Photovoltaic integrated shunt active power filter with simpler ADALINE algorithm for current harmonic extraction

ABSTRACT

This manuscript presents a significant work in improving the current harmonics extraction algorithm and indirectly improving the injection current produced by a single-phase Photovoltaic Shunt Active Power Filter (PV SAPF). Improvement to the existing adaptive linear neuron (ADALINE) technique has been carried out, leading to the formation of a simpler ADALINE; it is expected to perform as fast as the current harmonics extraction algorithm. Further analysis on the DC link capacitor control algorithm, called "self-charging with step size error cancellation", was also done to inspect the performance of the algorithm in a single-phase photovoltaic shunt active power filter system. Both algorithms, configured in single-phase PV SAPF, were simulated in MATLAB/Simulink (R2012b). A laboratory prototype was developed, and the algorithms were computed on a TMS320F28335 Digital Signal Processing (DSP) board for hardware implementation purposes. From the acquired results, the simpler ADALINE algorithm has effectively performed with lower total harmonic Distortion (THD) and outstanding compensation. The established algorithm of self-charging with step size error cancellation works well with single-phase PV SAPF and has shown less overshoot, a fast response time, and minimal energy losses.

Keyword: Adaptive linear neuron; DC link capacitor; Current harmonics; Photovoltaic; Shunt active power filter