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Control strategies for permanent magnet synchronous machines without mechanical sensors by sliding modes

Résumé

This thesis proposes an adaptive sensorless control based on sliding mode approach for interior permanent magnet synchronous motor (IPMSM). The proposed strategy is composed of an Adaptive High-Order Sliding Mode Observer (AHOSMO) in closed-loop with an Adaptive Super-Twisting Control (ASTWC), where the control and observer gains of the proposed strategy are parameterized in terms of a single parameter. Then, the main advantage of this strategy is the adaptable laws are easy to implement, avoiding overestimates of gains that increases of chattering, reducing the time to tune the gains, and reducing the damage of the actuators. Furthermore, an strategy for angular position estimation error extraction is proposed. Then, from this information, AHOSMO is designed for estimating the angular position and speed in a wide speed range, where the estimated variables provided by this observer are obtained with greater precision, despite the variations of the parameters, achieving greater robustness. These estimated states are used in the proposed robust control to track a desired reference of speed and direct-axis current. A stability analysis of the closed-loop system is presented, using a Lyapunov approach. In addition, the proposed strategy is validated throughout experimental and simulation set-up in order to show its effectiveness.

Mots-clés : IPMSM, Sensorless control, Adaptive observers, Adaptive controllers, Sliding mode