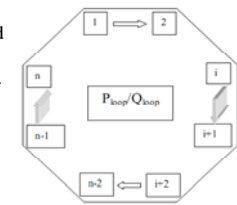
Table 1 Control parameters & objectives of IEEE 30 bus system

## Tupper Room (4) 17:32-17:56

### Identification and Mitigation of Circulating Power Flow Loops

B. Venkatesh and Narayana Prasad Padhy

- An objective function consisting of system loop flow index is introduced to optimally mitigate the loop flows without violating system constraints.
- Optimal Power Flow (OPF) algorithm has been imposed to minimize the system loop flow index while obtaining the utmost satisfaction of the violated load bus voltage constraints.



Network with circulating loop flows

# *Author Index*



## A

Abbey, Chad.....	T P 2 . 3
Abolghasem, Hossein.....	T E 1 . 3
Abumouti, Fahad S. ....	T P 3 . 4
Ahmed, Mohamed.....	T P 1 . 1
Ahmed, Mohammed.....	T P 2 . 2
Akamatov, Vladislav.....	T E 2 . 4
Al-azzawi, Abdul.....	T P 4 . 5
Aleyaasin, Majid.....	F P 3 . 1
Aliberti, Maaimo.....	F P 4 . 3
Aljankawey, A.s.....	F E 3 . 1
Aljankawey, Abduallah.....	T M 3 . 2
Aly, Hamed.....	T P 4 . 2
Aminlouei, Reza Tanha.....	F P 4 . 4
Amjadi, Zahra.....	T P 1 . 4
Andrey, Elise.....	T E 4 . 3
Arabali, Amirsaman.....	T P 3 . 3
Arifujjaman, Md.....	F P 1 . 3
Arifujjaman, Md.....	F P 1 . 4
Arifujjaman, Md.....	F P 1 . 5
Azizi, S.....	F P 4 . 5

## B

Babaei, Ebrahim.....	F P 3 . 4
Beguenane, R.....	T P 4 . 1
Berthold, Florence.....	T P 1 . 5
Bouchard, Pierre.....	T P 4 . 1
Brabec, Marek.....	T P 2 . 4
Brar, Y.....	T M 3 . 4
Buchta, Janusz.....	T M 4 . 3
Buchta, Janusz.....	T M 4 . 4

## C

Chang, L.....	F E 3 . 1
Chang, Liuchen.....	F P 1 . 1
Chang, Liuchen.....	T E 4 . 2
Chang, Liuchen.....	T M 2 . 4
Chang, Liuchen.....	T M 2 . 5
Chang, Liuchen.....	T M 3 . 2
Chatterjee, Suchismita.....	T P 1 . 2
Chen, Hao.....	T M 1 . 1
Chen, Hao.....	T M 1 . 2
Church, Craig.....	T E 4 . 2
Couture, Patrick.....	T P 4 . 5

## D

Dambhare, Sanjay.....	W M 1 . 4
Danyali, Saeed.....	F P 3 . 3
Dariani , Ali.....	W M 1 . 1
De Freige, Jr., M.....	F E 4 . 2
Desai, Chirag.....	T P 1 . 5
Deshpande, Anant.....	W M 1 . 4

Diduch, C.p.....	F E 3 . 1
Diduch, Chris.....	T E 4 . 2
Diduch, Chris.....	T M 2 . 4
Diduch, Chris.....	T M 2 . 5
Diduch, Chris.....	T M 3 . 2
Dong, Yinghua.....	T E 3 . 4
Dong, Yinghua.....	T E 3 . 5
Dubois, M. ....	F E 4 . 2

## E

Eben, Krystof .....	T P 2 . 4
Elgammal, Adel.....	F E 2 . 1
Elgammal, Adel.....	F E 2 . 2
Elgammal, Adel.....	F E 2 . 3
Elgammal, Adel.....	F E 2 . 4
Elgammal, Adel.....	F P 2 . 1
Elgammal, Adel.....	F P 2 . 2
Elgammal, Adel.....	F P 2 . 3
Elgammal, Adel.....	F P 2 . 4
El-havary, M.e.....	T E 4 . 2
El-keib, A. A. ....	W M 1 . 3
Ellabban, Omar.....	T M 1 . 3
Ellabban, Omar.....	T M 1 . 4
El-sayed, Mohamed.....	F E 1 . 1
El-sharkh, M. Y.....	W M 1 . 3
Espiari, Shirin.....	F P 3 . 1

## F

Fakhimghanbarzadeh, Babak.....	T E 1 . 3
Fang, Jiangxiao.....	F E 1 . 4
Farhat, Ibrahim.....	T P 3 . 5
Fasdi Nik Ismail, Nik.....	F E 4 . 1
Fathi, Amir Hosein.....	F P 3 . 2
Fathi, Amir Hossein.....	T P 1 . 3
Fayyad, Yara.....	T M 3 . 1
Feng, Zhimin.....	T E 3 . 3
Fofana, L.....	T P 4 . 1
Foss, Aidan.....	T M 3 . 5

