

# IEEE TRANSACTIONS ON SUSTAINABLE ENERGY

IEEE POWER & ENERGY SOCIETY  
IEEE POWER ELECTRONICS SOCIETY  
IEEE INDUSTRY APPLICATIONS SOCIETY  
IEEE INDUSTRIAL ELECTRONICS SOCIETY



TECHNICALLY COSPONSORED BY  
IEEE SOCIETY ON SOCIAL IMPLICATIONS OF TECHNOLOGY  
IEEE PHOTONICS SOCIETY  
IEEE INSTRUMENTATION & MEASUREMENT SOCIETY



JULY 2019

VOLUME 10

NUMBER 3

ITSEAJ

(ISSN 1949-3029)

## REGULAR PAPERS

Combination of Synchronous Condenser and Synthetic Inertia for Frequency Stability Enhancement in Low-Inertia Systems . . . . .	<i>H. T. Nguyen, G. Yang, A. H. Nielsen, and P. H. Jensen</i>	997
Flexibility Provisions From a Fast Charging Facility Equipped With DERs for Wind Integrated Grids . . . . .	<i>W. Alharbi and K. Bhattacharya</i>	1006
Optimization of Battery Energy Storage to Improve Power System Oscillation Damping . . . . .	<i>Y. Zhu, C. Liu, K. Sun, D. Shi, and Z. Wang</i>	1015
Fast yet Accurate Energy-Loss-Assessment Approach for Analyzing/Sizing PV in Distribution Systems Using Machine Learning . . . . .	<i>K. Mahmoud and M. Abdel-Nasser</i>	1025
Optimal Energy Management of EV Parking Lots Under Peak Load Reduction Based DR Programs Considering Uncertainty . . . . .	<i>İ. Şengör, O. Erdiñç, B. Yener, A. Taşcıkaraođlu, and J. P. S. Catalão</i>	1034
Fault Diagnosis of Wind Turbine Gearboxes Based on DFIG Stator Current Envelope Analysis . . . . .	<i>F. Cheng, L. Qu, W. Qiao, C. Wei, and L. Hao</i>	1044
An Approach for System Risk Assessment and Mitigation by Optimal Operation of Wind Farm and FACTS Devices in a Centralized Competitive Power Market . . . . .	<i>S. Dawn, P. K. Tiwari, A. K. Goswami, and R. Panda</i>	1054
Analysis of Dynamic Properties of VSCs Connected to Weak Grids Including the Effects of Dead Time and Time Delays . . . . .	<i>A. Rodríguez-Cabero, M. Prodanovic, and J. Roldán-Pérez</i>	1066
Dimensioning of Point Absorbers for Wave Energy Conversion by Means of Differential Evolutionary Algorithms . . . . .	<i>M. Blanco, M. Lafoz, D. Ramirez, G. Navarro, J. Torres, and L. García-Tabares</i>	1076
A Multi-time Reactive Power Optimization Under Interval Uncertainty of Renewable Power Generation by an Interval Sequential Quadratic Programming Method . . . . .	<i>C. Zhang, H. Chen, K. Shi, Z. Liang, W. Mo, and D. Hua</i>	1086
A Novel Position-Sensorless Algorithm for Field-Oriented Control of DFIG With Reduced Current Sensors . . . . .	<i>R. M. Prasad and M. A. Mulla</i>	1098
Hybrid Control of Networked Battery Systems . . . . .	<i>L. Y. Wang, F. Lin, W. Chen, Y. Jiang, and C. Zhang</i>	1109
Flow-Based Estimation and Comparative Study of Gas Demand Profile for Residential Units in Singapore . . . . .	<i>P. Gupta, T. T. T. Zan, J. Dauwels, and A. Ukil</i>	1120
A Transient Component Based Approach for Islanding Detection in Distributed Generation . . . . .	<i>R. Nale, M. Biswal, and N. Kishor</i>	1129

(Contents Continued on Page 995)



