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Parameter Estimation of Photovoltaic System Using Imperialist Competitive Algorithm

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Abstract: This paper presents a reliable methodology based on imperialist competitive algorithm (ICA) for estimating the optimal parameters of photovoltaic (PV) generating unit. The PV system is simulated by single diode model and double diode model. The proposed constrained objective function is derived from the voltage-power curve of the PV system which has unique maximum power point (MPP). The analysis is performed on different types of PV systems; mono-crystalline, poly-crystalline and amorphous modules. The validation of ICA is investigated for PV cell/module operated under different irradiances and temperatures; the obtained results are compared with experimental data and other reported meta-heuristic optimization algorithms. The results confirm the validity and reliability of ICA in extracting the optimal parameters of the PV generating unit.

Keywords: PV parameter estimation; Imperialist competitive algorithm; Single diode model; Double diode model.

1. Introduction

The main obstacle of fossil fuel is its negative effect on the environment; therefore alternative clean resources are used, renewable energy sources (RESs) gained great attention in the last years. One form of RESs is the solar power in which the electric current is produced by photovoltaic cell. The PV is manufactured from a semiconductor material which may be mono-crystalline, poly-crystalline or amorphous type. The PV module manufacturer's datasheet provides the parameters of open circuit voltage ($V_{oc}$), short circuit current ($I_{sc}$), maximum power ($P_{mpp}$), voltage and current at MPP ($V_{mpp}$ and $I_{mpp}$) and the temperature coefficients of voltage and current, ($K_v$ and $K_i$). However, the model of the PV module requires other parameters such as the photon current ($I_{ph}$), saturation current ($I_o$), ideality factor of diode ($n$), series resistance ($R_s$) and parallel resistance ($R_p$), the values of such parameters are not specified in the datasheet. Accordingly; the estimation of such parameters is considered essential issue. Many
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