

2022 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT 2022)

**New Orleans, Louisiana, USA
24 – 28 April 2022**



**IEEE Catalog Number: CFP22ISG-POD
ISBN: 978-1-6654-3776-9**

**Copyright © 2022 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP22ISG-POD
ISBN (Print-On-Demand):	978-1-6654-3776-9
ISBN (Online):	978-1-6654-3775-2
ISSN:	2167-9665

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

Harmonic Modeling, Data Generation, and Analysis of Power Electronics-Interfaced Residential Loads <i>Ankit Singhal, Dexin Wang, Andrew P. Reiman, Yuan Liu, Donald J. Hammerstrom, Soumya Kundu</i>	1
Analyzing Accuracy of Inverse Power Flow from Noisy Edge Measurements <i>Carl W. Morgenstern, Jamie H. Morgenstern, Rui Yang, Elizabeth Cook</i>	6
Faulty Feeder Identification Technology Utilizing Grid-Connected Converters for Reduced Outage Zone in Smart Grids <i>Huma Goyal, Akira Kikuchi</i>	11
Power System Event Identification with Transfer Learning Using Large-Scale Real-World Synchrophasor Data in the United States <i>Jie Shi, Koji Yamashita, Nanpeng Yu</i>	16
Analysis of STATCOM Oscillations Using Ambient Synchrophasor Data in Dominion Energy <i>Chetan Mishra, Duotong Yang, Chen Wang, Xin Xu, Kevin D. Jones, R. Matthew Gardner, Luigi Vanfretti</i>	21
A Reward Mechanism for Reliability-As-A-Service Usage of Electric Vehicles <i>Akhtar Hussain, Petr Musilek</i>	26
Data-Driven Generic Turbines for Distributed Wind Modeling, Optimization, and Economic Studies <i>Andrew P. Reiman, Thiagarajan Ramachandran, Alice C. Orrell</i>	31
Input Signal for Synthetic Inertia: Estimated ROCOF Versus Remote Machine Acceleration..... <i>Felipe Wilches-Bernal, Josh Wold, W. Hill Balliet</i>	36
A Data-Driven Democratized Control Architecture for Regional Transmission Operators <i>Xiaoyuan Fan, Daniel Moscovitz, Liang Du, Walid Saad</i>	41
Development and Implementation of a Holistic Flexibility Market Architecture <i>Oliver Kraft, Oliver Pohl, Ulf Hager, Kai Heussen, Nils Müller, Zeeshan Afzal, Mathias Ekstedt, Hossein Farahmand, Dmytro Ivanko, Ankit Singh, Sasiphong Leksawat, Andreas Kubis</i>	46
Evaluation Method of Spatio-Temporal Flexibility as Renewable Energy Absorption Potential of a Group of Electric Buses Using Bus Operation Data..... <i>Yuki Tomizawa, Yuto Ihara, Yasuhiro Kodama, Yutaka Iino, Yasuhiro Hayashi, Ohsei Ikeda, Jun Yoshinaga</i>	51
Power Management Via Integration of Battery Energy Storage Systems with Electric Bus Charging..... <i>Shashank Narayana Gowda, Amirhossein Ahmadian, Vishal Anantharaman, Chi-Cheng Chu, Rajit Gadh</i>	56
Reachability Analysis for Controlling DERs to Mitigate Disturbances in Distribution Grids <i>Jaimie Swartz, Alexandra Von Meier</i>	61
KEF: A Key Exchange Framework for Operational Technology Security Standards and Guidelines..... <i>Abubakar Sadiq Sani, Dong Yuan, Ke Meng, Zhao Yang Dong</i>	66

