

Lecture Notes in Electrical Engineering 607

Akhtar Kalam
Khaleequr Rehman Niazi
Amit Soni
Shahbaz Ahmed Siddiqui
Ankit Mundra *Editors*

Intelligent Computing Techniques for Smart Energy Systems

Proceedings of ICTSES 2018

 Springer

Contents

LED Driver Design and Thermal Management	1
Aniruddha Mukherjee, Amit Soni and Mukesh Gupta	
Automatic Generation Control of Interconnected Power Systems Using Elephant Herding Optimization	9
S. S. Dhillon, Surabhi Agarwal, Gui-Ge Wang and J. S. Lather	
Use of Ti-Doped Hafnia in Photovoltaic Devices: Ab Initio Calculations	19
Ushma Ahuja, Deepika Mali, Kishor Kumar and Amit Soni	
Electronic and Optical Response of Photovoltaic Semiconductor ZrS_2Te_{2-x}	25
Deepika Mali, Kishor Kumar and B. L. Ahuja	
Investigation of Optical Response of Silver Molybdate for Photovoltaic	31
Seema Kumari Meena and B. L. Ahuja	
Comparative Analysis of Conventional and Meta-heuristic Algorithm Based Control Schemes for Single Link Robotic Manipulator	39
Aishwarya Varma, Shailu Sachan, Pankaj Swarnkar and Savita Nema	
Synthesis of Antenna Array Pattern Using Ant Lion Optimization Algorithm for Wide Null Placement and Low Dynamic Range Ratio	47
Prerna Saxena, Ashwin Kothari and Saurabh Saxena	
Design and Analysis of a Hybrid Non-volatile SRAM Cell for Energy Autonomous IoT	57
Kanika, Nitin Chaturvedi and S. Gurunarayanan	

vii

Contents	ix
Risk-Averse G2V Scheduling of Electric Vehicle Aggregator for Improved Market Operations	195
S. Sharma, P. Jain and P. P. Gupta	
Optical Gain Tuning in Type-I $Al_{0.45}Ga_{0.25}As/GaAs_{0.84}P_{0.16}/Al_{0.45}Ga_{0.55}As$ Nano-heterostructure	205
Md. Riyaj, Sushil Kumar, P. A. Alvi and Amit Rathi	
Semantic Similarity Computation Among Hindi Words Using Hindi Lexical Ontology	211
Yogesh Gupta and Amit Saraswat	
A Dual-Band Microstrip Patch Antenna for Wireless Applications	219
P. Kumar	
Analysis of Energy Consumption and Implementation of R-Statistical Programming for Load Forecasting in Presence of Solar Generation	227
S. K. Singh, Harsh Vikram Singh, S. Chakrabarti and S. N. Singh	
A Comprehensive Analysis of Delta and Adaptive Delta Modulated Modular Multilevel Converter	239
Rahul Jaiswal, Anshul Agarwal and Vineeta Agarwal	
Speed Control of PMSM Drive Using Jaya Optimization Based Model Reduction	247
Akhilesh K. Gupta, Paulson Samuel and Deepak Kumar	
Jaya Optimization-Based PID Controller for Z-Source Inverter Using Model Reduction	257
Akhilesh K. Gupta, Paulson Samuel and Deepak Kumar	
Stability Analysis of an Offshore Wind and Marine Current Farm in Grid Connected Mode Using SMES	269
Satendra Kr Singh Kushwaha, S. R. Mohanty and Paulson Samuel	
Modeling and Simulation of Proton Exchange Membrane Fuel Cell Hybrid Electric Vehicle	281
Bandi Mallikarjuna Reddy and Paulson Samuel	
Optimum Performance of Carbon Nanotube Field-Effect Transistor Based Sense Amplifier D Flip-Flop Circuits	293
Komal Swami and Ritu Sharma	
Flower Pollination Based Solar PV Parameter Extraction for Double Diode Model	303
J. Prasanth Ram, Dhanup S. Pillai, N. Rajasekar and V. Kumar Chinnaiyan	

