ABSTRACT

The degradation of power quality due to harmonics from non-linear loads is a significant problem in electrical power systems. This research aims to design and evaluate the performance of a Model Predictive Control (MPC) controller for a three-phase four-wire active power filter. The controller was implemented on a Field Programmable Gate Array (FPGA) and tested using a Hardware-in-the-Loop (HIL) simulation methodology. In the HIL setup, the power system model was simulated in MATLAB/Simulink, while the MPC control algorithm was executed in real-time on a Zedboard FPGA. The test results revealed a failure in the MPC controller's implementation on the FPGA. Instead of reducing harmonics, the source current's Total Harmonic Distortion (THD) remained extremely high, ranging from 39% to 61%, far exceeding the IEEE 519-2022 standard (<5%). Furthermore, the resulting power factor was negative in all scenarios, indicating a complete failure of the compensation system. It is therefore concluded that the designed MPC control implementation was proven ineffective at improving power quality.

Keywords *: Active Filter, Field Programmable Gate Array (FPGA), Harmonics, MPC, Power Quality*