Application of LQR Theory to the Stator Field Oriented Control of Induction Motors

Mohamad Abd-Alraheim Badr ,O.S. Ebrahim ; M.F. Salem ; P.K. Jain ;

Abstract

Realisation of a digital control system, which implements a complete state feedback control strategy for the voltage-source inverter-fed induction motor (IM) drive, is reported. The controller design is based on the application of the linear quadratic regulator (LQR) theory to a linearised state-space model for the machine in the synchronous frame. The control objective is to achieve rotor speed control and orientation of the stator flux vector at constant magnitude by adjusting the stator voltage and frequency. To overcome the detrimental effects of inevitable modelling errors and disturbances, the structure of the feedback controller used here resembles that of the classical proportional-integral controller but is more versatile. The control system design considers the inverter-s output limits and proposes an anti-windup scheme to avoid instability risk under integral windup. A supplementary feedforward control loop is provided to enhance transient response of the controlled drive by utilising few future values of the speed reference and load torque signals in advance. The hardware implementation of a controller is discussed and experimental tests are presented, along with computer simulation results, to verify the validity of the method.

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