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A novel nature-inspired maximum power point tracking (MPPT) controller based on ACO-ANN algorithm for photovoltaic (PV) system fed arc welding machines

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Abstract: In this paper, a metaheuristic optimized multilayer feed?forward artificial neural network (ANN) controller is proposed to extract the maximum power from available solar energy for a three-phase shunt active power filter (APF) grid connected photovoltaic (PV) system supplying an arc welding machine. Firstly, in order to improve the maximum power point (MPP) delivered by PV arrays and to overcome the drawbacks in the conventional MPPT method under irradiation variation, a hybrid MPPT controller is designed, in which the input parameters include the PV array voltage and current, and the output parameter is the duty cycle of the DC/DC boost converter. The proposed approach abbreviated as ANN-ACO MPPT controller is based on an ant colony optimization (ACO) algorithm which is useful to train the developed ANN and to evolve the connection weights and biases to get the optimal values of duty cycle converter corresponding to the MPP of a PV array. Secondly, aiming to meet the various grid requirements such as power quality improvement, distortion free signals etc., a three-phase shunt APF is utilized, and a direct power control algorithm is designed for distributing the solar energy between the DC-link capacitor, arc welding machine and the AC grid. Finally, the performance of proposed control system is confirmed by simulation tests on a 12.2 kW PV system. Both simulation and experimental results have demonstrated that the deigned ANN-ACO MPPT controller can provide a better MPP tracking with a faster speed and a high robustness with a minimal steady-state oscillation than those obtained with the conventional INC method. Also, with the use of a three-phase shunt APF, all the power fluctuations from the arc welding machine disturbances are damped out and the output active and reactive power become controllable.

Keywords : Solar Photovoltaic (PV) system, DC/DC boost converter, three-phase shunt APF, Hybrid ACO-ANN MPPT control, Feed-forward artificial neural network (ANN), Ant Colony Optimization (ACO) algorithm, Arc welding machine