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ADAPTIVE NEURAL POSITION TRACKING CONTROL FOR INDUCTION MOTORS VIA BACKSTEPPING

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Abstract. *The position tracking control of induction motors with parameter uncertainties and load torque disturbance is addressed. Neural networks are employed to approximate the nonlinearities and an adaptive backstepping technique is used to construct controllers. The proposed adaptive neural controllers guarantee that the tracking error converges into a small neighborhood of the origin. Compared with the conventional backstepping, the designed neural controllers' structure is very simple. Simulation results illustrate the effectiveness of the proposed control scheme.*

Keywords: Nonlinear system, Neural networks, Adaptive control, Induction motor, Uncertainty, Backstepping

1. **Introduction.** During the past few decades, the control of the induction motor constitutes a theoretically challenging problem since the dynamical system is usually multivariable, coupled and highly nonlinear. One of the most significant developments in this area is the field-oriented control (FOC) proposed by Blaschke [1] during the early 1970s, which is based on decoupling of the torque and flux producing components of the stator current [2, 3]. Unfortunately, this control approach suffers from sensitivity to the motor parameter variations and load disturbances.

In order to cope with the above drawback, much research has been done and some advanced control techniques are applied to the speed or position control of IMs and references therein. Wai et al. [4] develop a sliding-mode controller for field-oriented induction motor servo drive which can overcome the common drawback of FOC. Theoretically, the sliding motion is smooth if the switching frequency of a system is infinite. However, in practice, the switching frequency is finite, and thus chattering comes out along the sliding surface [4-7]. Marino et al. [8] develop an adaptive input-output linearizing control of IM. A new approach to dynamic feedback linearization control for an induction motor was addressed by Chiasson in [9]. However, the employed method of feedback linearization requires the exact mathematical model, so the controller requires the desired dynamics to replace the system at the $d-q$ axis stator currents [10]. Chiaverini and Fusco describe speed and rotor flux norm tracking H_∞ controllers with unknown load torque disturbances for current-fed induction motors [11]. The key of the H_∞ control is to synthesize a feedback law that renders the closed-loop system to satisfy a prescribed H_∞-norm constraint which represents desired stability or tracking requirements. However, in order to ensure robustness under large uncertainty perturbations, the H_∞ design usually brings a solution with high control gain which employs this approach not feasible in practical application.