Determining an Operation Sequence for Proactive Islanding of the Power Grid	71
<i>Shuchismita Biswas, Virgilio A. Centeno</i>	
Proactive Posturing of Large Power Grid for Mitigating Hurricane Impacts	76
<i>Edward Quarm, Xiaoyuan Fan, Marcelo Elizondo, Ramtin Madani</i>	
Valuation of Behind-The-Meter Energy Storage in Hybrid Energy Systems.....	81
<i>Rodrigo D. Trevizan, Tu A. Nguyen, Stanley Atcitty, Alexander J. Headley</i>	
Sparse Time Series Sampling for Recovery of Behind-The-Meter Inverter Control Models.....	86
<i>Samuel Talkington, Santiago Grijalva, Matthew J. Reno</i>	
Dissipativity-Based Voltage Control in Distribution Grids.....	91
<i>K. C. Kosaraju, Lintao Ye, Vijay Gupta, Rodrigo Trevizan, Babu Chalamala, Raymond H. Byrne</i>	
DERMS Online: A New Voltage Sensitivity-Enabled Feedback Optimization Framework.....	96
<i>Yiyun Yao, Ketian Ye, Junbo Zhao, Fei Ding, Julieta Giraldez</i>	
An Algorithm for Fast Fault Location and Classification Based on Mathematical Morphology and Machine Learning.....	101
<i>Felipe Wilches-Bernal, Miguel Jimenez-Aparicio, Matthew J. Reno</i>	
Chance Constrained Distributionally Robust Optimal HVAC Scheduling for Commercial Building Demand Response	106
<i>Guanyu Tian, Qun Zhou Sun</i>	
Integrating Geospatial Data for Weather Station Selection and Enhanced Electric Load Forecasting.....	111
<i>Daniel L. Donaldson, Dilan Jayaweera</i>	
Privacy-Enhancing Settlements Protocol in Peer-To-Peer Energy Trading Markets	116
<i>Robbie Thandi, Mustafa A. Mustafa</i>	
Dynamics-Aware Optimal Operation of Microgrids in Islanded Mode	121
<i>Roohallah Khatami, Bo Chen, Yu Christine Chen</i>	
NILM-Synth: Synthetic Dataset Generation for Non-Intrusive Load Monitoring Algorithms	126
<i>John Donnal</i>	
Decentralized Coordinated State Estimation in Integrated Transmission and Distribution Systems	131
<i>Ying Zhang, Yanbo Chen, Jianhui Wang, Yue Meng, Tianqiao Zhao</i>	
An End-To-End Cyber-Physical Infrastructure for Smart Grid Control and Monitoring.....	136
<i>Arnab Dey, Soham Chakraborty, Murti V. Salapaka</i>	
Unsupervised Identification of Electrical Loads from Aggregate Power Measurements.....	141
<i>Namir Jawdat, John Donnal</i>	
A Novel Continuum Approximation to Power System Electromechanical Dynamics.....	147
<i>S. Lei, D. A. Maldonado, E. Constantinescu, J. Zhao, S. Yarahmadi, L. Mili, M. Anitescu</i>	
Hierarchical Transactive Control of Flexible Building Loads Under Distribution LMP.....	152
<i>Byungkwon Park, Kadir Amasyali, Yang Chen, Mohammed Olama</i>	
Impact of Smart Meter Measurement Granularity on Control Parameters of OLTC in Distribution Networks with PV	157
<i>Marika Nakamura, Akihisa Kaneko, Shinya Yoshizawa, Hideo Ishii, Yasuhiro Hayashi</i>	

