

11th IFAC Symposium on Control of Power and Energy Systems (CPES 2022)

IFAC PapersOnline Volume 55, Issue 9

Online
21 – 23 June 2022

Editor:

Yrjo Majanne

ISBN: 978-1-7138-5937-6

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

To the extent permissible under applicable laws, no responsibility is assumed by the Owner, the Publisher or the Licensee for any injury and/or damage to persons or property as a result of any actual or alleged libelous statements, infringement of intellectual property or privacy rights, or products liability, whether resulting from negligence or otherwise, or from any use or operation of any ideas, instructions, procedures, products or methods contained in the material therein.

The publication of an advertisement in the POD Edition does not constitute on the part of the Owner, the Publisher or the Licensee a guarantee or endorsement of the quality or value of the advertised products or services described therein or of any of the representations or the claims made by the advertisers with respect to such products or services.

Copyright© (2022) by IFAC (International Federation of Automatic Control)
All rights reserved.

Printed with permission by Curran Associates, Inc. (2022)

For permission requests, please contact the publisher, Elsevier Limited
at the address below.

Elsevier Limited
The Boulevard, Langford Lane
Kidlington
Oxford OX5 1GB UK

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
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

Energy Technologies for Decarbonizing the Steel Processing Industry – a Numerical Study 1 <i>Tobias Goschin, Mathias Vogel, Robert Flassig</i>	1
Scenarios for Future Power System Development in Finland 6 <i>Y. Majanne, T. Björkqvist, M. Vilkkö</i>	6
Automatic Emergency Load Control of Electric Power Systems: Trends, New Solutions, Problems 12 <i>N. I. Voropai, M. V. Chulyukova, A. A. Petrov</i>	12
Estimation of Operating Parameters in Power Grids with Distributed Generation Based on Discriminator Methods 18 <i>Pavel V. Ilyushin, Aleksander L. Kulikov, Konstantin V. Suslov, Sergey P. Filippov</i>	18
Monitoring the Compliance of Balancing Reserves Power with the System Operation * Guideline of Continental Europe..... 24 <i>Philipp Maucher, Hendrik Lens</i>	24
Control Aspects of the Interzonal Exchange of Automatic Frequency Restoration Reserves 30 <i>Philipp Maucher, Simon Remppis, Dominik Schlipf, Hendrik Lens</i>	30
Phasor Measurement Unit Based Local Fault Detection in Distribution Systems..... 36 <i>Márton Greber, Attila Fodor, Attila Magyar</i>	36
Simultaneous Frequency and Amplitude Estimation for Grid Quality Monitoring: New Partitioning with Memory Based Newton-Schulz Corrections 42 <i>Alexander Stotsky</i>	42
Phase Current Estimation Based Shunt Active Power Compensation..... 48 <i>Márton Greber, Attila Fodor, Attila Magyar</i>	48
Online Koopman Mode Decomposition for Power System Synchrophasor Data 54 <i>Yoshihiko Susuki, Takahiro Shimomura, Yutaka Ota, Atsushi Ishigame</i>	54
Modeling Investment Decisions to Increase Renewable Generation..... 59 <i>Valery K. Akinfiev, Oleg I. Dranko</i>	59
The Growth Assessment of Renewable Energy in Russia: The Retrospective Analysis 64 <i>Oleg I. Dranko, Marina M. Dvoryashina, Yevgeniy V. Blagodarnyy</i>	64
Evaluation of the Symmetrically Switched Converter Structures on the Frequency Regulation of Standalone Micro Hydro Power Plants..... 70 <i>H. Bory, L. Vazquez, H. Martínez, Y. Majanne</i>	70
An Approach to Stabilizing the Dynamic Loads of a Wind Turbine Generator Based on the Control of the Blades Setting Angle 76 <i>Svetlana Solodusha, Konstantin Suslov</i>	76
Advanced Management of Network Overload in Areas with Renewable Energies Sources..... 81 <i>Thanh-Hung Pham, Alessio Iovine, Sorin Olaru, Jean Maeght, Manuel Ruiz</i>	81
Solar Microsystem Modeling and Simulation: Photovoltaic Inverter Control Based on Energy Technical Product Quality Criteria..... 87 <i>F. Grau, L. Vazquez, J. Cervantes, Y. Majanne</i>	87

