A self-tuning filter-based adaptive linear neuron approach for operation of three-level inverter-based shunt active power filters under non-ideal source voltage conditions

ABSTRACT

This paper presents a self-tuning filter (STF)-based adaptive linear neuron (ADALINE) reference current generation algorithm to enhance the operation of a three-phase three-level neutral-point diode clamped (NPC) inverter-based shunt active power filter (SAPF) under non-ideal (unbalanced and/or distorted) source voltage conditions. SAPF is an effective and versatile mitigation tool for current harmonics. As for its controller, ADALINE-based reference current generation algorithmd have widely been applied and proven to work effectively under balanced and purely sinusoidal source voltage conditions. However, no work has been conducted to study its performance under non-ideal source voltage conditions. In this work, a STF-based fundamental voltage extraction algorithm is integrated with an ADALINE algorithm, serving as synchronizer algorithm to ensure in-phase operation of the generated reference current with the non-ideal source voltage. Hence, it completely eliminates any dependency on conventional synchronizer algorithms such as phase-locked loop (PLL) and zero-crossing detector (ZCD). Additionally, the proposed STF-based ADALINE algorithm implements the modified Widrow-Hoff (W-H) weight updating algorithm for fast generation of reference current. Both simulation and experimental works are performed to verify design concept and effectiveness of the proposed algorithm. Comparative study with another recently reported algorithm is performed to investigate the performance improvement achieved by SAPF while using the proposed algorithm.

Keyword: Artificial neural network (ANN); Current harmonics; Multilevel inverter; Non-sinusoidal supply voltage; Reactive power compensation; Total harmonic distortion (THD)