Improved ADALINE harmonics extraction algorithm for boosting performance of photovoltaic shunt active power filter under dynamic operations

ABSTRACT

This paper presents improved harmonics extraction based on Adaptive Linear Neuron (ADALINE) algorithm for single phase photovoltaic (PV) shunt active power filter (SAPF). The proposed algorithm, named later as Improved ADALINE, contributes to better performance by removing cosine factor and sum of element that are considered as unnecessary features inside the existing algorithm, known as Modified Widrow-Hoff (W-H) ADALINE. A new updating technique, named as Fundamental Active Current, is introduced to replace the role of the weight factor inside the previous updating technique. For evaluation and comparison purposes, both proposed and existing algorithms have been developed. The PV SAPF with both algorithms was simulated in MATLAB-Simulink respectively, with and without operation or connection of PV. For hardware implementation, laboratory prototype has been developed and the proposed algorithm was programmed in TMS320F28335 DSP board. Steady state operation and three critical dynamic operations, which involve change of nonlinear loads, off-on operation between PV and SAPF, and change of irradiances, were carried out for performance evaluation. From the results and analysis, the Improved ADALINE algorithm shows the best performances with low total harmonic distortion, fast response time and high source power reduction. It performs well in both steady state and dynamic operations as compared to the Modified W-H ADALINE algorithm.

Keyword: Active power filter; Artificial neural network; Harmonics; Photovoltaic; Maximum power point tracking