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ROBUST PERFORMANCE CONTROL OF VECTOR-CONTROLLED INDUCTION MOTORS WITH GAIN-SCHEDULED ESTIMATION AND INPUT-OUTPUT LINEARIZATION

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Abstract. *The direct vector control of induction motors mainly relies on an accurate flux estimation. However, due to the variations of electrical parameters, the inaccuracy of estimated fluxes will cause the performance degradation of speed control. In this paper, a gain-scheduled flux observer is provided subject to parameter variations. As for the speed and flux tracking, an input-output linearization controller is proposed in the presence of flux estimation error and unknown load torque. To further improve the control performance, both the H_∞ performance index and pole assignment are considered as the design specifications. The derivations of the observer and controllers are in terms of linear matrix inequalities. Finally, a DSP/FPGA based experimental platform is set up to evaluate the feasibility of proposed control scheme. Experimental results illustrate that the proposed scheme works well in a wide speed-range. It also shows that the gain-scheduled flux estimation and input-output linearization controller can provide better tracking performance and robustness.*

Keywords: Vector control, Induction motor, Gain-scheduled, H_∞ performance, Input-output linearization, Linear matrix inequality

1. Introduction.

Induction motors are popularly used in industries due to the high durability and low cost of maintenance [1]. To precisely control an induction motor is not easy because of the highly nonlinear dynamics. Vector control of an AC induction motor is analogous to the control of a separately excited DC motor, and then the control complexity can be reduced. In the direct vector-controlled induction motors, the rotor flux is estimated rather than directly measured. As a matter of fact, the accuracy of the flux estimation is sensible to the achievability of high-performance control of induction motors. The development of a robust flux estimator is believed to be a promising challenge. In practice, the existence of flux-estimation errors will degrade the control performance of induction motors. Researches have been attracted to increase the accuracy robustness subject to parameter uncertainties. Current model and voltage model are two typical flux observers which have the advantage of computation simplicity. However, the incapability of dealing with parameter variations is the common drawback of conventional flux observers [2]. In some cases, the voltage signals used for the flux estimation are replaced with voltage commands and only the measurements of stator currents are required, but