Special Issue List in Section

Machine Learning and Data Based Optimization for Smart Energy Systems
Guest Editor: Prof. Dr. Holger Hesse
Deadline: **15 November 2022**

Application of Artificial Intelligence in Power System Monitoring and Fault Diagnosis
Guest Editors: Dr. Guang Wang, Dr. Jiale Xie and Prof. Dr. Shunli Wang
Deadline: **15 November 2022**

Energy and Artificial Intelligence
Guest Editor: Dr. Piotr Kosowski
Deadline: **15 November 2022**

Artificial Intelligence and Data Mining in Energy and Environment
Guest Editors: Dr. Sohrab Zendehboudi and Dr. Yankai Cao
Deadline: **20 November 2022**

Artificial Intelligence for Control Applications in Power and Energy Systems
Guest Editor: Dr. Rémy Rigo-Mariani
Deadline: **21 November 2022**

AI-Enhanced Power Grid Systems
Guest Editors: Dr. Giuliano Armano and Dr. Paolo Attilio Pegoraro
Deadline: **10 December 2022**

Optimal Control, Automation and Intelligent Energy Systems
Guest Editor: Dr. Krzysztof Lalik
Deadline: **30 December 2022**

Machine Learning and Data Mining Applications in Power and Multi-Energy Systems
Guest Editors: Dr. Tawfiq M. Aljohani and Prof. Dr. Osama A. Mohammed
Deadline: **5 January 2023**

Deep Learning Artificial Intelligence Methods and Applications in Renewable Energy Management System
Guest Editors: Prof. Dr. Ravinesh Deo and Prof. Dr. Sancho Salcedo-Sanz
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Research on Security and Data Protection for Energy Systems
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Deadline: **10 January 2023**

Smart Solutions and Devices for the Power Industry
Guest Editors: Prof. Dr. Andrey A. Kurkin and Dr. Dauren S. Akhmetbayev
Deadline: **30 January 2023**

Machine Learning Applications for Subsurface Energy Resources
Guest Editors: Dr. Emre Artun, Dr. Sercan Gul and Dr. Qian Sun
Deadline: **1 March 2023**

Artificial Intelligence and Smart Energy: The Future Approach
Guest Editors: Dr. Israa Medlej and Dr. Ambra Fioravanti
Deadline: **31 October 2023**

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Section Information

Artificial intelligence (AI) offers a smart way to help society achieve goals in a modern manner by implementing techniques involving predictive analytics, claims analytics, emerging issues detection, survey analysis, etc. AI covers a wide range, but the fields were not formally founded until 1956, at a conference at Dartmouth College, in Hanover.

On account of drastic progress in intelligent energy systems, the AI and Smart Energy Section aims to provide a platform for showcasing the front-line research at the crossing point between AI applications, smart approaches, and energy systems. This Section also provides the latest research progress in the multidisciplinary approach of AI in the energy system, technology, development, etc. This Section considers full-length, short communications, perspective, and review articles. Focal points of the AI and Smart Energy Section include but are not limited to:

- Energy topics:
- Statistic approach:
- Artificial intelligence and evolutionary computation:
- Data mining and analysis:

Section Artificial Intelligence and Smart Energy

Featured Papers

DOI: 10.3390/en13112762

A Comprehensive Review on IoT Protocols' Features in Smart Grid Communication

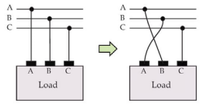
Authors: Lilia Tightiz and Hyosik Yang

Abstract: Since the smart grid deals with a large mass of data and critical missions, it requires ubiquitous, reliable, and real-time communication. The Internet of Things (IoT) technology, which has the potential of connecting all objects over the globe through the Internet, excels in providing robust information transmission infrastructure in the smart grid. There are a multitude of possible protocols, standards, and configurations for communication in the smart grid. A commonly applied communication standard IEC 61850 recommends the use of Manufacturing Message Specification (MMS) protocol for communication in Local Area Network (LAN) and eXtensible Messaging and Presence Protocol (XMPP) in Wide Area Network (WAN). However, a plethora of research on this topic compares the behavior of other IoT protocols and standard recommendations in the smart grid. On the other hand, the sky-rocketing penetration of Renewable Energy Sources (RES), especially in the form of micro grid, transformed the central control structure of the smart grid into a distributed style called Multi-Agent Systems (MAS). This new approach defined new communication requirements and more particular IoT protocol characteristic requirements. However, a limited number of the existing studies have considered IoT protocol characteristic requirements of the smart grid and its new control structures. In this paper, we initially investigate the communication requirements of the smart grid and introduce all IoT protocols and their specifications. We analyze IoT protocol characteristics and performances in the smart grid through literature review based on the smart grid communication requirements. In this approach, we highlight weak points of these practices making them fail to acquire the holistic guidelines in utilizing proper IoT protocol that can meet the smart grid environment interaction requirements. Using the existing facilities, the public Internet, we follow the arrangement of cost-effective high penetration communication requirements for new structures of the smart grid, i.e., the MAS and multi-micro grid. In this case, we consider IoT protocol Quality of Services (QoS) requirements, especially in the case of security and reliability, to satisfy stakeholders, namely utilities and prosumers. Addressing effective elements in applying IoT in the smart grid's future trends is another contribution to this paper.