---

Hybrid Energy Sharing for Multiple Microgrids in an Integrated Heat–Electricity Energy System . . . . .	1139
Integrated Disturbance Response Modeling of Wind-Integrated Power Systems to Quantify the Operational Reliability Benefits of Flywheel Energy Storage . . . . .	1152
Enhancement of Solar Farm Connectivity With Smart PV Inverter PV-STATCOM . . . . .	1161
Real-Time Neural Inverse Optimal Control for a Wind Generator . . . . .	1172
Optimal Sizing and Operation of Battery Energy Storage Systems Connected to Wind Farms Participating in Electricity Markets . . . . .	1184
Model Order Reduction of Wind Farms: Linear Approach . . . . .	1194
Investigation of Horizontal and Vertical Wind Shear Effects Using a Wind Turbine Emulator . . . . .	1206
Optimal Design and Operation of a Low Carbon Community Based Multi-Energy Systems Considering EV Integration . . . . .	1217
Robust Two-Stage Regional-District Scheduling of Multi-carrier Energy Systems With a Large Penetration of Wind Power . . . . .	1227
Grid Synchronization of a PV System With Power Quality Disturbances Using Unscented Kalman Filtering . . . . .	1240
A Sequence-Component-Based Power-Flow Analysis for Unbalanced Droop-Controlled Hybrid AC/DC Microgrids . . . . .	1248
Hedging Strategies for Heat and Electricity Consumers in the Presence of Real-Time Demand Response Programs . . . . .	1262
Control Performance Based Dynamic Regulation Reserve Allocation for Renewable Integrations . . . . .	1271
Using the MATPOWER Optimal Scheduling Tool to Test Power System Operation Methodologies Under Uncertainty . . . . .	1280
Wind Field Reconstruction Using Inverse Process With Optimal Sensor Placement . . . . .	1290
Integrated Power and Heat Dispatch Considering Available Reserve of Combined Heat and Power Units . . . . .	1300
Adaptive Robust Backstepping Control of the Speed Regulating Differential Mechanism for Wind Turbines . . . . .	1311
Robust Voltage Control Strategy for Hybrid AC/DC Sending-Side Systems to Prevent Cascading Trip Failures . . . . .	1319
Adaptive Confidence Boundary Modeling of Wind Turbine Power Curve Using SCADA Data and Its Application . . . . .	1330
Probabilistic Analysis of PV Generation Impacts on Voltage Sags in LV Distribution Networks Considering Failure Rates Dependent on Feeder Loading . . . . .	1342
Hierarchical Anomaly Detection and Multimodal Classification in Large-Scale Photovoltaic Systems . . . . .	1351
Case Studies of Energy Grid Hybridization in a Northern European City . . . . .	1362
Direct Connection of Supercapacitor–Battery Hybrid Storage System to the Grid-Tied Photovoltaic System . . . . .	1370
Robust Model Predictive Rotor Current Control of a DFIG Connected to a Distorted and Unbalanced Grid Driven by a Direct Matrix Converter . . . . .	1380

---

---

**SPECIAL SECTION ON DYNAMIC MODELING SYSTEM IDENTIFICATION, ANALYSIS, AND CONTROL OF RENEWABLE DISTRIBUTED ENERGY RESOURCES FOR GRID INTEGRATION**

---

EDITORIAL

Introduction to the Special Section on Dynamic Modeling, System Identification, Analysis, and Control of Renewable Distributed Energy Resources for Grid Integration ..... *A. Yazdani and L. Fan* 1397

---

SPECIAL SECTION PAPERS

A State-Space Dynamic Model for Photovoltaic Systems With Full Ancillary Services Support ..... *E. I. Batzelis, G. Anagnostou, I. R. Cole, T. R. Betts, and B. C. Pal* 1399

On the Risk for Subsynchronous Control Interaction in Type 4 Based Wind Farms ..... *M. Beza and M. Bongiorno* 1410

