ABSTRACT

The goal of this research work is to improve performance of BLDC motor control using sensor less vector control technique where the photovoltaic source is preferred for powering the motor. The sensor less control technique does not use position and speed sensors instead make use of voltage and current measurements. Sensor less vector control technique with back EMF estimation methods corresponds to reference speed commands quickly. The convergence error that is error between estimated speed and measured speed is relatively low and there is no noise in estimated speed. In this thesis in order to minimize the harmonics in stator current of BLDC motor different control techniques were implemented and the performance is compared by the value of THD.

The first part of this thesis discusses about designing a standalone PV source consists of PV panel, Non-inverting four switch buck-boost converter with perturb & observe MPPT algorithm for BLDC motor drive. A single hysteresis band controller is used to generate reference voltage for sine PWM generation which removes the phase delay in back-EMF which limits ripple in output voltage to a lesser value. Further P&O algorithm is replaced by incremental conductance algorithm which improves the PV performance even under rapid changes in solar parameters. A modern vector controller scheme using phase current infusion technique is introduced it has wide control over developed torque and speed of motor. Space vector PWM is used to generate switching pulse based on phase current infusion technique resulted in reduced THD compared to hysteresis comparator based sine PWM technique.

Multi power conversion system is replaced by single stage power conversion system for solar power source fed BLDC motor drives. A Non inverting four switch buck-boost converter is replaced with switched inductor quasi z-source network which can extract high power from PV source with voltage enhancing capacity. A simple maximum boost PWM (MB-PWM) technique is used in which modulation index is controlled using incremental conductance MPPT technique. Simple boost PWM

technique further enhanced the harmonic profile of BLDC motor by minimizing harmonics present in stator current. A self-tuning fuzzy PID controller which gives appropriate speed regulation with no manual tuning generates reference current for MB-PWM. A simplified indirect field oriented control (IFOC) with back-EMF observer for speed estimation replaces the MB-PWM control technique which results in reduction of torque ripple and obtains a trapezoidal stator current waveform. It also results in reduction of total harmonic distortion in stator current of BLDC motor when compared with simple boost PWM. The phase current infusion based Space vector PWM technique reduces the THD content in stator current to 15.89% whereas hysteresis comparator based sine PWM technique has THD content as high as 18.62%. Further the THD in stator current is reduced to 13.93% by the use of simple boost PWM technique. The IFOC technique applied shows improved harmonic profile with THD content of 11.76% in stator current which is very less in comparison with previously applied techniques. The improved performances of sensor less BLDC motor with various control techniques are verified by using FFT analysis on stator current of BLDC motor for mitigating THD. The dc link voltage, harmonics of stator current is reduced, Speed and torque characteristics is achieved using indirect field oriented control method.