Artificial Neural Network-Based Flexibility Assessment of the Electric Power System with High Wind Energy Penetration	93
<i>E. Aksaeva, A. Glazunova</i>	
Trajectory Tracking of Robotic Arm Based on Power Regulation of Actuator Using Neural Averaged Subgradient Control	99
<i>A. Hernandez-Sanchez, C. Mireles-Perez, A. Poznyak, O. Andrianova, I. Chairez</i>	
Indirect Acceleration Tracking of Robotic Arm by Power Regulation of Actuator Using Averaged Subgradient Control.....	105
<i>A. Hernandez-Sanchez, C. Mireles-Perez, A. Poznyak, O. Andrianova, I. Chairez</i>	
An Office Building Power Consumption Dataset for Energy Grid Analysis and Control Algorithms	111
<i>Nikolay I. Bazhenkov, Sergey V. Dushin, Mikhail V. Goubko, Vsevolod O. Korepanov, Alla G. Shinkaryuk</i>	
Detection of Oil Pipelines' Heat Loss Via Machine Learning Methods	117
<i>A. Yu. Vladova, Yu. R. Vladov</i>	
Behavior Trees for Smart Grid Control	122
<i>A. V. Perger, P. Gamper, R. Witzmann</i>	
Accelerated Algorithm for Calculating Gramians of Bilinear Models of Electric Power Systems	128
<i>Alexey B. Iskakov, Dmitry E. Kataev, Evgeny Yu. Kutyaev, Igor B. Yadykin</i>	
Optimal Adaptive Control of Electromechanical Oscillations Modes in Power Systems	134
<i>I. B. Yadykin, N. V. Tomin, A. B. Iskakov, I. A. Galyaev</i>	
Grid-Forming Converter Current Limiting Design to Enhance Transient Stability for Grid Phase Jump Events	140
<i>Xianxian Zhao, Damian Flynn</i>	
Coordinate-Wise Prescribed-Time Stabilization in Block Control Form.....	146
<i>Vadim Utkin, Yury Orlov</i>	
Selective LQ Wide Area Damping of Power Networks Based on the Spectral Decomposition of Gramians	152
<i>Alexey B. Iskakov, Nikita V. Tomin, Igor B. Yadykin, Daniil A. Panasetsky, Nikolai I. Voropai</i>	
Real-Time Data-Driven Electromechanical Oscillation Monitoring Using Dynamic Mode Decomposition with Sliding Window	158
<i>Orlando Delgado Fernández, Sini Tiistola, Azwirman Gusrialdi</i>	
A Neuro-Adaptive Control Scheme to Improve Dynamic Stability of Wind Power System Using Battery Energy Storage.....	164
<i>Faisal Jamsheed, Sheikh Javed Iqbal</i>	
A Review of World-Wide Advanced Pumped Storage Hydropower Technologies.....	170
<i>Jing-Feng Zhao, Ung-Jin Oh, Joo-Chang Park, Eun Seong Park, Jae-Seok Choi</i>	
Autonomous Frequency Regulation of a Grid-Following Converter Powered by Battery Energy Storage System	175
<i>Changwoo Yoon, Young-Il Lee, Yong Cheol Kang</i>	
Management of Compressed Air Production at an Industrial Enterprise According to Technical and Economic Criteria.....	181
<i>A. Tsvirkun, V. Kushnikov, A. Bogomolov, A. Selyutin, E. Kushnikova</i>	

