1- D. Yousri, Dalia Allam, M. B. Eteiba, “Optimal Photovoltaic Array Reconfiguration for Alleviating the Partial Shading Influence Based on a modified Harris Hawks Optimizer”. Energy Conversion and Management, Elsevier. Volume206, Article Number112470, DOI10.1016/j.enconman.2020.112470, Published FEB 15 2020.

Abstract

Mismatch power loss is the unfortunate problem created as a result of the partial shading phenomenon. To relieve the entire photovoltaic system from this issue, reconfiguring the photovoltaic modules of the considered photovoltaic array is proposed as a favorable solution to disperse the shadow regularly. Therefore, in the current work, a novel developed optimization algorithm named modified Harris Hawks optimizer is introduced aiming to provide the optimal reconfiguration pattern of the switching matrix to maximize the generated power from the array. The basic version of the Harris Hawks optimizer is implemented for the same problem over several stages of the analysis, as well. Rearrangements of four patterns of shadow (short broad, long broad, short narrow, and long narrow patterns) are implemented on 9×9 photovoltaic array. Moreover, the algorithm is also validated on another two shade patterns with 6×4 and 6×20 photovoltaic arrays are reported in the simulation part. The results of the proposed techniques are compared to those obtained by a total-cross-tied, competence square, particle swarm optimizer, and genetic-based reconfiguration techniques based on several metrics. The utilized measures are mismatch power, fill factor, percentage power loss, as well as percentage power enhancement. The analysis reveals that the introduced approach enhances the produced power by 33.274%, 27.79%, 6.99%, 7.197% over the first four shaded patterns, respectively and increases the generated power by 20%for the other shade patters. Further, the modified Harris Hawks optimizer proves its excellency in providing the optimal photovoltaic array configuration in less than 1 s. For intensive justification, the modified Harris Hawks optimizer reconfiguration approach is validated based on an experimental work for 9×9 photovoltaic array with twelve shade patterns during a day from 8 ante meridiem to 7 post meridiem with one- hour step. Comparing the produced power based on the modified Harris Hawks optimizer arrangements to those of total-cross-tied and Harris Hawks Optimizer schemes over the daily hours proves the superiority of the modified Harris Hawks Optimizer interconnected system in generating the highest values of power with a uniform dispersion for the shadow and smooth characteristics with saving the energy by 12.569% compared with that produced by total cross- tied across the day hours.