Abstract

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Vector controlled-induction motor drive: operation and analysis

Many industrial applications require a continuously adjustable range of speeds. DC motors have been used in such drives. However, DC motors are expensive, prohibitive in hazardous atmospheres and require frequent commutators and brushes maintenance. Induction Motors (IM's), on the other hand, are cheap, rugged, have no commutators, and are suitable for high-speed applications but they exhibit highly coupled nonlinear multi-variable structures. The availability of solid-state controllers, although more complex than those used for DC motors, has made it possible to drive induction motors in the same way as a separately excited DC motor using vector control scheme where torque control is achieved by controlling the torque and flux current components of the armature current independently. Vector control has a fast torque response which allows accurate torque, speed position control and it can operate the induction motor in a four-quadrant mode. Also, decoupled flux and torque control allows operating induction machine with a low load torque. This paper presents the operation and analysis of the indirect-vector controlled induction motor drive. The basic principle of vector control induction motor is presented. The dynamic model is explained. The effect of torque and flux producing components of stator current on steady state performance is studied. The transient response of vector controlled induction motor is analyzed and then compared with that of the DC machine to show analogy between both drives. The reversal of speed direction and field weakening operation are explained. A comparison between vector controlled induction motor and chopped dc drives are compared.