Analysis of Flow Factor Control Strategy in Vanadium Redox Flow Batteries.....	187
<i>Sergei Parsegov, Mikhail Pugach, Andrey Polyakov, Federico Ibáñez</i>	
Analytic Steady State Solution for Interfacial Overpotential Distribution in Li-Ion Battery and Degradation Prognosis.....	193
<i>Hyeonjang Pyeon, Huiyong Chun, Kwanwoong Yoon, Jangwoo Lee, Soohee Han</i>	
Applying the Principles of Cyber-Physical Management to Enhance Cybersecurity of the Demand Response Aggregator Structure	198
<i>I. Kolosok, E. Korkina</i>	
Some Aspects of Intelligent Human-Operators Decision Support Systems for NPP	204
<i>Elena Jharko, Ekaterina Abdulova, Kirill Chernyshov</i>	
Application of Probabilistic Reasoning for Risk Assessment and Mitigation in Hydrocarbon Field Development	210
<i>Alena Zakharova, Aleksandr Podvesovskii</i>	
Informational Task “Calculation of Technical and Economic Indicators” NPP I&C ULCS and Risk Potential Assessment	216
<i>Elena Jharko, Ekaterina Abdulova</i>	
Authentication Model for Mobile Access Subjects	222
<i>Andrey Y. Iskhakov, Anastasia O. Iskhakova, Roman V. Meshcheryakov, Anton M. Smirnov</i>	
Practical Method of the I&C System Security Architecture Design Using Graph Models	227
<i>Vitaly G. Promyslov, Kirill V. Semenov, Georgy V. Promyslov</i>	
On Cybersecurity Risk Assessment in Nuclear Power Systems.....	233
<i>A. A. Baybulatov, V. G. Promyslov</i>	
A Cybersecurity Risk Assessment Method and Its Application for Instrumentation and Control Systems in Nuclear Power Plants	238
<i>Y. Tian, J. Li, X. Huang</i>	
Comparison of the Effectiveness of Countermeasures Against Tracking User Browser Fingerprints	244
<i>Alexander A. Salomatin, Andrey Yu. Iskhakov, Roman V. Meshcheryakov</i>	
Optimization of the Structure of Power System Multi-Agent Control	250
<i>A. Domyshchev, D. Sidorov</i>	
Development of a Day-Ahead Demand Side Management Strategy to Improve the Microgrid Efficiency	256
<i>A. Glazunova</i>	
Approximate Dynamic Programming Decompositions for Economic Dispatch in Microgrids	262
<i>Mikhail V. Goubko, Nikita I. Shushko</i>	
Sequential Convex Optimization for the Dynamic Optimal Power Flow of Active Distribution Networks	268
<i>Simon Sepulveda, Alejandro Garces, Juan Mora-Flórez</i>	
Bilevel Optimization Based on Building Dynamic Flexibility Capacity in Microgrid.....	274
<i>Zhigang Zhang, Hervé Guéguen</i>	
Energy Management System of Microgrid Using Optimization Approach.....	280
<i>Jigar S. Sarda, Kwang Lee, Hirva Patel, Nishita Patel, Dhairya Patel</i>	

