ABSTRACT

In order to reduce the adverse effect of parameter variation in position sensorless speed control of permanent magnet synchronous motor (PMSM) based on stator feedforward voltage estimation (FFVE), multi-parameter estimation using PV-Battery-model reference adaptive system (MRAS) is proposed . Since the FFVE scheme relies on motor parameters, the stator resistance and rotor flux linkage are estimated and continuously updated in the feedforward voltage estimation model in a closed-loop fashion, sensitivity to multi-parameter changes at low speed is eliminated. To improve the dynamics and stability of the overall system and eliminate transient oscillations in speed estimation, a PLL-like speed estimation method is proposed which is obtained by passing the qq-axis PI current regulator output through a first order filter in the FFVE scheme. Furthermore, a feasibility study is conducted for solar PV array based three wheeler EVs and found out that these systems are highly feasible and can contribute enough power for motor propulsion at steady state operation. The payback period of such system is less compared to the conventional LEVs. Currently, light EVs are mostly driven by brushed DC motors, induction motors and pervii manent magnet brushless DC motors. As these motors suffer setback due to various drawbacks, six different surfaces mounted permanent magnet synchronous motors (SPMSM) based low voltage and interior PMSM (IPMSM) based high voltage configurations with solar PV array are proposed in this project work. These high performance drives are operated in online MTPA control for high efficiency while eliminating the mechanical position sensors for improved reliability, compactness and cost- effectiveness. Nonetheless, the proposed sensorless control strategies are useful and well applicable for variable speed domestic and industrial electric drive applications too. Maximum power point tracking control is utilized in solar PV array assisted LV and HV configurations for extracting optimum power under varying atmospheric conditions. Therefore, the proposed PMSM based LEV configurations with the aforesaid mentioned features lead to a zero carbon emission true EV. All the designed LEV configurations and their control algorithms are modelled, simulated and analyzed in the MATLAB/Simulink environment. Detailed discussion on their control performance and efficacy during starting, steady state and dynamic drive operating conditions are presented in this work. The proposed PV- Battery - PMSM motor drive using MARS controller based speed estimator has two different operating modes, which are suitable for generator- and motor-type applications, respectively. The effectiveness of the proposed speed estimators are verified by simulation.