## G

Ge, P.....	F E 1 . 5
Ghaderi, Farid.....	F P 4 . 4
Gole, Ani.....	T M 4 . 1
Gomez, Rolando.....	T M 3 . 3
Groza, Voicu.....	F P 1 . 2
Groza, Voicu.....	F P 4 . 1
Groza, Voicu.....	T M 2 . 2
Groza, Voicu.....	T M 2 . 3
Gu, Jason.....	T M 1 . 1
Gu, Jason.....	T M 1 . 2
Guillemette, Pierre.....	F P 1 . 2

## H

Habash, Riadh.....	F P 1 . 2	Luo, Yongchao.....	T E 3 . 3
Habash, Riadh	F P 4 . 1		
Hafeez, Muhammad .....	W M 1 . 2	<b>M</b>	
Haghi, R.....	T E 3 . 1	Mannem, Karthik.....	W M 1 . 4
Han, Yu.....	F P 1 . 1	Martirano, Luigi.....	F P 4 . 3
Hawary , Mohamed.....	T P 3 . 4	Marzi, Arash.....	T E 1 . 1
Hawary , Mohamed	T P 3 . 5	Marzi, Arash	T E 1 . 2
Hawary , Mohamed	T P 4 . 2	Marzi, Elham.....	T E 1 . 1
Heckenbergerova, Jana.....	T P 3 . 1	Marzi, Elham	T E 1 . 2
Herrera, Alfredo.....	F E 3 . 2	Marzi, Hosein.....	T E 1 . 1
Hidalgo, Rodrigo.....	T P 2 . 3	Marzi, Hosein	T E 1 . 2
Hoseinnia, Sajad.....	F P 3 . 2	Marzi, Hosein	T E 1 . 3
Hosseini, S.h.....	F P 3 . 3	Mashhadi, H.....	T E 1 . 5
Hosseini, S.h.	F P 3 . 4	Masoumzadeh, Amin.....	T P 1 . 3
Hosseini, Seyed Hossein.....	F E 3 . 3	Massarella, Ferdinando.....	F P 4 . 3
		Mendiratta, Jugal.....	T M 4 . 2
<b>I</b>		Merabet, Adel.....	F E 1 . 2
		Mierlo, Joeri Van.....	T M 1 . 3
Iqbal, M. Tariq.....	F E 1 . 3	Mierlo, Joeri Van	T M 1 . 4
Iqbal, M.t.....	F P 1 . 5	Mirsamadi, M.....	T E 1 . 4
		Morelli, Jordan.....	T E 4 . 3
<b>J</b>		Morelli, Jordan	T E 4 . 3
		Morsi, Walid.....	T M 2 . 4
Javan, Dawood Seyed.....	T E 1 . 5	Morsi, Walid	T M 2 . 5
Jensen, Kim.....	T E 2 . 4	Morsi, Walid	T M 3 . 2
Jiang, Ningqiu.....	T E 3 . 5	Morsi, Walid G.....	F E 3 . 1
Joos, G. ....	F E 4 . 2	Morsi, Walid G.	T E 4 . 2
Joos, Geza.....	T P 2 . 3	Mostefa, Mohammed.....	T P 4 . 5
Joshi, K.....	T P 1 . 2	Mouftah, Hussein T.....	T E 4 . 1
		Mousa, Effat.....	F E 1 . 1
<b>K</b>		Moya, Isaias Guillen.....	T M 3 . 3
		Mozafari Niapoor, S.a.kh.....	F P 3 . 3
Kantarci, Melike Erol.....	T E 4 . 1	Multani, Munish.....	T E 2 . 1
Karim, Md. Maruf Ul.....	F E 1 . 3	Musilek, P.....	T M 2 . 1
Kaur, Harprit.....	T M 3 . 4	Musilek, Petr.....	T P 2 . 4
Khaki, Milad.....	T P 3 . 1	Musilek, Petr	T P 3 . 1
Khani, S.....	F E 3 . 3	Musilek, Petr	T P 3 . 2
Khosravi, Hamed.....	T P 3 . 3		
Knight, Andrew.....	T M 2 . 1	<b>N</b>	
Kotb, Omar.....	T E 2 . 3	Nasiri, Mojtaba.....	F P 3 . 2
Koval, Don.....	T P 3 . 1	Nasirian, V.....	T P 1 . 3
Krc, Pavel .....	T P 2 . 4	Nazarloo, A.....	F P 3 . 4
		Nejabatkhah, Farzam.....	F P 3 . 3
<b>L</b>		Nezam-saemadi, S.a.....	F P 4 . 5
		Noroozi, N.....	T E 3 . 1
Lataire, Philippe.....	T M 1 . 3	Nouri-zadeh, S.....	F P 4 . 5
Lataire, Philippe	T M 1 . 4	Nourizadeh, Saber.....	T M 1 . 5
Leppik, Kalle.....	T M 3 . 5		
Li, Howard.....	T M 2 . 4	<b>O</b>	
Li, Howard	T M 2 . 5	Osman, Ahmed.....	TM3.1
Little, Timothy.....	T E 4 . 4		
Lopez, Juan Alvarez.....	T M 3 . 3	<b>P</b>	
Lu, S.....	T M 1 . 1		
Lu, Xiaoquan.....	T E 3 . 5		