Bandgap Engineering of $AgGaS_2$ for Optoelectronic Devices: First-Principles Computational Technique	67
Maneesha Purohit, Seema Kumari Meena, Alpa Dashora and B. L. Ahuja	
Intelligent Power Sharing Control for Hybrid System	75
Preeti Gupta and Pankaj Swarnkar	
Comparative Analysis of Various Classifiers for Gesture Recognition	85
Rahul Gupta, Sarthak Rana, Swapnil Gupta, Kavita Pandey and Chetna Dabas	
Artificial Intelligence Based Optimization Techniques: A Review	95
Agrani Swarnkar and Anil Swarnkar	
Optimal Location and Sizing of Microgrid for Radial Distribution Systems	105
Shalaka N. Chaphekar, Anandkumar Nale, Anjali A. Dharma and Nitant Mate	
Constraint Tariff Model to Reduce the Amount of Cross Subsidy Incorporated in Electricity Tariff Using Iterative Optimization Technique	115
Varada J. Tambe and S. K. Joshi	
Tilration Machine: A New Approach Using Arduino	125
Vijayalaxmi, S. H. Ashwin and S. V. Harish	
Hybrid Method for Cluster Analysis of Big Data	133
Chetna Dabas and Gaurav Kumar Nigam	
A New Radio Frequency Harvesting System	141
Syed Mahmood Ali Mahboob, Shaik Qadeer and Ajaz Fatima	
Backpropagation Algorithm-Based Approach to Mitigate Soiling from PV Module	153
Sujit Kumar and Vikramaditya Dave	
Real-Time Low-Frequency Oscillations Monitoring and Coherency Determination in a Wind-Integrated Power System	163
Abhilash Kumar Gupta, Kusum Verma and K. R. Niazi	
Design and Performance Analysis of Different Structures of MEMS PVDF-Based Low-Frequency Piezoelectric Energy Harvester	173
Namrata Saxena, Varshali Sharma, Ritu Sharma, K. K. Sharma and Santosh Chaudhary	
Designing and Implementation of Overhead Conductor Altitude Measurement System Using GPS for Sag Monitoring	183
Sangeeta Kamboj and Ratna Dahiya	

Contents	ix
Cost-Benefit Calculation Using AB_2X_4 ($A = Zn, Cd; B = Ga; X = Te$): A Promising Material for Solar Cells	313
Pancham Kumar, Amit Soni and Jagrati Sahariya	
Detection and Analysis of Power System Faults in the Presence of Wind Power Generation Using Stockwell Transform Based Median	319
Sheesh Ram Ola, Amit Saraswat, Sunil Kumar Goyal, S. K. Jhajharia and Om Prakash Mahela	
A Directional Relaying Scheme for Microgrid Protection	331
Ruchita Nale, Ruchi Chandrakar, Harishankar Verma and Monalisa Biswal	
Wavefunctions and Optical Gain in $In_{0.24}Ga_{0.76}N/GaN$ Type-I Nano-heterostructure Under External Uniaxial Strain	341
Md. Riyaj, Amit Kumar Singh, P. A. Alvi and Amit Rathi	
Cost-Benefit Analysis in Distribution System of Jaipur City After DG and Capacitor Allocation	351
Ankush Tandon, Sarfaraz Nawaz and Shahbaz Ahmed Siddiqui	
Comparative Simulation Study of Dual-Axis Solar Tracking System on Simulink Platform	359
Neeraj Tiwari, Ravi Soni, Amit Saraswat and Brijesh Kumar	
Performance Evaluation and Quality Analysis of Line and Node Based Voltage Stability Indices for the Determination of the Voltage Instability Point	367
Pradeep Singh, Jyotsna Singh and Rajive Tiwari	
Channel Estimation in Massive MIMO with Spatial Channel Correlation Matrix	377
Bijoy Kumar Mandal and Ankita Pramanik	
A New Array Reconfiguration Scheme for Solar PV Systems Under Partial Shading Conditions	387
Malisetty Siva Sai Nihanth, N. Rajasekar, Dhanup, S. Pillai and J. Prasanth Ram	
Adaptability Analysis of Particle Swarm Optimization Variants in Maximum Power Tracking for Solar PV Systems	397
B. G. Dharshan, N. Rajasekar and R. Srinivasa Sankarkumar	
Fault Location Methods in HVDC Transmission System—A Review	411
Jay Prakash Keshri and Harpal Tiwari	