An Iterative Control Method for Voltage Source Converters to Eliminate Uncharacteristic Harmonics Under Unbalanced Grid Voltages for High-Power Applications ..... *Y.-H. Lo, Y.-C. Chen, K. L. Lian, H. Karimi, and C.-Z. Wang* 1419

Reactive Power Synchronization Method for Voltage-Sourced Converters ..... *A. P. Asensio, S. A. Gómez, J. L. Rodriguez-Amenedo, and M. Á. Cardiel-Álvarez* 1430

Large-Signal Impedance-Based Modeling and Mitigation of Resonance of Converter-Grid Systems ..... *S. Shah, P. Koralewicz, V. Gevorgian, R. Wallen, K. Jha, D. Mashtare, R. Burra, and L. Parsa* 1439

Time-Domain Modeling of a Distribution System to Predict Harmonic Interaction Between PV Converters ..... *G. Todeschini, S. Balasubramaniam, and P. Igie* 1450

The Small-Signal Stability Analysis of the Droop-Controlled Converter in Electromagnetic Timescale ..... *R. Wang, Q. Sun, D. Ma, and Z. Liu* 1459

Harmonics and Stability Analysis of Single-Phase Grid-Connected Inverters in Distributed Power Generation Systems Considering Phase-Locked Loop Impact ..... *J. Xu, Q. Qian, B. Zhang, and S. Xie* 1470

Impedance Analysis of Virtual Synchronous Generator-Based Vector Controlled Converters for Weak AC Grid Integration ..... *A. Asrari, M. Mustafa, M. Ansari, and J. Khazaei* 1481

An Improved Damping Method for Virtual Synchronous Machines ..... *M. Ebrahimi, S. A. Khajehoddin, and M. Karimi-Ghartemani* 1491

LQR-Based Adaptive Virtual Synchronous Machine for Power Systems With High Inverter Penetration ..... *U. Markovic, Z. Chu, P. Aristidou, and G. Hug* 1501

Linear and Uniform Swing Dynamics ..... *D. Raisz, A. Musa, F. Ponci, and A. Monti* 1513

Transient Stability Assessment of Prone-to-Trip Renewable Generation Rich Power Systems Using Lyapunov's Direct Method ..... *C. Mishra, A. Pal, J. S. Thorp, and V. A. Centeno* 1523

Frequency-Domain Modal Analysis of the Oscillatory Stability of Power Systems With High-Penetration Renewables ... *Y. Zhan, X. Xie, H. Liu, H. Liu, and Y. Li* 1534

Coordination of Distributed Reactive Power Sources for Voltage Support of Transmission Networks ..... *G. Valverde, D. Shchetinin, and G. Hug-Glanzmann* 1544

A Novel Dynamic Aggregation Modeling Method of Grid-Connected Inverters: Application in Small-Signal Analysis ... *S. Liao, X. Zha, X. Li, M. Huang, J. Sun, J. Pan, and J. M. Guerrero* 1554

Evaluation Method for Equivalent Models of PMSG-Based Wind Farms Considering Randomness ..... *Z. Zheng, Z. An, and C. Shen* 1565

Data-Driven Adaptive Control for Distributed Energy Resources ..... *L. Cupelli, M. Cupelli, F. Ponci, and A. Monti* 1575

Distribution System Parameter and Topology Estimation Applied to Resolve Low-Voltage Circuits on Three Real Distribution Feeders ..... *M. Lave, M. J. Reno, and J. Peppanen* 1585

Hardware- and Software-in-the-Loop Simulation for Parameterizing the Model and Control of Synchronous Condensers ..... *H. T. Nguyen, G. Yang, A. H. Nielsen, and P. H. Jensen* 1593

Design and Stability Analysis of DC Microgrid With Hybrid Energy Storage System ..... *S. Kotra and M. K. Mishra* 1603

SDN-Enabled Cyber-Physical Security in Networked Microgrids ..... *Y. Li, Y. Qin, P. Zhang, and A. Herzberg* 1613

---