Evaluating and Improving Model-Based Assessment of Contextual Data Quality in Smart Grids.....	162
<i>Dominik Vereno, Katharina Polanec, Christian Neureiter</i>	
A Practical Adversarial Attack on Contingency Detection of Smart Energy Systems	167
<i>Moein Sabounchi, Jin Wei-Kocsis</i>	
ML-Based Anomaly Detection System for DER Communication in Smart Grid	172
<i>Moataz Abdelkhalek, Gelli Ravikumar, Manimaran Govindarasu</i>	
Measurement-Based Component-Level Load Modeling for Evaluation of a Current-Suppressing Loading Scenario for Microgrid Black Start Events	177
<i>Mina Mirzadeh, Axel Mertens</i>	
Physics-Aware Fast Learning and Inference for Predicting Active Set of DC-OPF	182
<i>Hossein Khazaei, Yue Zhao</i>	
Small-Signal Stability Analysis of Low-Inertia Power Grids with Inverter-Based Resources and Synchronous Condensers.....	187
<i>Lizhi Ding, Xiaonan Lu, Jin Tan</i>	
Risk-Adjusted Unit Commitment for Systems with High Penetration of Renewables.....	192
<i>Denis Osipov, Syed A. R. Naqvi, Sai R. K. M. S. Palepu, Koushik Kar, Joe H. Chow, Aparna Gupta</i>	
Prediction of Power Measurements Using Adaptive Filters	197
<i>Khaled Hamad, Nader Aljohani, Tierui Zou, Arturo Bretas</i>	
Machine Learning-Based Cyber-Physical Anomaly Detection in Wide Area Voltage Control Systems.....	202
<i>Burhan Hyder, Vivek Kumar Singh, Manimaran Govindarasu, Reynaldo Nuqui</i>	
Advanced Persistent Threat (APT)-Style Attack Modeling and Testbed for Power Transformer Diagnosis System in a Substation.....	207
<i>Seerin Ahmad, Bohyun Ahn, Syed. R. B. Alvee, Daniela Trevino, Taesic Kim, Young-Woo Youn, Myung-Hyo Ryu</i>	
Three-Phase Distribution Locational Marginal Pricing for Competitive Electricity Markets with Distributed Generators and Flexible Loads	212
<i>Emily Ma, Anton Lodder, Siyan Guo, Shahed Mortazavian, Yan Zhang, Zamry Jamaludin, Pranav Bhaswanth Madabhushi, Daniel Dias Oliveira, Wajid Muneer</i>	
A Simple Application for Executing Dynamic Simulations in Parallel on Cluster Machines.....	217
<i>Miguel A. Carreno, Diego Rodriguez, Juan M. Gers</i>	
Variation-Cognizant Probabilistic Power Flow Analysis Via Multi-Task Learning	221
<i>Kejun Chen, Yu Zhang</i>	
A Cryptographic Method for Defense Against MiTM Cyber Attack in the Electricity Grid Supply Chain	226
<i>Shuva Paul, Yu-Cheng Chen, Santiago Grijalva, Vincent John Mooney</i>	
Impact Analysis and Mitigation of Losing Time Synchronization at Micro-PMUs in Event Location Identification	231
<i>Zong-Jhen Ye, Mohammad Farajollahi, Hamed Mohsenian-Rad</i>	
Differentially Private Load Restoration for Microgrids with Distributed Energy Storage.....	236
<i>Shourya Bose, Yu Zhang</i>	

Dynamic Modeling and Model Predictive Control of Hybrid Solid-State Transformers	241
<i>Lizhi Ding, Yuhua Du, Xiaonan Lu, Alex Q. Huang</i>	
Overloading Analysis of Distribution Transformers Using Smart Meter Data	246
<i>Valliappan Muthukaruppan, Mesut Baran, Ning Lu, P. Rehm, Edmond Miller, Matthew Makdad</i>	
Hierarchical Model-Free Transactive Control of Residential Building Loads: An Actual Deployment	251
<i>Kadir Amasyali, Christopher Winstead, Yang Chen, Jeffrey Munk, Mohammed Olama, Justin Hill</i>	
Replacing Transmission Infrastructure with Solar and Energy Storage Systems: An Islanded Microgrid Case Study.....	256
<i>Alvaro Furlani Bastos, Tu A. Nguyen, Raymond H. Byrne, Russ Weed</i>	
A Hybrid Data-Driven and Model-Based Anomaly Detection Scheme for DER Operation.....	261
<i>Yiyun Yao, Fei Ding, Weijia Liu</i>	
Optimal Voltage Control in Low-Observable Unbalanced Distribution Systems	266
<i>Mohammad Abujubbeh, James R. K. Rajasekaran, Anil Pahwa, Balasubramaniam Natarajan</i>	
Comparative Analysis of Frequency Support Provided by Grid-Forming and Grid-Following PVs.....	271
<i>Somesh Bhattacharya, Brian Azzopardi</i>	
Prediction of Relay Settings in an Adaptive Protection System.....	276
<i>Adam Summers, Trupal Patel, Ronald Matthews, Matthew J. Reno</i>	
Cost Analysis of DCFC Fast Charging Station Power Rates for Workplace Charging.....	281
<i>Sadik Kucuksari, Nuh Erdogan</i>	
Quasi-Dynamic Domain Modeling and Simulation of Voltage Source Converters	286
<i>Kaiyu Liu, A. P. Sakis Meliopoulos, Obadolagbonyi Osamuyi, Siyao Cai</i>	
Power System Resilience Evaluation Framework and Metric Review.....	291
<i>Yiyun Yao, Weijia Liu, Rishabh Jain</i>	
Dymola-Enabled Reinforcement Learning for Real-Time Generator Set-Point Optimization.....	296
<i>Aisling Pigott, Kyri Baker, Sergio A. Dorado-Rojas, Luigi Vanfretti</i>	
VAC: A Software Approach to Resilient SCADA Automation	301
<i>Jordan Johnson, Brian Weber, Jared Smith, Chris Hathhorn, Philip Irminger, Savannah Norem, Jennifer Guerra, Joel Dawson, Tyler McDaniel</i>	
A Fast and Accurate Transient Stability Assessment Method Based on Deep Learning: WECC Case Study.....	306
<i>Yinfeng Zhao, Shutang You, Mirka Mandich, Lin Zhu, Chengwen Zhang, Hongyu Li, Yu Su, Yilu Liu, Huaiguang Jiang, Haoyu Yuan, Yingchen Zhang, Jin Tan</i>	
Energy Storage-Based Packetized Delivery of Electricity	311
<i>Tu A. Nguyen, Raymond H. Byrne</i>	
A Distributed Control Architecture for Optimal Allocation of Grid-Responsive Load Aggregations	316
<i>Joel Mathias, Sean Meyn, Hala Ballouz, Meisam Ansari</i>	