Optimal Reactive Power Dispatch Through Minimization of Real Power Loss and Voltage Deviation	421
Ravi Ucheniya, Amit Saraswat and Shahbaz Ahmed Siddiqui	
IoT Enabled Intelligent Energy Management and Optimization Scheme with Controlling and Monitoring Approach in Modern Classroom Applications	431
Vidyalhar Aski, Rajveer Singh Shekhawat, Sushant Mehta, Pratik Kr. Jain and Prachal Goyal	
High Power Density Parallel LC-Link PV Inverter for Stand-alone and Grid Mode of Operation	441
Rudra Santhosh Kumar Athikamsetti and Safish Kumar Gudey	
A Hybrid Forecasting Model Based on Artificial Neural Network and Teaching Learning Based Optimization Algorithm for Day-Ahead Wind Speed Prediction	455
Madasthu Santhosh, Chintham Venkaiah and D. M. Vinod Kumar	
Risk Averse Energy Management for Grid Connected Microgrid Using Information Gap Decision Theory	465
Tanuj Rawat and K. R. Niazi	
Power Quality Improvement of Microgrid Using Double Bridge Shunt Active Power Filter (DBSAPF)	475
Rajesh Kumar Meena, Dheeraj Kumar, Vinay Kumar Jadoun and Saurabh Kumar Pandey	
Opposition Theory Enabled Intelligent Whale Optimization Algorithm	485
Prateek Jain, Pooja Jain and Akash Saxena	
Adaptive Inertia-Weighted Firefly Algorithm	495
Shailja Sharma, Pooja Jain and Akash Saxena	
A Review of Scheduling Techniques and Communication Protocols for Smart Homes Capable of Implementing Demand Response	505
Gurpinder Singh, Anil Swarnkar, Nikhil Gupta and K. R. Niazi	
A Robust Open-Loop Frequency Estimation Method for Single-Phase Systems	515
Anant Kumar Verma, C. Subramanian and R. K. Jarial	
Demand-Side Load Management for Peak Shaving	525
Shailendra Baraniya and Manoj Sankhe	
A New Line Voltage Stability Index (NLVSI) For Voltage Stability Assessment	535
Trinadha Burle, V. V. S. Bhaskara Reddy Chintapalli and Phanindra Thota	

Color Image Watermarking with Watermark Hashing	673
Neha Singh, Sandeep Joshi and Shilpi Birla	
Global Neighbourhood Algorithm Based Event-Triggered Automatic Generation Control	683
Pankaj Dahiya, Pankaj Mukhija and Anmol Ratna Saxena	
A Review on Voltage and Frequency Control of Micro Hydro System	693
Priya Singh Bhakar, Saumendra Sarangi and Kirti Gupta	
Performance Analysis of Solar and Plug-in Electric Vehicle's Integration to the Power System with Automatic Generation Control	703
Subhranshu Sekhar Pati, Tapas Kumar Panigrahi and Aurobindo Behera	
A Bibliographical View on Research and Developments of Photovoltaic and Thermal Technologies as a Combined System: PV/T System	713
Anmol Gupta, Sourav Diwania, Sanjay Agrawal, Anwar S. Siddiqui and Yash Pal	
UPM-NoC: Learning Based Framework to Predict Performance Parameters of Mesh Architecture in On-Chip Networks	723
Anil Kumar and Basavaraj Talawar	
Comparison of Performance Analysis of Optimal Controllers for Frequency Regulation of Three-Area Power System	735
Preeti, Vivek Shrivastava, Vikas Singh Bhadoria and Harish Pulluri	
Optimal DG Allocation in a Microgrid Using Droop-Controlled Load Flow	745
Ankit Uniyal and Saumendra Sarangi	
A Comparative Study of Classification Algorithms for Predicting Liver Disorders	753
Rashi Bhardwaj, Rajat Mehta and Prakash Ramani	
Performance Analysis of Fabricated Buck-Boost MPPT Charge Controller	761
Neeraj Tiwari, Amit Saraswat, Ravi Soni and Suchi Rawat	
Performance Improvement of Cycloconverter Fed Induction Machine Using Shunt Active Power Filter	769
Vishnu Goyal and Sulochana Wadhawani	
Comparative Analysis of Speaker Recognition System Based on Voice Activity Detection Technique, MFCC and PLP Features	781
Akanksha Kalia, Shikar Sharma, Saurabh Kumar Pandey, Vinay Kumar Jadoun and Madhulika Das	

