

**DESIGN AND PERFORMANCE OF FUZZY LOGIC SPEED
CONTROLLER FOR DC MOTOR**

This project is presented in partial of fulfillment for the award of Bachelor of Electrical
Engineering (Hons)

UNIVERSITI TEKNOLOGI MARA



KAMARUL AZWAN BIN MOHD ZAWAWI
Faculty of Electrical Engineering
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
OCTOBER 2003

Acknowledgement

I wish to acknowledge my debt to all those who have somehow contribute to my knowledge and efforts on this project.

First of all, I would like to show my gratitude to my respected supervisor who has proposed this project, En Razali Bin Hj Abd Hadi for his invaluable support, patient, guidance, assistance and especially his encouragement to this project. A token of appreciation is also to lecturer Associate Prof Ir Dr Shah Rizam bt Mohd Shah Baki for their kind and generous advice.

Finally, I am greatly indebted to all my course mates who have involve directly or indirectly for their aid and comments throughout development of this project. Moreover, great appreciation also goes up to my family for their wholeheartedly supports and patience.

Abstract

This thesis presents the research study and design of a Fuzzy Logic Controller (FLC) to be implemented in the experiment of DC Motor speed controller. Separately excited DC motor with fuzzy controller is simulated. The linear and optimization process of fuzzy logic controller (FLC) is supported by tuning parameter from Proportional Integrative Derivative (PID) controller.

Experiments are conducted in order to obtain the best performance design for the close-loop system. The result shows that for certain value of the scaling factor of FLC, minimum error can be obtained and the performance of the system provides a faster transient response. Further analysis on the functionality of the fuzzy controller is evaluated by comparing the result in Fuzzy Logic with classical method (PID).

This model used an implementation under MATLAB/SIMULINK. Furthermore, it is also very useful in designing a controller in order to make sure a specific control system is stable.

TABLE OF CONTENTS

CHAPTER	DESCRIPTION	PAGE
	ACKNOWLEDGEMENT	v
	ABSTRACT	vi
	TABLE OF CONTENTS	vii
	LIST OF FIGURES	xi
	LIST OF TABLES	xiv
	LIST OF ABBREVIATIONS	xv
1	INTRODUCTION	
	1.1 Introduction	1
	1.2 Objective	2
	1.3 Scope of Work	3
	1.4 Organization of the Thesis	4
2	DC MOTOR	
	2.1 Introduction to the Modeling Electrical Machines	5
	2.1.1 Voltage and Torque equations of the Cylindrical Electric Machine with two windings	6
	2.1.2 General circuit Model of the Electrical Machine	7
	2.2 Introduction to DC Motors	9
	2.3 Modeling electric DC Motor	10
	2.3.1 Methods of speed control	13
	2.3.1.1 Armature Voltage Control	13
	2.3.1.2 Field Flux Control	14
	2.3.1.3 Armature Resistance Control	14

CHAPTER	DESCRIPTION	PAGE
	2.3.2 Feedback control system	15
	2.3.3 Separately Excited DC Motor	15
	2.3.3.1 Transfer Functions and Block Diagrams	16
	2.3.3.2 Armature control equation	16
 3	 PID CONTROLLER (CLASSICAL METHOD)	
	3.1 Introduction	20
	3.2 Three term controller	21
	3.3 Transient response analysis	22
	3.4 Tuning method	24
	3.4.1 Ziegler Nichol's method	24
	3.4.2 Trial and Error method	25
	3.4.2.1 Proportional control	26
	3.4.2.2 PD control	26
	3.4.2.3 PI control	26
	3.4.2.4 PID control	26
 4	 FUZZY LOGIC CONTROL (FLC)	
	4.1 Introduction	27
	4.2 Definition of Fuzzy Logic Control (FLC)	28
	4.3 Classical Logic and Fuzzy Logic	28
	4.4 Direct Fuzzy Logic Control	29
	4.5 Foundation of Fuzzy Logic	30
	4.5.1 Fuzzy sets	30
	4.5.2 Basic fuzzy sets operation	31
	4.6 General control scheme	33
	4.6.1 Fuzzifier	33
	4.6.2 Membership functions	34