Volt-VAR Optimization in Distribution Networks Using Twin Delayed Deep Reinforcement Learning	321
<i>Rakib Hossain, Mukesh Gautam, Mohammad Mansour Lakouraj, Hanif Livani, Mohammed Benidris</i>	
Feasibility of a Real-World Test Microgrid Facility to Provide Economic and Resiliency Benefits in Extreme Weather Conditions	326
<i>Rabindra Bhatta, Rajendra Shrestha, Cesar Negri, Konrad Schmitt, Mahatab Musraf, Manohar Chamana, Osman Illham, Stephen Bayne</i>	
Importance of Model Fidelity of Power to X Devices in Energy System Analysis.....	331
<i>Digvijay Gusain, Milos Cvetkovic, Bekir Caner Yagci, Peter Palensky</i>	
Regional PV Energy Forecasting Using Distributed Data and Deep Neural Networks	336
<i>Lucio Pereira Franco, Pascal Hirmer, Lucineia Heloisa Thom</i>	
OPF-Learn: An Open-Source Framework for Creating Representative AC Optimal Power Flow Datasets	341
<i>Trager Joswig-Jones, Kyri Baker, Ahmed S. Zamzam</i>	
A Bagging MLP-Based Autoencoder for Detection of False Data Injection Attack in Smart Grid	346
<i>Shuva Paul, Ripan Kumar Kundu</i>	
A Novel Methodology for Cybersecurity Investment Optimization in Smart Grids Using Attack-Defense Trees and Game Theory	351
<i>Burhan Hyder, Manimaran Govindarasu</i>	
Evaluation of Optimal Net Load Management in Microgrids Using Hardware-In-The-Loop Simulation	356
<i>Jing Wang, Soham Chakraborty, Vivek Khatana, Blake Lundstrom, Govind Sarawat, Murti Salapaka</i>	
Substation-Level Circuit Topology Estimation Using Machine Learning	361
<i>Daniel Ruiz Garcia, Binod Poudel, Ali Bidram, Matthew J. Reno</i>	
Microgrid Controller Evaluation Using Real-Time Digital Simulation	367
<i>Alejandro Avendano</i>	
Impact of PV Farms with Smart Inverters on the Protection of Distribution System.....	372
<i>Priya Raghuraman, Mesut E. Baran</i>	
Robust Autoencoder-Based State Estimation in Power Systems	377
<i>Marine Picot, Francisco Javier Messina, Fabrice Labeau, Pablo Piantanida</i>	
Day-Ahead Load Forecasting Using Explainable Artificial Intelligence	382
<i>Daniel Aunan Bolstad, Umit Cali, Murat Kuzlu, Ugur Halden</i>	
A Dual-Mode Real-Time Electrical Load Forecasting Framework.....	387
<i>Xinlin Wang, Marios Papaefthymiou</i>	
Security Monitoring of the Microgrid Using IEC 62351-7 Network and System Management	392
<i>Mark Karanfil, Dhiaa Elhak Rebbah, Mohsen Ghafouri, Marthe Kassouf, Mourad Debbabi, Aiman Hanna</i>	
Hardening Substations Against Supply Chain Attacks Under Operational Constraints.....	397
<i>Onur Duman, Lingyu Wang, Minh Au, Marthe Kassouf, Mourad Debbabi</i>	

