Prediction Model for the Performance of Different PV Modules Using Artificial Neural Networks

ABSTRACT

This study presents a prediction model for comparing the performance of six different photovoltaic (PV) modules using artificial neural networks (ANNs), with simple inputs for the model. Cell temperature (Tc), irradiance, fill factor (FF), short circuit current (Isc), open-circuit voltage (Voc), maximum power (Pm), and the product of Voc and Isc are the inputs of the neural networks' processes. A Prova 1011 solar system analyzer was used to extract the datasets of IV curves for six different PV modules under test conditions. As for the result, the highest FF was the mono-crystalline with an average of 0.737, while the lowest was the CIGS module with an average of 0.66. As for efficiency, the most efficient was the mono-crystalline module with an average of 10.32%, while the least was the thin-film module with an average of 7.65%. It is noted that the thin-film and flexible mono-modules have similar performances. The results from the proposed model give a clear idea about the best and worst performances of the PV modules under test conditions. Comparing the prediction process with the real dataset for the PV modules, the prediction accuracy for the model has a mean absolute percentage error (MAPE) of 0.874%, with an average root mean square error (RMSE) and mean absolute deviation (MAD) of, respectively, 0.0638 A and 0.237 A. The accuracy of the proposed model proved its efficiency for predicting the performance of the six PV modules.