## IEEE EPEC2010 Author Index

Padhy, Narayana.....	F E 4 . 3	Sharaf, Adel	F P 2 . 1
Padhy, Narayana	F E 4 . 4	Sharaf, Adel	F P 2 . 2
Pahlavan, Karen.....	T E 4 . 4	Sharaf, Adel	F P 2 . 3
Patel, Hiteshkumar.....	T E 2 . 2	Sharaf, Adel	F P 2 . 4
Paull, Liam.....	T M 2 . 4	Sharma, Ranjan.....	T E 2 . 4
Pelikan, Emil.....	T P 2 . 4	Shu, Lily.....	T P 2 . 1
Perera, Nuwan.....	T M 4 . 1	Sisworahardjo, N. S. ....	W M 1 . 3
Pimentel, Demian.....	T M 2 . 1	Soliman, Mohamed.....	T P 1 . 1
Pishvaie, Mahmoudreza.....	T P 3 . 3	Soliman, Mohammed.....	T P 2 . 2
Pitis, Constantin.....	T M 2 . 3	Song, Q.....	T M 1 . 2
Popa , Lucian Mihet .....	T M 2 . 2	Sood, Vijay.....	T E 2 . 1
Pytlak, Pawel.....	T P 3 . 2	Sood, Vijay	T E 2 . 2
		Sood, Vijay	T E 2 . 3
		Sotoodeh, Pedram.....	T P 3 . 3
<b>Q</b>			
Qiu, Xiaohui.....	T E 3 . 4	<b>T</b>	
Qiu, Xiaohui	T E 3 . 5	Taherbaneh, M.....	T E 1 . 4
Quaicoe, J.e.....	F P 1 . 5	Tarnini, Mohamed.....	T E 3 . 2
		Thongam, Jogendra.....	F E 1 . 2
		Thongam, Jogendra Singh.....	T P 4 . 1
<b>R</b>			
Radcliffe, Paul.....	T P 2 . 1	<b>U</b>	
Rahman, A.....	W M 1 . 3	Uddin, M. Nasir .....	W M 1 . 2
Rajapakse, Athula.....	T M 4 . 1	<b>V</b>	
Randhawa, J.....	T M 3 . 4	Vakilian, Mehdi.....	F P 4 . 2
Ranjbar, A.m.....	F P 4 . 5	Venkatesh, Bala.....	F E 4 . 3
Ranjbar, Alimohammad.....	T M 1 . 5	Venkatesh, Bala	F E 4 . 4
Ranjitkar, Ghanashyam.....	T P 4 . 6	<b>W</b>	
Rasmussen, Tonny.....	T E 2 . 4	Wallace, James.....	T P 2 . 1
Rastegar , Reza.....	W M 1 . 1	Wang, X. ....	T M 1 . 1
Reddy, Jayapal.....	T M 4 . 2	Wang, X.	T M 1 . 2
Ren, Jing.....	T E 2 . 1	Warathe, Shanker.....	F E 3 . 4
Rezaei, Pooya.....	F P 4 . 2	Wawszczak, Andrzej.....	T M 4 . 3
Rezaie, A.....	T E 1 . 4	Williamson , Sheldon.....	T P 1 . 5
Rong, Rong.....	T E 3 . 3	Williamson, Sheldon.....	T P 1 . 4
Rong, Rong	T E 3 . 4	<b>X</b>	
Rong, Rong	T E 3 . 5	Xu, Dianguo.....	F E 1 . 5
Rong, Rong	T E 3 . 5	Xu, Zhuang.....	F E 1 . 5
Roshandel, R.....	T P 1 . 3	<b>Y</b>	
Ross, Michael.....	T P 2 . 3	Yan, Wei.....	T E 3 . 3
Rouhani, M.....	T E 1 . 5	Yan, Wei	T E 3 . 4
		Yari, Vahid.....	T M 1 . 5
		Yusof, Muhammad Jamhuri.....	F E 4 . 1
<b>S</b>			
S. Rebeiro , Ronald .....	W M 1 . 2		
Sadeghi, M.....	F E 3 . 3		
Safiuddin, Mohammed.....	T P 2 . 2		
Salehi, A.....	F P 4 . 5		
Seoud, Tarek Aboul.....	T P 4 . 3		
Seoud, Tarek Aboul	T P 4 . 4		
Sepulveda, Arnaldo.....	T M 2 . 4		
Sharaf, A.....	T P 4 . 3		
Sharaf, A.	T P 4 . 4		
Sharaf, Adel.....	F E 2 . 1		
Sharaf, Adel	F E 2 . 2		
Sharaf, Adel	F E 2 . 3		
Sharaf, Adel	F E 2 . 4		

**Z**

Zhang, C.h.....	F E 1 . 5
Zhao, Bo.....	T E 3 . 3
Zhao, Yang.....	T E 3 . 3
Zhao, Yang	T E 3 . 4
Zhao, Yang	T E 3 . 5
Zhou, Hui.....	F E 1 . 4
Zolghadri, M.....	T E 3 . 1
Zolghadri, M.	T P 1 . 3
Zolpirani, Mostafa.....	T M 2 . 5



