Silicon PV module fitting equations based on experimental measurements

ABSTRACT

Solar photovoltaic (PV) characteristic curves (P-V and I-V) offer the information required to configure the PV system to operate as near to its optimal performance as possible. Measurement-based modeling can provide an accurate description for this purpose. This work analyzes the PV module performance and develops a mathematical formula under particular weather conditions to accurately express these curves based on a custom neural network (CNN). The study initially presents several standard mathematical model equations, such as polynomial, exponential, and Gaussian models to fit the PV module measurements. The model selection is subjected to the minimum value of an evaluation parameter. To simplify the solution of the symbolic equations for the CNN network, two neurons in the hidden layer with nonlinear activation function and linear for the output layer were selected. The results show the effectiveness of the proposed CNN model equations over other standard fitting models according to the root mean squared error (RMSE) evaluation. This method promises further improved results with multi-input parameter modeling.

Keyword: Curve fitting; Custom neural network; I-V curve; Mathematical modeling