



**AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
ELECTRIC POWER AND MACHINES DEPARTMENT**

***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.

TABLE OF CONTENTS

LIST OF FIGURES	XIV
LIST OF TABLES	XVII
LIST OF SYMBOLS	XVIII

CHAPTER 1

INTRODUCTION

1.1- General	1
1.2- Variable Speed Drive	1
1.3- Evolution Of Direct Torque Control_.....	2
1.3.1- DC Motor drives.....	3
1.3.2-AC Motor drives	6
1.3.2.1-AC Drives -frequency control using PWM.....	7
1.3.2.2-AC Drives -flux vector control using PWM	9
1.3.2.3-AC Drives - Direct Torque Control (DTC) ...	12
I. 4- Thesis Objective And Layout.....	13

CHAPTER 2

PERMANENT MAGNET SYNCHRONOUS MOTOR (PMSM)

2.1- The Factors Taken Into Account When Selecting a Drive...	15
2.2- Types Of Famous Motors Used In Industry	17
2.2.1- Commutator motors.....	17
2.2.2- Squirrel cage induction motors.....	18
2.2.3- Wound rotor induction motor.....	18
2.2.4- Synchronous motors.....	19
2.2.5- Synchronous-reluctance motors.....	20
2.2.6- Permanent magnet synchronous motors design concept.....	20
2.2.7- Permanent magnet-reluctance motors.....	22
2.3- Comparison Between PMSM And Other Motors.....	23
2.3.1- Losses and efficiency.....	23
2.3.2- Applications in industrial drives.....	25
2.3.3- Constant power applications.....	26
2.3.4- Cost and design complexity	27
2.4- The Advantages Of PMSM Motors.....	28
2.5- Types Of PMSM Motors According To The Construction.....	29
2.5.1- Surface-mounted magnets.....	29

2.5.2- Inset magnets.....	30
2.5.3- Interior (Burried) permanent magnet with radial magnetization.....	30
2.5.4-Interior (Burried) permanent magnet with circumferential magnetization.....	30

CHAPTER 3

DIRECT TORQUE CONTROL

3.1- General.....	34
3.2- Main Components Of Direct Torque Control.....	35
3.2.1- Torque/flux comparators.....	36
3.2.2- Optimal switching logic.....	37
3.2.3- Adaptive motor model.....	41
3.3- Control Of Stator Flux Linkage By Selection Of The Proper Stator Voltage Vector.....	45
3.3.1- The control of the amplitude of stator flux linkage.....	47
3.3.2- The control of the rotation of Ψ_s	48

CHAPTER 4

MATHEMATICAM MODELING OF PMSM

4.1- General.....	51
4.2- Basic Assumptions.....	52
4.3- Motor Equations In Original Phase Values Reference Frame.....	54
4.4- Motor Equations In The Rotor Reference Frame.....	56

CHAPTER 5

SIMULATION RESULTS AND DISCUSSIONS

5.1- General	58
5.2- Dynamic Response.....	58
5.2.1- Dynamic response for constant command torque	59
5.2.2- Dynamic response for sequential changes in the command torque	65
5.2.3- Dynamic response for a ramp change in the command torque	71

5.3- Effect of Varying the Sampling Time on the Torque Ripple	76
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CHAPTER 6

DTC FOR SPEED CONTROL

6.1- General.....	82
6.2- Simulation Results and Comments for Speed Control...	82
6.2.1- The dynamic response for constant command speed.....	83
6.2.2- The dynamic response for step command Speed.....	89

CHAPTER 7

CONCLUSION

7.1-Conclusions	95
7.2-Future Work	96

LIST OF FIGURES

Chapter 1

Fig. 1.1. Control loop of a DC Motor Drive

Fig. 1.2. Control loop of an A C Drive with frequency control
using PWM

Fig. 1.3. Control loop of an AC Drive with flux vector control
using PWM

Fig. 1.4. Control loop of an A C Drive using DTC

Chapter 2

Fig. 2.1.-a Surface - mounted magnet

Fig. 2.1.-b Inset magnet

Fig. 2.1.-c Buried magnets with radial magnetization

Fig. 2.1.-d Buried magnets with circumferential magnetization

Chapter 3

Fig. 3.1. Basic direct torque-control scheme

Fig. 3.2. Available stator voltage vectors

Fig. 3.3. Stator spatial vector relationships

Fig. 3.4. An inverter fed PMSM

Fig. 3.5. The control of the stator flux linkage

Chapter 4

Fig. 4.1. Permanent Magnet Synchronous Machine

Chapter 5

Fig.5.1. The command torque

Fig. 5.2. The developed torque of PMSM equipped with DTC.

The sampling time equals 25 μ s.

Fig. 5.3. Motor speed

Fig. 5.4. Stator rotating flux

Fig. 5.5. Stator flux magnitude.

Fig.5.6.The simulation results for the d and q axis component
of the stator flux.

Fig. 5.7. Stator flux position in space.

Fig. 5.8. The command torque

Fig. 5.9. The simulation results of the developed torque

Fig. 5.10. Motor speed

Fig. 5.11. Stator rotating flux

Fig. 5.12. Stator flux magnitude

Fig. 5.13. The simulation results of the direct and quadrature
axis component of the stator flux.

Fig. 5.14. Stator flux position.

Fig. 5.15. The command torque.

Fig. 5.16. The simulation results of the developed torque