ABSTRACT:

This paper proposes the use of a 3-level Cascaded H-Bridge Multilevel Inverter (CHMI) topology which results in further torque ripple minimization compared to the 2-level inverter-based Direct Torque Control (DTC). This is due to the increase in the inverter switching voltage vectors that allows minimization of the torque error. This in turn can reduce the Total Harmonic Distortion (THD) of the output voltage and current as well. This paper also presents two different control methods in selecting the appropriate output voltage vector for reducing the torque and flux error to zero. The first is based on the conventional DTC scheme using a pair of hysteresis comparators and look-up table to select the output voltage vector for controlling the torque and flux. The second is based on a new fuzzy logic controller (FLC) with Sugeno as its inference method to select the output voltage vector by replacing the hysteresis comparators and look-up table in the conventional DTC scheme. The latter has solved the problem of variable switching frequency which is the main characteristic of the former. By using FLC DTC not only the flux ripples reduce significantly but also the THD of the phase current decreases since a more sinusoidal current waveform is achieved. The simulation results have proven that by using the 3-level CHMI, torque ripple reduction is obtained compared to the 2-level inverter-based DTC while fuzzy DTC shows reduction in the stator flux ripples and the THD of the phase current.