

SLIDING MODE CONTROLLER DESIGN OF INDUCTION MOTOR BASED ON SPACE-VECTOR PULSEWIDTH MODULATION METHOD

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ABSTRACT. *In this paper, an integrated sliding mode controller (SMC) based on space-vector pulsewidth modulation method is proposed to achieve high-performance speed control of an induction motor. Using a field-oriented control principle, a flux SMC is first established to achieve fast direct flux control and then a speed SMC is presented to enhance speed control by the direct torque method. Both SMCs are designed in light of predetermined load disturbance and parameter uncertainties. Finally, the effectiveness of the proposed control scheme under the load disturbance and parameter uncertainties is verified by simulation results and comparison with the direct torque control (DTC) and proportional-integral direct torque control (PIC) approaches.*

Keywords: Induction motor, Sliding mode controller, Direct torque control

1. Introduction. The squirrel-cage induction motor has been widely used in many control systems and industrial automatic systems. It has many advantages, such as simple structure, firmness and low maintenance cost. In many applications of the induction motor, high performance speed control is the fundamental issue. However, induction motors are difficult to control for several reasons: their dynamics are intrinsically nonlinear and multivariable; not all of the state variables and not all of outputs to be controlled may be available for feedback; there are critical parameters (for instance, load torque, stator and rotor resistances) which may considerably vary during operations [1]. In recent years, various high-performance control strategies have been developed for the induction motor [1-9]. A well-known method in AC servo drive systems is field-oriented control (FOC) [1,2]. With field-oriented techniques, the decoupling of the induction motor's flux and torque can be controlled separately as an excited DC motor. But FOC requires accurate and complex calculation of the decoupling, so it is difficult to operate and easily influenced by load disturbance and parameter uncertainties.

The conventional direct torque control (DTC) strategy is useful for overcoming these disadvantages of FOC [3,4]. The principle of DTC is to use the respective hysteresis band comparators of torque and stator flux to determine errors, and then to select the stator voltage vector according to the switching table to control the torque and stator flux directly. DTC doesn't require complex decoupling calculation and is easy to implement due to its simple structure. However, DTC has some drawbacks during induction motor operation, such as large ripples in torque and flux at low speeds. In order to reduce ripples in torque and flux, a discrete space vector modulation (DSVM) has been proposed [5] by means of a new switching table. Since its sampling period is subdivided, this new switching table will be more complex, with the result that its DSVM takes more time to calculate and requires a greater sampling time than that of the DTC does. As