A Comprehensive Comparative Economic Analysis of ACO and CS Technique for Optimal Operation of Stand-alone HES	549
Sri Lakshmi E and S. P. Singh	
Demand Response in Distribution Systems: A Comprehensive Review	565
Bhuvan Sharma, Nikhil Gupta, K. R. Niazi and Anil Swarnkar	
Stochastic Operational Management of Grid-Connected Microgrid Under Uncertainty of Renewable Resources and Load Demand	573
Sonam Parashar, Anil Swarnkar, K. R. Niazi and Nikhil Gupta	
Real-Time High-Speed Novel Data Acquisition System Based on ZYNQ	583
Himanshu Tyagi, Nagendra P. Gajjar, Mainak Bandyopadhyay and Arun Chakraborty	
Exergetic Analysis of Glazed Photovoltaic Thermal (Single-Channel) Module Using Whale Optimization Algorithm and Genetic Algorithm	591
Sourav Diwania, Anmol Gupta, Anwar S. Siddiqui and Sanjay Agrawal	
An 8-Bit Charge Redistribution SAR ADC	601
Yahya Mohammed Ali Al-Naamani, K. Lokesh Krishna and A. Krishna Mohan	
Analysis of Triple-Threshold Technique for Power Optimization in SRAM Bit-Cell for Low-Power Applications at 45 Nm CMOS Technology	611
Sudershan Kumar, Shaifali Ruhlil, Neeraj KR. Shukla and Shilpi Birla	
Low Power Adder Circuits Using Various Leakage Reduction Techniques	619
Shreya Upadhyay, Sugandha Tiwari, Shilpi Birla and Neha Singh	
A Nature-Inspired Metaheuristic Swarm Based Optimization Technique BFOA Based Optimal Controller for Damping of SSR	631
Rajeev Kumar, Rajveer Singh and Haroon Ashfaq	
New Fuzzy Divergence Measures, Series, Its Bounds and Applications in Strategic Decision-Making	641
Ram Nareesh Saraswat and Neha Khatod	
Mutual Coupling Reduction of Biconvex Lens Shaped Patch Antenna for 5G Application	655
Ribhu Abhusan Panda, Udit Narayan Mohapatra and Debasis Mishra	
Analysis of Anti-Islanding Protection Methods Integrated in Distributed Generation	663
Vikram Singh, Manoj Fozdar, Ajeet Kumar Singh and Satyendra Singh	

Nonintrusive Load Monitoring: Making Smart Meters Smarter	789
DeepRaj Bedi and Vineet Sharma	
Stabilization of Chaotic Systems Using Robust Optimal Controller	795
Madhulika Das and Vinay Kumar Jadoun	
Jaya Algorithm Based Optimal Allocation of Distributed Energy Resources	805
Manoj Kumawat, Nitin Gupta, Naveen Jain and R. C. Bansal	
Bayesian Game Model: Demand Side Management for Residential Consumers with Electric Vehicles	815
Akash Talwariya, Santosh Kumar Sharama, Pushpendra Singh and Mohan Kolhe	
Classification of Power System Disturbances Using Support Vector Machine in FPGA	825
Vivek Patel	
Designing a Smart System for Air Quality Monitoring and Air Purification	837
Palak Gandhi, Kartik Upadhyay, Ashwani Kumar Yadav and Vaishali	
Activation Map Networks with Deep Graphical Model for Semantic Segmentation	845
Cheruku Sandesh Kumar, Ratnadeep Roy, Sanyog Rawat and Archeek Praveen Kumar	
Grey Wolf Optimized PI Controller for Hybrid Power System Using SMES	853
Sandeep Bhongade and Ritu Verma	
JAYA-Evaluated Frequency Control Design for Hydroelectric Power System Using RFB and UPFC	863
Akhilesh Panwar, Gulshan Sharma, Ibraheem Nasiruddin and R. C. Bansal	
A Human Face-Shaped Microstrip Patch Antenna for Ultra-Wideband Applications	873
Anandhi Dharmarajan, Pradheep Kumar and Thomas J. O. Afullo	
Scheduling Energy Storage to Provide Balancing During Line Contingency at High Wind Penetration	881
Bal Krishna, Anjali Jain and Ajay Bharadwaj	
Multilevel Inverter Topologies in Renewable Energy Applications	891
Prakash Kumar, Manjeet Kour, Sunil Kumar Goyal and Bhuvan Pratap Singh	

