ABSTRACT:

This paper presents an improved FPGA-based torque and stator flux estimators for direct torque control (DTC) induction motor drives, which permit very fast calculations. The improvements are performed by 1) using two"s complement fixed-point format approach to minimize calculation errors and the hardware resources usage in all operations, 2) calculating the discrete integration operation of stator flux using backward Euler approach, 3) modifying the non-restoring method to calculate complicated square root operation of stator flux, 4) introducing a new sector judgment method, and 5) reducing the sampling frequency down to 5µs. To avoid saturation due to DC offset present in the sensed currents, the LP Filter is applied. The simulation results of DTC model in MATLAB/Simulink, which performed double-precision calculations, are used as references to digital computations executed in FPGA implementation. The Hardware-in-the-loop (HIL) method is used to verify the minimal error between MATLAB/Simulink simulation and the experimental results, and thus the well functionality of the implemented estimators.