



UNIVERSITI PUTRA MALAYSIA

***INDIRECT FIELD-ORIENTED CONTROL OF INDUCTION MOTOR USING FUZZY
LOGIC TECHNIQUE***

WAN MOHAMAD KHAIRUDIN B. WAN ABD. MALIK

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MALIK**

**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA**

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By

WAN MOHAMAD KHAIRUDIN B. WAN ABD. MALIK

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

May 2012

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
Fulfillment of the partial requirements of the degree of Master of Science

**INDIRECT FIELD-ORIENTED
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By

WAN MOHD KHAIRUDIN B. WAN ABDUL MALIK

May 2012

Chairman: Professor Norman Bin Mariun, PhD, PEng

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In modern application of electric motors, wide ranges of speed and torque are required to drive the industrial processes, electric vehicles, water pumps, home appliances and others. While some of the processes require various speeds with constant torque, other processes require various torques with constant speed or both. These processes are using continuous, non-continuous, linear and non-linear loads. Many control methods have been designed and implemented to increase quality, process efficiencies and reduction in energy consumption.

The Indirect Field Oriented Control (IFOC) is a method of controlling three-phase induction motor which converts the three-phase induction motor into a linear device

where the torque and the flux in the motor can be controlled independently. The aim of this work is to simulate IFOC in MATLAB/Simulink and further to implement the system using MATLAB/Simulink and Code Composer Studio (CCS) software with DSPF2812 controller board. The simulations of IFOC system include Proportional / Integral (PI) and Fuzzy Logic controller. The simulation will determine response and stability of the system.

The system implementation is divided into three steps. The first step is to design the system using Matlab/Simulink software. This includes the IFOC system, parameter setting and configuration of the controller board input and output interfaces. Second part is to develop three-phase inverter, driver circuit and signal conditioning circuit. The third part is to test the IFOC system and to record the response of the system in both simulation and implementation works. The results show the speed response with different PI gain setting and Fuzzy Logic controller.

The configuration of the controller board is done through MATLAB DSP toolbox. New Fuzzy controller is designed using MATLAB/Simulink block set and direct implementation through the software is introduced. The results showed that Fuzzy Logic controller produced better response as compared to PI.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

**KAWALAN MEDAN TIDAK LANGSUNG
MOTOR ARUHAN TIGA FASA MENGGUNAKAN TEKNIK LOGIK
SAMAR**

Oleh

WAN MOHD KHAIRUDIN B. WAN ABDUL MALIK

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Penggunaan motor elektrik pada masa kini memerlukan pelbagai tahap kelajuan dan daya kilas bagi memacu proses-proses industri, kenderaan elektrik, pam air, peralatan rumah dan sebagainya. Sebahagian daripada proses ini memerlukan tahap kelajuan yang berubah-ubah dengan daya kilas yang tetap, manakala sebahagian lagi memerlukan daya kilas yang berubah-ubah dengan kelajuan yang tetap atau kedua-duanya berubah. Proses-proses ini terdiri dari pelbagai keadaan samada linear, tidak linear, beban yang tetap atau beban yang berubah-ubah. Pelbagai kaedah litar pengawal telah direka bagi tujuan peningkatan kualiti, kecekapan proses dan penjimatan tenaga.

Kaedah kawalan medan merupakan kaedah untuk mengawal motor aruhan tiga fasa yang menukarkan parameter motor tersebut kepada peranti linear di mana tork dan

medan dikawal secara berasingan. Kerja ini bertujuan mereka bentuk simulasi kawalan orientasi medan secara tidak langsung dalam perisian Matlab/Simulink dan implimentasi sistem ini menggunakan Matlab/Simulink, Code Composer Studio dan Pemproses Isyarat Digit DSPF2812.

