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ORIGINAL ARTICLE

Development of deep learning method for predicting DC power based on renewable solar energy and multi-parameters function

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Abstract

In recent decades, the world has witnessed a great expansion in the world of technology and electronics, in addition to the tremendous development in various industries, which has led to an increase in the need for electrical energy significantly. Renewable energy generated from environmentally friendly sources such as energy (solar, water, windmills, etc.) is the solution. The alternative is to provide that energy, especially as it is clean energy that does not cause the emission of carbon dioxide, which pollutes the air and the environment in general. This work presents a software model for producing the largest amount of energy by developing one of the best prediction techniques and using multi-parameter objective functions, where the proposed model called zero to maximum energy based on developing gradient boosting machine (DMP-DGBM) consists of several stages. The problem of this work is divided into parts: The first part is related to programming challenges, while the second part is related to application challenges; as we know, the prediction techniques are split based on the scientific field into two fields: prediction techniques related to data mining and predictions related to deep learning techniques; this work deals with the first type of prediction technique. (a) One of the data mining prediction techniques is the gradient boosting machine characterized by many features that make it the best. These features are GBM gives high accuracy results and works with huge data stream of data, but on the other hand, the core of that algorithm is a decision tree (DT) that has many limitations such as requiring choosing the root of the tree, determining the maximum number of levels of the tree, and also having high computation and long time. Therefore, the first challenge of this paper is how can avoid these limitations (i.e., high computation and implementation time) of this algorithm and benefit from their features. (b) The problem of generating electrical energy from environmentally friendly sources with high efficiency is one of the most important challenges in this field. Therefore, the second challenge of this paper is how can avoid these limitations by building an efficient technique to predict maximum energy from solar energy. DMP-DGBM model consists of many stages applied through a stepwise style. The first stage presents capturing datasets from scientific site which contains the data related to both weather and solar plant. The second stage is preprocessing which contains multi-steps including: (a) merging between two datasets; (b) splitting readings into intervals and deleting the duplicate; and (c) applying Pearson's correlation to the new dataset. In the third stage, the ZME-DGBM model is constructed based on developing gradient boosting techniques by replacing its kernel (i.e., decision tree function) with multi-parameter optimization functions. The stage begins with dividing the dataset into two sets using five cross-validation methods, and the training dataset is used to construct the DMP-DGBM models, while the testing dataset is used to evaluate them. Finally, the results of the DMP-DGBM are evaluated based on three measures (i.e., coefficient of determination, mean error, and root mean square error. The stage of constructing the predictor relied on replacing the GBM kernel with four different multi-parameter functions, as these were the parameters with the highest correlation with the target, and a threshold value of 0.95 was adopted as determining the importance of the parameters. The proposed model was characterized by giving the best results using a three-parameter function MPF4 for the GBM kernel, and those parameters were AC, TEM, and IRR, where the scale was (R^2 = 0.9742), while for MSE = 0.0099 and RMSE = 0.0522 also the system is taken only 80 Ms to implement.

Keywords Renewable energy · Solar energy · DC power · Multi-parameters functions · DGBM · Prediction techniques · Data Mining techniques · Neurocomputing techniques

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