Energy Community Consumption and Generation Dataset with Appliance Allocation.....	285
<i>Calvin Goncalves, Ruben Barreto, Pedro Faria, Luis Gomes, Zita Vale</i>	
Comparison of PV Power Generation Forecasting in a Residential Building Using ANN and DNN.....	291
<i>Inês Tavares, Ricardo Manfredini, José Almeida, João Soares, Zita Vale</i>	
Classification of New Active Consumers Performance According to Previous Events Using Decision Trees.....	297
<i>Cátia Silva, Pedro Faria, Zita Vale</i>	
Retail Electricity Tariffs for Electric Vehicles in Europe: A Multivariate Analysis in 4 European Countries.....	303
<i>D. R. Bairrão, J. Soares, B. Canizes, F. Lezama, Z. Vale</i>	
CECOS: A Centralized Management Platform Supported by Distributed Services to Represent and Manage Resources Aggregation Entities and Its End-Users in a Smart Grid Context.....	309
<i>Helder Pereira, Bruno Ribeiro, Luís Gomes, Zita Vale</i>	
Flexible Object-Oriented Modelling for the Control of Large Gas Networks.....	315
<i>Matteo Luigi De Pascali, Simone Bosotti, Paolo Curatolo, Lavinia Marina Paola Ghilardi, Roberto Palazzo</i>	
A MILP Approach for the Operational Optimization of Gas Networks.....	321
<i>Lavinia Marina Paola Ghilardi, Matteo Luigi De Pascali, Francesco Casella, Daniele Barbati, Emanuele Martelli</i>	
Comparison Study of Power Supplies in Real-Time Robust Control Systems of Vertical Plasma Position in Tokamak.....	327
<i>Artem E. Konkov, Yuri V. Mitrishkin</i>	
Direct Current Motor Position Control by a Sliding Mode Controlled Dual Three-Phase AC-DC Power Converter.....	333
<i>Isaac Chairez, Vadim Utkin</i>	
Control of Photovoltaic System Connected Directly to the Grid by a 3-Phase BOOST Inverter.....	339
<i>Maurice Fadel, Tri Desmana Rachmildha</i>	
Adaptive Controller for a Synchronous Generator Via Sliding Mode.....	344
<i>Alejandro Alvarez Canabal, Victor A. Utkin, Alexander G. Loukianov, Jose Manuel Cañedo</i>	
A Review and Comparison of Current Trends in Virtual Synchronous Generator's Models.....	350
<i>Alisher B. Askarov, Aleksey A. Suvorov, Mikhail V. Andreev, Alexander S. Gusev</i>	
Mechanism Design of Incentive Retail Electricity Prices.....	356
<i>N. Aizenberg, E. Stashkevich</i>	
Investigation of New Prosumer Peer-To-Peer Decisions into Energy Community Integration.....	362
<i>Aleksei Rozhnov</i>	
Comprehensive Mechanism for Four-Level Energy Cost Control.....	366
<i>Vladimir V. Tsyganov</i>	
Organizational Mechanisms to Promote Energy Efficiency.....	372
<i>A. Enaleev</i>	
A Gaming Laboratory for Understanding Strategic Behavior in Power Markets.....	378
<i>Vsevolod Korepanov, David Pozo, Nikolay Korgin</i>	

TECHNO-ECONOMIC ANALYSIS OF EXCESS WIND ENERGY UTILITZATION IN THE ENERGY SUPPLY OF RESIDENTIAL QUARTERS	384
<i>Mathias Vogel, Tobias Goschin, Robert Flassig</i>	
A Robust Economic Load Dispatch in Community Microgrid Considering Incentive-Based Demand Response	389
<i>Yutaka Sasaki, Makoto Ueoka, Yuki Uesugi, Naoto Yorino, Mumbere Samuel Kihembo</i>	
COMPONENT BASED AGGREGATE LOAD MODELLING OF MODERN LOADS	395
<i>Pradip Neupane, Bishal Silwal, Sagun Katuwal, Brijesh Adhikary</i>	
Service Restoration in Distribution Networks Using Available Data Including Uncertainty	401
<i>Hirota Takano, Junichi Murata, Kazuki Morishita, Hiroshi Asano</i>	
Robust Optimization for Network Decomposition of VQC with Scatter-Search-Predator-Prey Brain Storm Optimization	407
<i>Shota Ogawa, Hiroyuki Mori</i>	
Optimal Power Flow Considering Global Voltage Stability Based on a Hybrid Modern Heuristic Technique	413
<i>Wenlei Bai, Kwang Y. Lee, Ibrahim Eke</i>	
Electrocardiographically Signal Simulator Based on a Sliding Mode Controlled Buck DC-DC Power Converter	419
<i>Isaac Chairez, Vadim Utkin</i>	
Grid-Forming Converter Angular Speed Freezing to Enhance Transient Stability in 100% Grid-Forming and Mixed Power Systems	425
<i>Xianxian Zhao, Damian Flynn</i>	
Genetic Algorithm Applied to State-Feedback Control Design of Grid and Circulating Current in Modular Multilevel Converters	431
<i>Rashad Ghassani, Antoneta Iuliana Bratcu, Remus Teodorescu</i>	
Practical Implementation Method of Reinforcement Learning for Power Converter	437
<i>Soonhyung Kwon, Changwoo Yoon, Young-Il Lee</i>	
Latched Limit Strategy for Single-Phase Synchronous Inverter for Realization of Designed Grid Forming Performance	442
<i>Shinya Sekizaki, Naoto Yorino, Yutaka Sasaki, Yoshifumi Zoka, Ichiro Nishizaki</i>	
Flexible Parameterizable Grid-Forming Converter Control by Separated Fast Synchronization and Slow Inertia Response Control Loops of Direct Voltage Control	448
<i>Mahshid Maherani, Jens Denecke, Hendrik Vennegeerts</i>	
Development of an Ontology for Smart Distributed Energy Systems *	454
<i>Fedor S. Nepsha, Alexei A. Nebera, Alexander A. Andrievsky, Mikhail I. Krasilnikov</i>	
Distributed Energy Resources Management: From Digital Twin to Digital Platform	460
<i>Serge P. Kovalyov</i>	
Neuro-Fuzzy Digital Twin of a High Temperature Generator	466
<i>William Chicaiza Salazar, Diogo Ortiz Machado, Antonio Javier Gallego Len, Juan Manuel Escaño Gonzalez, Julio Elias Normey-Rico</i>	
Using a Computer Simulator to Create a Digital Model of a CCGT Power Unit	472
<i>E. K. Arakelyan, A. V. Andryushin, S. V. Mezin, F. F. Pashchenko, A. A. Kosoy</i>	