DOI: 10.3390/en14051282

Application of the Vortex Search Algorithm to the Phase-Balancing Problem in Distribution Systems

Authors: Brandon Cortés-Caicedo, Laura Sofía Avellaneda-Gómez, Oscar Danilo Montoy, et at.

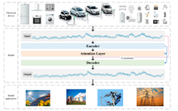


Abstract: This article discusses the problem of minimizing power loss in unbalanced distribution systems through phase-balancing. This problem is represented by a mixed-integer nonlinear-programming mathematical model, which is solved by applying a discretely encoded Vortex Search Algorithm (DVSA). The numerical results of simulations performed in IEEE 8-, 25-, and 37-node test systems demonstrate the applicability of the proposed methodology when compared with the classical Cuh & Beasley genetic algorithm. In addition, the computation times required by the algorithm to find the optimal solution are in the order of seconds, which makes the proposed DVSA a robust, reliable, and efficient tool. All computational implementations have been developed in the MATLAB® programming environment, and all the results have been evaluated in DigSILENT© software to verify the effectiveness and the proposed three-phase unbalanced power-flow method.

DOI: 10.3390/en14061596

Deep-Learning Forecasting Method for Electric Power Load via Attention-Based Encoder-Decoder with Bayesian Optimization

Authors: Xue-Bo Jin, Wei-Zhen Zheng, Jian-Lei Kong, et at.

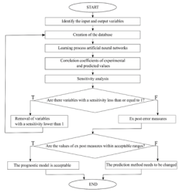


Abstract: Short-term electrical load forecasting plays an important role in the safety, stability, and sustainability of the power production and scheduling process. An accurate prediction of power load can provide a reliable decision for power system management. To solve the limitation of the existing load forecasting methods in dealing with time-series data, causing the poor stability and non-ideal forecasting accuracy, this paper proposed an attention-based encoder-decoder network with Bayesian optimization to do the accurate short-term power load forecasting. Proposed model is based on an encoder-decoder architecture with a gated recurrent units (GRU) recurrent neural network with high robustness on time-series data modeling. The temporal attention layer focuses on the key features of input data that play a vital role in promoting the prediction accuracy for load forecasting. Finally, the Bayesian optimization method is used to confirm the model's hyperparameters to achieve optimal predictions. The verification experiments of 24 h load forecasting with real power load data from American Electric Power (AEP) show that the proposed model outperforms other models in terms of prediction accuracy and algorithm stability, providing an effective approach for migrating time-serial power load prediction by deep-learning technology.

DOI: 10.3390/en14092639

Use of Artificial Neural Networks to Predict Fuel Consumption on the Basis of Technical Parameters of Vehicles

Authors: Jarosław Ziółkowski, Mateusz Oszczypała, Jerzy Małachowski and Joanna Szkutnik-Rogoż



Abstract: This publication presents a multi-faceted analysis of the fuel consumption of motor vehicles and the way human impacts the environment, with a particular emphasis on the passenger cars. The adopted research methodology is based on the use of artificial neural networks in order to create a predictive model on the basis of which fuel consumption of motor vehicles can be determined. A database containing 1750 records, being a set of information on vehicles manufactured in last decade, was used in the process of training the artificial neural networks. The MLP (Multi-Layer Perceptron) 22-10-3 network has been selected from the created neural networks, which was further subjected to an analysis. In order to determine if the predicted values match the real values, the linear Pearson correlation coefficient r and coefficient of determination R^2 were used. For the MLP 22-10-3 neural network, the calculated coefficient r was within range 0.93–0.95, while the coefficient of determination R^2 assumed a satisfactory value of more than 0.98. Furthermore, a sensitivity analysis of the predictive model was performed, determining the influence of each input variable on prediction accuracy. Then, a neural network with a reduced number of neurons in the input layer (MLP-20-10-3) was built, retaining a quantity of the hidden and output neurons and the activation functions of the individual layers. The MLP 20-10-3 neural network uses similar values of the r and R^2 coefficients as the MLP 22-10-3 neural network. For the evaluation of both neural networks, the measures of the ex post prediction errors were used. Depending on the predicted variable, the MAPE errors for the validation sets reached satisfactory values in the range of 5–8% for MLP 22-10-3 and 6–10% for MLP 20-10-3 neural network, respectively. The prediction tool described is intended for the design of passenger cars equipped with internal combustion engines.