AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
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INVESTIGATION OF DYNAMIC PERFORMANCE OF DIRECT TORQUE CONTROLLED PERMANENT MAGNET SYNCHRONOUS MOTORS

BY
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Investigation Of Dynamic Performance Of Direct Torque Controlled Permanent Magnet Synchronous Motors.

M.Sc. Thesis

By

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Submitted in partial fulfillments of the requirements for
the M.Sc.degree in electrical engineering

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STATEMENT

This thesis is submitted to Ain Shams University in partial fulfillment of the requirements for M.Sc. degree in Electrical Engineering.

The included work in this thesis has been carried out by the author at the Electrical Power and Machine Department, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

The Direct Torque Control (DTC) is the more efficient method in AC motor control. It provides a high performance motor drive which is very important in industrial applications such as robotics, rolling mills, machine tools and paper industry.

The key issue of the DTC is to keep the stator flux constant within prescribed hysteresis band and hence the torque can be controlled by selecting the proper stator space voltage vector.

This thesis presents a study of the dynamic behavior of a direct torque controlled permanent magnet synchronous motor (PMSM) based on a simulation of the mathematical model of the system under study. This model comprises the mathematical equations of the motor in the d-q reference frame along with the inverter model and the representation of the direct torque control main blocks.

The simulation results of the DTC PMSM for different command torques show fast and accurate torque response. Meanwhile, the DTC shows robustness to follow step and ramp torque commands.

The effect of varying the sampling time on the dynamic response of the PMSM driven by DTC is carried out to select the most suitable value.

This thesis demonstrates also the dynamic response when the DTC is used for speed control. A traditional proportional-plus-integral PI controller is implemented to close the outer speed control loop. In this context, different speed trajectories are tested through the simulation program for step changes in the speed reference command. The simulation results cover different reference speeds. The effect of changing the proportional gain of the PI controller is investigated. This controller has been found capable of improving the overall dynamic response of the PMSM driven by DTC.

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