Simulasi sistem kawalan medan ini menggunakan pengawal berkadar dan intergrasi dan pengawal Logik Samar. Simulasi akan menentukan sambutan dan kestabilan sistem. Pelaksanaan sistem ini adalah dibahagikan kepada tiga bahagian. Bahagian pertama ialah mereka bentuk sistem yang menggunakan perisian Matlab/Simulink. Ini termasuk sistem kawalan medan, menentukan parameter yang sesuai dan konfigurasi terminal masukan dan keluaran sistem Pemproses Isyarat Digit.

Bahagian kedua ialah membangunkan penyongsang tiga fasa, litar pemandu dan litar isyarat bersyarat. Bahagian ketiga adalah menguji sistem kawalan medan dan merekod sambutan sistem untuk simulasi dan implimentasi. Keputusan menunjukkan sambutan halaju bagi nilai PI yang berbeza dan juga menggunakan kawalan Logik Samar.

Konfigurasi pemproses ini dilakukan melalui Pemproses Isyarat Digit di dalam Matlab/Simulink. Pengawal Logik Samar yang baru telah direka dengan menggunakan blok yang terdapat di dalam Matlab/Simulink dan implimentasi secara terus melalui perisian tersebut telah diperkenalkan. Keputusan menunjukkan

pengawal Logik Samar memberikan respon yang lebih baik jika dibandingkan dengan kaedah pengawal berkadar dan integrasi.



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I certified that a Thesis Examination Committee has met on 11th May 2012 to conduct the final examination of Wan Mohamad Khairudin on his thesis entitled “**Indirect Field Oriented Controlled of Induction Motor Using Fuzzy Logic Technique**” in accordance with the Universities and University Colleges Act 1971 and the Constitution of Universiti Putra Malaysia (P.U.(A) 106) 15 March 1998. The committee recommends that the student be awarded the Master of Science.

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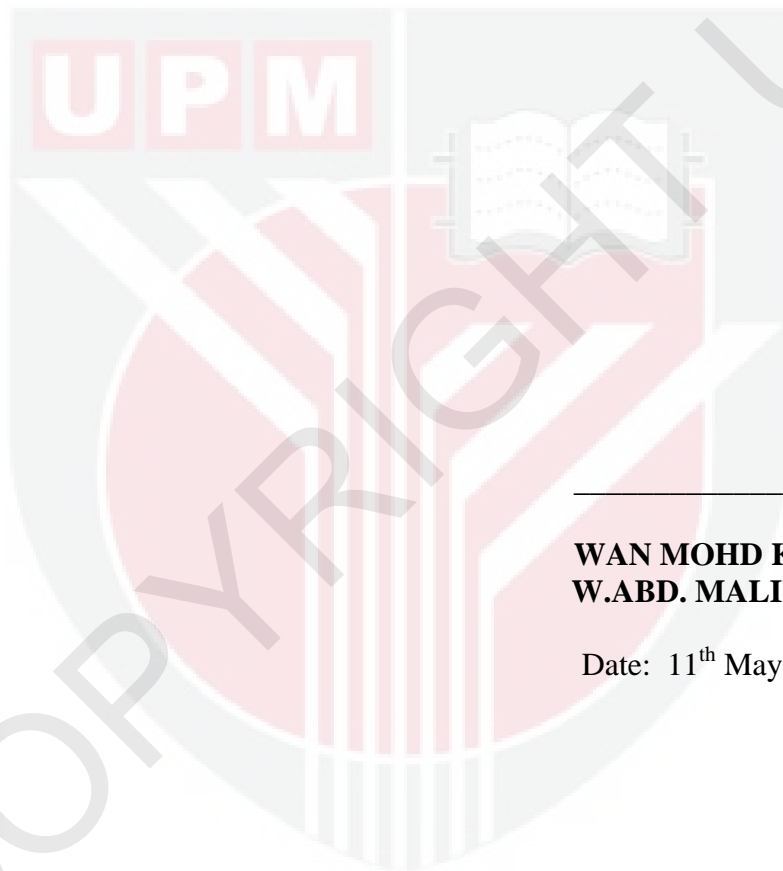
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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.



**WAN MOHD KHAIRUDIN B.
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Date: 11th May 2012

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