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Section Information

Industrial electronics play a vital role in improving the efficiency and productivity of industries like energy, transportation, petroleum, chemical, semiconductor, mining, agriculture, and others. As a branch of electronics dealing with power electronic switches, sensors, actuators, meters, intelligent electronic devices (IEDs), automation equipment, semiconductors, nanotechnology, etc., current emphasis is placed on power conditioning using power semiconductor devices in modernizing industry technology.

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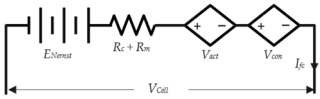
Section Industrial Electronics

Selected Papers

DOI: 10.3390/electronics11121808

Optimal PEM Fuel Cell Model Using a Novel Circle Search Algorithm

Authors: Mohammed H. Qais, Hany M. Hasanien, Rania A. Turky, Saad Alghuwainem, Ka-Hong Loo and Mohmmed Elgendy

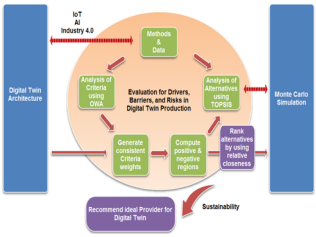


Abstract: The aim of this article is to introduce a novel Circle Search Algorithm (CSA) with the purpose of obtaining a precise electrical model of a proton exchange membrane fuel cell (PEMFC). Current-voltage and current-power curves are used to characterize the performance of PEMFCs. A nonlinear model with seven unknown parameters is used to describe these polarization curves. Estimating these unknown parameters is a critical issue because they influence the dynamic analysis of fuel cells in a variety of applications such as transportation and smart grids. The suggested method is based on minimizing the fitness function (the sum of the squared errors (SSE)) between estimated and measured voltage values. The CSA is compared to the neural network algorithm (NNA), grey wolf optimization (GWO), and the sine cosine algorithm (SCA). The optimization results reveal that the simulation times of the CSA, NNA, GWO, and SCA are 5.2, 6, 5.8, and 5.75 s, respectively. Moreover, the CSA converges to the best minimum within the first 100 iterations, which is faster than the other algorithms. The robustness of the CSA is verified using 20 independent runs, where the CSA achieves the smallest average and standard deviation. In addition, the t-test proves the superiority of the CSA compared to the other algorithms, where all *p*-values are less than 5%. The simulated *I-V* and *I-P* curves of the CSA-PEMFC model match the measured curves very closely. Moreover, the efficacy of the CSA-PEMFC model is evaluated under a variety of temperature and pressure conditions. Therefore, the suggested CSA-PEMFC model has the potential to be an accurate and efficient model.

DOI: 10.3390/electronics11081268

Evaluation of Production of Digital Twins Based on Blockchain Technology

Authors: Nada A. Nabeeh, Mohamed Abdel-Basset, Abduallah Gamal andVictor Chang

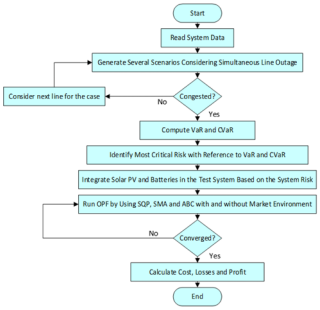


Abstract: A blockchain, as a form of distributed ledger technology, represents the unanimity of replication, synchronization, and sharing of data among various geographical sites. Blockchains have demonstrated impressive and effective applications throughout many aspects of the business. Blockchain technology can lead to the advent of the construction of Digital Twins (DTs). DTs involve the real representation of physical devices digitally as a virtual representation of both elements and dynamics prior to the building and deployment of actual devices. DT products can be built using blockchain-based technology in order to achieve sustainability. The technology of DT is one of the emerging novel technologies of Industry 4.0, along with artificial intelligence (AI) and the Internet of Things (IoT). Therefore, the present study adopts intelligent decision-making techniques to conduct a biased analysis of the drivers, barriers, and risks involved in applying blockchain technologies to the sustainable production of DTs. The proposed model illustrates the use of neutrosophic theory to handle the uncertain conditions of real-life situations and the indeterminate cases evolved in decision-makers' judgments and perspectives. In addition, the model applies the analysis of Multi-criteria Decision Making (MCDM) methods through the use of ordered weighted averaging (OWA) and the Technique of Order Preference Similarity to the Ideal Solution (TOPSIS) to achieve optimal rankings for DT production providers based on consistent weighted decision-maker's judgments in order to maintain and to assure sustainability...

DOI: 10.3390/electronics11081251

A Risk Curtailment Strategy for Solar PV-Battery Integrated Competitive Power System

Authors: Arup Das, Subhojit Dawn, Sadhan Gope and Taha Selim Ustun

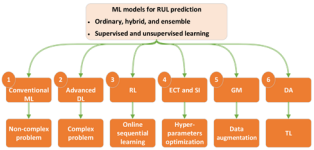


Abstract: Power system networks are becoming more complex and decentralized with the foreword of deregulation in the global power sector. In this scenario, an independent system operator (ISO) is responsible for determining the appropriate actions to deliver stable and quality power to the customers connected to the network at the lowest cost without violating the system security limits. Violations of any security limit may result in system risk. The unstable and non-reliable system always has some drawbacks and is not desirable from the consumer's point of view. A deregulated power market always keeps the consumer on the advantage side by giving stable, reliable, and less costly power. By using risk assessment tools, we identify the fault conditions and we try to minimize the risk by various uses of sequential programming methods. In this paper, a novel power system risk analysis and congestion management approach are introduced with considering meta-heuristic algorithms i.e., Slime Mould Algorithm (SMA) and Artificial Bee Colony Algorithm (ABC) in renewable energy integrated electricity market. The proposed power system risk analysis is constructed with the help of two risk valuation tools named Conditional-Value-at-risk (CVaR) and Value-at-risk (VaR). The higher negative value of VaR and CVaR represents the higher risk system and lower negative value or towards a positive value of VaR and CVaR denotes the less risk or stable system. The projected method has been experienced on the IEEE 14-bus test system and IEEE 30-bus test system to examine the usefulness of the meta-heuristic algorithm in system risk analysis under the deregulated environment. The importance of renewable energy integration in system risk curtailment has also been depicted in this work: basically, to measure the system's risk, hence enhancing the system's reliability and societal welfare. As a result, it will benefit both supply and demand-side participants.

DOI: 10.3390/electronics11071125

A Systematic Guide for Predicting Remaining Useful Life with Machine Learning

Authors: Tarek Berghout and Mohamed Benbouzid



Abstract: Prognosis and health management (PHM) are mandatory tasks for real-time monitoring of damage propagation and aging of operating systems during working conditions. More definitely, PHM simplifies conditional maintenance planning by assessing the actual state of health (SoH) through the level of aging indicators. In fact, an accurate estimate of SoH helps determine remaining useful life (RUL), which is the period between the present and the end of a system's useful life. Traditional residue-based modeling approaches that rely on the interpretation of appropriate physical laws to simulate operating behaviors fail as the complexity of systems increases. Therefore, machine learning (ML) becomes an unquestionable alternative that employs the behavior of historical data to mimic a large number of SoHs under varying working conditions. In this context, the objective of this paper is twofold. First, to provide an overview of recent developments of RUL prediction while reviewing recent ML tools used for RUL prediction in different critical systems. Second, and more importantly, to ensure that the RUL prediction process from data acquisition to model building and evaluation is straightforward. This paper also provides step-by-step guidelines to help determine the appropriate solution for any specific type of driven data...

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