International Journal of Modelling and Simulation

Volume 43, Issue 4, 2022, Pages 507-522

Enhanced the modeling accuracy by the design of new photovoltaic models including the proposed nonlinear thermal resistors

Sami KAHLA, Mohcene Bechouat, Toufik Amieur, Moussa Sedraoui, Hanni Guessoum

Abstract: This article proposes new photovoltaic (PV) models, with which the modeling accuracies are much improved, regardless of wide absolute temperature variations. The desired PV models are designed by an equivalent electrical circuit consisting of a single diode and two proposed nonlinear thermal resistors. The realization of such resistors is therefore the key contribution of this article since they significantly increase the degrees of freedom of similar circuits, including fixed resistors. As a result, the given modeling accuracies are clearly improved not only under standard test conditions but also in more severe climatic environments, characterized by high absolute temperatures. To achieve this goal, the parameters of the two proposed PV models were optimized using the gnetic algorithm, where a fitness function for each PV model is well minimized. Each fitness function was previously formulated from comparing actual output currents, prerecorded from the existing ISOFOTON I-50 PV panel, by predicted output currents, computed using the Lambert-W function. The given performances by the proposed PV models were compared with those provided by the standard PV ones where the given simulation results reveal the superiority of the proposed PV models under different weather conditions.

Keywords : Genetic algorithm, Lambert-W function, Photovoltaic, Resistance-based metallic conductor, Resistance-based thermistance material, standard climatic condition