Microclimate Monitoring System Design for the Smart Grid Analysis and Constructive Parameters Estimation*	479
<i>Alexander F. Pashchenko, Yuriy M. Rassadin</i>	
Cyber Resilience Models of Systems for Monitoring and Operational Dispatch Control of Electric Power Systems	485
<i>I. Kolosok, L. Gurina</i>	
Forecasting Research on Long-Term Solar Irradiance with an Improved Prophet Algorithm	491
<i>Yang Xinpei, Li Yiguo, Shen Jiong</i>	
Rule-Based Dual Planning Strategy of Hybrid Battery Energy Storage System	495
<i>Luo Zhuotong, Zhang Yi, Ju Yun, Fang Fang</i>	
Optimal Configuration of a Negative Carbon Emission Energy System for Green Agriculture	501
<i>Jie Qiu, Lihua Yang, Xianhao Chen, Xiao Wu</i>	
Distributed Model Predictive Coordinated Control for Combined Heat and Power Load of an Integrated Energy System	507
<i>Yuhui Jin, Xiao Wu, Jiong Shen, Kwang Y. Lee</i>	
Influence of Thermal Characteristics on Optimal Scheduling of Integrated Energy System	513
<i>Shang-Shang Wei, Xing-Xing Han, Xu Chang, Yi-Guo Li</i>	
Control Optimization Via a Practical Closed-Loop Identification Method for a Low-Pressure Heater in Power Plant	519
<i>Zhenlong Wu, Yanhong Liu, Liming Sun, Fengping Pan, Lei Yang</i>	
A Comparative Study of Single-Loop Control and Multi-Loop Control of Gas Turbine	525
<i>Li Wang, Fan Zhang, Yali Xue</i>	
Optimal Scheduling of Supercritical Coal-Fired Power Plant Integrated with CO ₂ capture Process Considering Solvent Storage	531
<i>Ruohan Qiu, Han Xi, Xiao Wu</i>	
Fault Tolerant Control System for a Mini Hydropower Plant	537
<i>Vlad Muresan, Mihail Abrudean, Daniel Moga, Dorin Petreus, Mircea Cohut</i>	
Developing a Method for Determining the Dynamic Characteristics of Heat Exchangers with Cross-Flowing Stream	543
<i>G. A. Pikina, A. F. Pashchenko, A. S. Kulikov</i>	
Statistical Analysis of the Steam Boiler Elements' Maintenance Results	549
<i>A. Yu. Vladova, Yu. R. Vladov</i>	
Intelligent Scheduling and Flexible Operation for the Commercial-Scale Coal-Fired Power Plant Integrated with Post-Combustion Carbon Capture	553
<i>Peizhi Liao, Xiao Wu, Meihong Wang</i>	

Author Index