Abstract of Ph.D. Thesis

"Control and Implementation of Solar PV Fed Sensorless PMSM Drive for Electric Vehicles"

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This thesis presents the control and implementation of a solar photovoltaic (PV) fed, sensorless permanent magnet synchronous motor (PMSM) drive for EV applications, aimed at enhancing energy efficiency, system reliability, and operational flexibility. The research focuses on the development of advanced control strategies and observer-based techniques for eliminating mechanical position sensors, thereby improving system compactness, robustness, and cost-effectiveness. Both surface-mounted PMSM (SPMSM) based low-voltage and interior PMSM (IPMSM) based high-voltage electric vehicle configurations are proposed in this research work. These high-performance drives are integrated with solar PV array and operated under online Maximum Torque per Ampere (MTPA) control to ensure optimal efficiency while maintaining sensorless operation for enhanced system reliability and reduced hardware complexity. The sensorless control framework is developed using advanced estimation algorithms capable of accurately determining rotor position and speed across a wide range of operating conditions, including low-speed and transient states. A comprehensive energy management approach is also incorporated, enabling efficient coordination of the solar PV array, battery storage, and motor drive. Regenerative braking capability further enhances energy utilization, contributing to extended driving range and reduced battery dependency. Extensive simulation and experimental validation of the proposed system are carried out to assess its steady-state, dynamic, and transient performance under real-world scenarios. The results confirm that the proposed control architecture offers a reliable, energy-efficient, and renewable-integrated drive system, making it a suitable solution for future electric mobility applications with enhanced performance and sustainability.