A Review on Demand Side Management Forecasting Models for Smart Grid	903
Sweta Singh and Neeraj Kanwar	
Detection of Suspicious Activity in ATM Booth	911
Anjali Saini, Mushtaq Ahmed and Kartikey Sharma	
Mitigation of Power Quality for Wind Energy Using Transmission Line Based on D-STATCOM	927
Sourabh Kumar Jain and Amit Soni	
Performance Evaluation of Solar Power Plant	937
Amit Rai, Ashish Shrivastava and K. C. Jana	
GWO Based PID Controller Optimization for Robotic Manipulator	943
Sandeep Tripathi, Ashish Shrivastava and K. C. Jana	
A 26 W Power Supply Based on Luo Converter with Improved Power Factor and Total Harmonic Distortion	953
Amit Agrawal, Ashish Shrivastava, Amit Rai and K. C. Jana	
Optimal Strategic Bidding Using Intelligent Gravitational Search Algorithm for Profit Maximization of Power Suppliers in an Emerging Power Market	963
Satyendra Singh, Manoj Fozdar and Ajeet Kumar Singh	
Synchrophasor Measurements Assisted Naïve Bayes Classification Based Real-Time Transient Stability Prediction of Power System	973
Divya Rishi Shrivastava, Shahbaz Ahmed Siddiqui and Kusum Verma	
Device Modeling and Characteristics of Solution Processed Perovskite Solar Cell at Ambient Conditions	981
Anupam Agrawal, Shahbaz Ahmed Siddiqui, Amit Soni and Ganesh D. Sharma	
Control and Remote Sensing of an Irrigation System Using ZigBee Wireless Network	989
Jay Praful Chheda and Vikash Kumar Boradak	
Analysis and Classification of Maximum Power Point Tracking (MPPT) Techniques: A Review	999
Bhuwan Pratap Singh, Sunil Kumar Goyal and Shahbaz Ahmed Siddiqui	
A Study and Comprehensive Overview of Inverter Topologies for Grid-Connected Photovoltaic Systems (PVS)	1009
Bhuwan Pratap Singh, Sunil Kumar Goyal, Shahbaz Ahmed Siddiqui and Prakash Kumar	

IOT Based Smart Writer	1019
Chirag Agarwal and Bhawna Singh	
Design and Implementation of Arduino Based Control System for Power Management of Household Utilities	1025
Mahipal Bukya, Aayush Bajaj, Peeyush Garg and Amit Saraswat	
Interfacing Python with DigSILENT Power Factory: Automation of Tasks	1033
Divya Rishi Shrivastava, Shahbaz Ahmed Siddiqui and Kusum Verma	
Recent Development in Perovskite Solar Cell Based on Planar Structures	1039
Anupam Agrawal, Shahbaz Ahmed Siddiqui, Amit Soni and Ganesh D. Sharma	

Scheduling Energy Storage to Provide Balancing During Line Contingency at High Wind Penetration



Bal Krishna, Anjali Jain and Ajay Bharadwaj

Abstract Decarbonization of electrical sector increases the penetration of nonfossil fuel-based energy resources in power system. These resources are intermittent in nature which result in frequent demand–supply imbalance. Moreover, operational constraints of conventional generating units and technical limits of network restrict required amount of balancing from supply side. This necessitates the integration of flexible resources to increase system reliability by reducing gap between demand and supply. In this context, a battery energy storage system is integrated as flexible resource. This framework is modeled on RTS-24 bus system with 40% wind penetration using mix-integer linear programming (MILP). A security-constrained unit commitment (SCUC) is performed with (N-1) line contingency. This results in improved demand–supply balance along with reduced wind curtailment.

Keywords Energy storage · Load following · Microgrid · Outage mitigation · Uncertainty

Nomenclature

Sets and Indices

$u \in U$	Dispatchable Generating Units
T	Set for time interval indexed by t
b, n	Index for bus, node
$w \in W$	Wind units
$s \in ST$	Storage units

B. Krishna · A. Bharadwaj
Swami Keshvanand Institute of Technology, Management and Gramothan, Jaipur, India
e-mail: research.balkrishna@gmail.com

A. Jain (✉)
Malaviya National Institute of Technology, Jaipur, India
e-mail: anjalijain025@gmail.com

© Springer Nature Singapore Pte Ltd. 2020
A. Kalam et al. (eds.), *Intelligent Computing Techniques for Smart Energy Systems*,
Lecture Notes in Electrical Engineering 607,
https://doi.org/10.1007/978-981-15-0214-9_93