Using Terminal Circuit for Power System Electromagnetic Transient Simulation.....	402
<i>Yijing Liu, Xiang Zhang, Renchang Dai, Guangyi Liu</i>	
Real-Time Co-Simulation Platform for Security Analysis of Distribution Automation Systems	407
<i>Dhiaa Elhak Rebbah, Afshin Ebtia, Mohsen Ghafouri, Marthe Kassouf, Ribal Atallah, Mourad Debbabi, Arash Mohammadi</i>	
Positive-Sequence Phasor Modeling of Droop-Controlled, Grid-Forming Inverters with Fault Current Limiting Function.....	412
<i>Wei Du, Yuan Liu, Renke Huang, Francis K. Tuffner, Jing Xie, Zhenyu Huang</i>	
Online Optimization of Heat Pump Systems for Building Heating Based on Lyapunov Method.....	417
<i>Mengfan Cao, Shibo Chen, Zaiyue Yang, Haoyu Miao</i>	
Deploying 5G Architecture for Protection Systems in Smart Distribution Grids.....	422
<i>Charles M. Adrah, David Palma, Oivind Kure, Poul E. Heegaard</i>	
A Privacy-Preserving Three-Step Demand Response Market Using Multi-Party Computation	427
<i>Fairouz Zobiri, Mariana Gama, Svetla Nikova, Geert Deconinck</i>	
An Experiment-Based Distribution Level Performance Comparison Among PMUs.....	432
<i>He Yin, Linwei Zhan, Wenxuan Yao, Yilu Liu</i>	
Quantitative Analysis of Demand Response Using Thermostatically Controlled Loads	437
<i>Praveen Dhanasekar, Cunzhi Zhao, Xingpeng Li</i>	
Standardization of Smart Contracts for Energy Markets and Operation	442
<i>Umit Cali, D. Jonathan Sebastian-Cardenas, Shammya Saha, Shawn Chandler, Sri Nikhil Gupta Gouriseti, Tamara Hughes, Komal Khan, Claudio Lima, Farrokh Rahimi, Leonard C. Tillman</i>	
Testing Machine Learned Fault Detection and Classification on a DC Microgrid.....	447
<i>Samuel T. Ojetola, Matthew J. Reno, Jack Flicker, Daniel Bauer, David Stoltzfuz</i>	
Physics-Aware Sparse Harmonic State Estimation in Power Distribution Systems.....	452
<i>Fatemeh Ahmadi Gorjayi, Hamed Mohsenian-Rad</i>	
Reliability Assessment of Patched SCADA EMS/DMS Servers Through Similarity Matching.....	457
<i>Jit Biswas, David K. Y. Yau, Li Zihao, Yu Ming, Kon Ih Lunn, Tan Keng Nan, Zhang Zhimin, Jimmy Chua, Tso Wai Ann, Heng Yong Kean</i>	
Power Hardware-in-the-Loop-Based Diesel Generator for Flexible Microgrid Testing Applications.....	462
<i>Nicolas Seubert, Nikola Stankovic, Etienne Toutain</i>	
Knowledge-Based Fault Diagnosis for a Distribution System with High PV Penetration	467
<i>Shuva Paul, Santiago Grijalva, Miguel Jimenez Aparicio, Matthew J. Reno</i>	
A Machine Learning-Based Method Using the Dynamic Mode Decomposition for Fault Location and Classification	472
<i>Felipe Wilches-Bernal, Miguel Jimenez-Aparicio, Matthew J. Reno</i>	
IoT-Enabled Decentralized Moving Target Defense for Enhancing Privacy in Microgrid Control.....	477
<i>Jairo Giraldo, Masood Parvania</i>	
Allocating Reserves in Active Distribution Systems for Tertiary Frequency Regulation	482
<i>Mukesh Gautam, Mohammad Mansour Lakouraj, Narayan Bhusal, Mohammed Benidris, Hanif Livani</i>	

Black-Start of HVDC-Connected Offshore Wind Generators for System Restoration	487
<i>Lina He</i>	
Detection of Stealthy False Data Injection Attacks in Unobservable Distribution Networks	492
<i>James R. K. Rajasekaran, Balasubramaniam Natarajan, Anil Pahwa, Hongyu Wu</i>	
A Cyber-Physical Resilience-Based Survivability Metric Against Topological Cyberattacks	497
<i>Abolfazl Rahiminejad, Mohsen Ghafouri, Ribal Atallah, Arash Mohammadi, Mourad Debbabi</i>	
Resilient Predictor-Based Load Frequency Control for Multi-Region Power Systems Under DoS Attacks.....	502
<i>Zhenhua Wang, William Danilczyk, Hepeng Li, Haibo He, Yan Lindsay Sun</i>	

Author Index