Section Artificial Intelligence
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Section Editor-in-Chief

Prof. Dr. Yoichi Hayashi
Artificial Intelligence Lab, Department of Computer Science, Meiji University, Kawasaki, Kanagawa 214-8571, Japan
hayashiy@cs.meiji.ac.jp

Section Information

The Section Artificial Intelligence mainly covers topics of interest within unique hardware-based deep learning AI and algorithmic deep learning AI using machine learning. The purpose of this Section is to bring together researchers and engineers, from both academia and industry, to present novel ideas and solid research on the hardware and algorithmic aspects of advanced applications of deep-learning-based AI.

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Novel Control Strategy for Enhancing Microgrid Operation Connected to Photovoltaic Generation and Energy Storage Systems

Authors: Dina Emara, Mohamed Ezzat, Almoataz Y. Abdelaziz, Karar Mahmoud, Matti Lehtonen and Mohamed M. F. Darwish

Abstract: Recently, the penetration of energy storage systems and photovoltaics has been significantly expanded worldwide. In this regard, this paper presents the enhanced operation and control of DC microgrid systems, which are based on photovoltaic modules, battery storage systems, and DC load. DC–DC and DC–AC converters are coordinated and controlled to achieve DC voltage stability in the microgrid. To achieve such an ambitious target, the system is widely operated in two different modes: stand-alone and grid-connected modes. The novel control strategy enables maximum power generation from the photovoltaic system across different techniques for operating the microgrid. Six different cases are simulated and analyzed using the MATLAB/Simulink platform while varying irradiance levels and consequently varying photovoltaic generation. The proposed system achieves voltage and power stability at different load demands. It is illustrated that the grid-tied mode of operation regulated by voltage source converter control offers more stability than the islanded mode. In general, the proposed battery converter control introduces a stable operation and regulated DC voltage but with few voltage spikes. The merit of the integrated DC microgrid with batteries is to attain further flexibility and reliability through balancing power demand and generation. The simulation results also show the system can operate properly in normal or abnormal cases, thanks to the proposed control strategy, which can regulate the voltage stability of the DC bus in the microgrid with energy storage systems and photovoltaics.

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An Advanced CNN-LSTM Model for Cryptocurrency Forecasting

Authors: Ioannis E. Livieris, Niki Kiriakidou, Stavros Stavroyiannis and Panagiotis Pintelas

Abstract: Nowadays, cryptocurrencies are established and widely recognized as an alternative exchange currency method. They have infiltrated most financial transactions and as a result cryptocurrency trade is generally considered one of the most popular and promising types of profitable investments. Nevertheless, this constantly increasing financial market is characterized by significant volatility and strong price fluctuations over a short-time period therefore, the development of an accurate and reliable forecasting model is considered essential for portfolio management and optimization. In this research, we propose a multiple-input deep neural network model for the prediction of cryptocurrency price and movement. The proposed forecasting model utilizes as inputs different cryptocurrency data and handles them independently in order to exploit useful information from each cryptocurrency separately. An extensive empirical study was performed using three consecutive years of cryptocurrency data from three cryptocurrencies with the highest market capitalization i.e., Bitcoin (BTC), Etherium (ETH), and Ripple (XRP). The detailed experimental analysis revealed that the proposed model has the ability to efficiently exploit mixed cryptocurrency data, reduces overfitting and decreases the computational cost in comparison with traditional fully-connected deep neural networks.
**Review on Generative Adversarial Networks: Focusing on Computer Vision and Its Applications**

*Authors: Sung-Wook Park, Jae-Sub Ko, Jun-Ho Huh, and Jong-Chan Kim*

Abstract: The emergence of deep learning model GAN (Generative Adversarial Networks) is an important turning point in generative modeling. GAN is more powerful in feature and expression learning compared to machine learning-based generative model algorithms. Nowadays, it is also used to generate non-image data, such as voice and natural language. Typical technologies include BERT (Bidirectional Encoder Representations from Transformers), GPT-3 (Generative Pretrained Transformer-3), and MuseNet. GAN differs from the machine learning-based generative model and the objective function. Training is conducted by two networks: generator and discriminator. The generator converts random noise into a true-to-life image, whereas the discriminator distinguishes whether the input image is real or synthetic. As the training continues, the generator learns more sophisticated synthesis techniques, and the discriminator grows into a more accurate differentiator. GAN has problems, such as mode collapse, training instability, and lack of evaluation matrix, and many researchers have tried to solve these problems. For example, solutions such as one-sided label smoothing, instance normalization, and minibatch discrimination have been proposed. The field of application has also expanded. This paper provides an overview of GAN and application solutions for computer vision and artificial intelligence healthcare field researchers. The structure and principle of operation of GAN, the core models of GAN proposed to date, and the theory of GAN were analyzed. Application examples of GAN such as image classification and regression, image synthesis and inpainting, image-to-image translation, super-resolution and point registration were then presented. The discussion tackled GAN’s problems and solutions, and the future research direction was finally proposed.

**Controlling Teleportation-Based Locomotion in Virtual Reality with Hand Gestures: A Comparative Evaluation of Two-Handed and One-Handed Techniques**

*Authors: Alexander Schäfer, Gerd Reis and Didier Stricker*

Abstract: Virtual Reality (VR) technology offers users the possibility to immerse and freely navigate through virtual worlds. An important component for achieving a high degree of immersion in VR is locomotion. Often discussed in the literature, a natural and effective way of controlling locomotion is still a general problem which needs to be solved. Recently, VR headset manufacturers have been integrating more sensors, allowing hand or eye tracking without any additional required equipment. This enables a wide range of application scenarios with natural freehand interaction techniques where no additional hardware is required. This paper focuses on techniques to control teleportation-based locomotion with hand gestures, where users are able to move around in VR using their hands only. With the help of a comprehensive study involving 21 participants, four different techniques are evaluated. The effectiveness and efficiency as well as user preferences of the presented techniques are determined. Two two-handed and two one-handed techniques are evaluated, revealing that it is possible to move comfortable and effectively through virtual worlds with a single hand only.
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