UNIVERSITI TEKNOLOGI MARA

A MUTATED HYBRID CUCKOO SEARCH-ARTIFICIAL NEURAL NETWORK FOR GRID-CONNECTED PHOTOVOLTAIC SYSTEM OUTPUT PREDICTION

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ABSTRACT

This thesis presents a hybrid technique for predicting the AC power output from a Grid-Connected Photovoltaic (GCPV) system. Initially, the prediction was conducted using six classical Multi-Layer Feedforward Neural Network (MLFNN) models. These models were developed based on different sets of inputs. A key feature for developing these models is the inclusion of time-series inputs. The inclusion of time-series inputs to the network is important as the solar irradiance, ambient temperature and module temperature have different time-constant; i.e. they have different rate of change as the climate changes. The results showed that the classical MLFNN with time-series inputs had outperformed the other five classical MLFNNs by producing the lowest Root Mean Square Error (RMSE). In addition, the study also showed that the classical MLFNN with no time-series input was found to be the worst MLFNN for the prediction. Upon completion of classical MLFNN, Hybrid Multi-Layer Feedforward Neural Network (HMLFNN) was developed to facilitate the training process and thus reducing the overall training period of classical MLFNN. A Cuckoo Search Algorithm (CSA) was proposed as a new meta-heuristics for the HMLFNN. CSA was used to determine the optimal number of neurons in hidden layer, learning rate and momentum rate of the MLFNN such that the RMSE was minimized. At this stage, the best classical MLFNN with time-series inputs was selected to be hybridized with CSA. The results showed that CSA is more accurate than Evolutionary Programming (EP) and Firefly Algorithm (FA) as it produced lowest RMSE with highest coefficient of determination, R^2. CSA was found to be 42.86% and 47.55% more accurate than EP and FA respectively. In addition, CSA was also found to be 81.14% and 82.21% faster than EP and FA respectively. Besides that, Mutated Cuckoo Search Algorithm (MCSA) was introduced to reduce the computation time during the search of the optimal solution. At this stage, each cuckoo was mutated to produce a mutant which carries the information from the parent cuckoo. As a result, the information of the previous search can be incorporated during the current search such that the global optimal solution can be discovered at a faster rate. The results showed that MCSA outperformed the conventional CSA by producing 8% lower RMSE and 15.5% lower computation time. Therefore, the proposed MCSA for the prediction is justified.

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