

A new robust tilt-PID controller based upon an automatic selection of adjustable fractional weights for permanent magnet synchronous motor drive control

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Abstract: This paper focuses on achieving a good trade-off between performance and robustness for a class of uncertainty models including unstructured multiplicative uncertainties. In robust control, the simultaneous improvement of the two secure margins for nominal performances and robust stability using a standard controller structure represents two contradictory objectives and guaranteeing simultaneously of these goals represents therefore a major challenge for most researchers. In this context, a robust tilt-proportional integral derivative (T-PID) controller synthesized with an automatic selection of adjustable fractional weights (AFWs) is discussed in our work. Their parameters are optimized through solving a weighted-mixed sensitivity problem using an optimization tool which is based on the genetic algorithm. This problem is formulated from performance and robustness requirements where a fitness function is accordingly determined. Furthermore, thus its search space is built according to some guidelines for ensuring an automatic selection of adequate AFWs. The proposed constrained optimization problem is initialized by using arbitrary T-PID speed controller as well as through initial fixed integer weights (FIWs) which were chosen previously by the designer. To highlight the proposed control strategy, the synthesized robust T-PID speed controller is applied on the permanent magnet synchronous motor. Their performance and robustness are compared to those provided by an integer-order PID (IO-PID) and two conventional fractional-order PID (FO-PID) controllers. This comparison reveals superiority of the proposed robust T-PID controller over the remaining controllers in terms of robustness with reduced control energy.

Keywords : Weighted-mixed sensitivity problem, Tilt-proportional integral derivative controller, Fractional-order FO-PID speed controller, Permanent magnet synchronous motor