ELECTRICAL AUTOMATION SYSTEMS TOWARDS INTELLIGENT AND ENERGY EFFICIENCY APPLICATIONS

Musse Mohamud Ahmed

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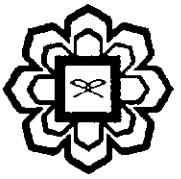

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CHAPTER 26

ENERGY EFFICIENCY IMPLEMENTATION OF PERMANENT MAGNET SYNCHRONOUS MOTOR

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26.1 Introduction

The Permanent Magnet Synchronous Motor (PMSM) need to be implemented in the industry because of its potential for higher efficiency, power factor and low sensitivity to supply voltage variations, are more desirable than induction motors for high duty factor applications. The permanent magnet rotor has mechanical reliability equal to that of an induction motor. The excitation losses found in induction and synchronous machines are absent. This increases operating efficiency permanent magnet machines offer the highest inherent electrical efficiency along with the potential for a life cycle cost (initial cost and operating cost) equal to or lower than that of induction motor in similar applications.

PMSM has numerous advantages over other machines that are conventionally used for ac servo drives. The stator current of the induction motor (IM) contains magnetizing as well as torque-producing components. The use of the permanent magnet in the rotor of the PMSM makes it unnecessary to supply magnetizing current through the stator for constant air-gap flux; the stator current need only be torque producing. Hence for the same output, the PMSM will operate at a higher power factor (because of the absent of magnetizing current).and will be more efficient than Induction Motor. The development of the PMSM was to remove the foregoing disadvantages of the Synchronous Motor by replacing its field coil, DC power supply and slip rings with a permanent magnet [11].

26.2 Model of Permanent Magnet Synchronous Motor

The two axes of PMSM stator windings can be considered to have equal turn per phase. The rotor flux can be assumed concentrated along the "d" axis while there is zero flux along the "q" axis, an assumption similarly made in the derivation of indirect vector controlled induction motor drives. Also, rotor flux is assumed to be constant at a given operating point.

There is no need to include the rotor voltage equation as in the induction motor since there is no external source connected to the rotor magnet and variation in the rotor flux with respect to time is negligible.

The stator equations of the induction machine in the rotor reference frames using flux linkages are taken to derive the model of the PMSM. The rotor reference frame is chosen because the position of the rotor magnets that determines independently of the stator voltages