□□□□□

□□□□□□ □□□□□□ □□□□ □□□

□□□□□□ □□□□ □□□

Dedication

I dedicate This

:Work To

My mother

MY father

My husband

My brothers and my sisters

My daughter and my sun

And all My friends

Acknowledgment

All my thanks go to alla, the most beneficent, the most merciful for his great help in doing my studies and completing this works.

I would like to express my sincerest gratitude and to my supervisor Dr. Awad Alla Taifour Ali for his guidance .I would like to thank him for his patience, encouragement, helpful and intelligent suggestions.

Abstract

This study presents the design of a fuzzy model reference adaptive control for the inverted pendulum-cart system. Inverted pendulum is well known as a testing bed for various controllers. Fuzzy logic controller is one of the most important applications of fuzzy-rule-based system that models the human .decision processing with a collection of fuzzy rules

The main goal of this work is to provide a comparative between three kinds of controllers for inverted pendulum : proportional integral derivative control (PID control) , fuzzy logic controller and finally fuzzy model reference . adaptive control

□□□□□□

هذه الدراسة ت قدم تصميم نظام تحكم نموذجي مرجعي تكيفي للبندول العكسي باستخدام المتحكم الغامض

, البندول العكسي معروف عادة كوسيلة اختبار للعديد من المتحكمات . المتحكم الغامض هو أحد أهم تطبي قات وحدات النظام الغامض المعتمد علي ال قواعد والتي ت قوم بنمذجة عملية اتخاذ ال قرار عند الانسان اعتمادا علي مجموعة قوانين غامضة .

الهدف الأساسي من هذا العمل هو الم قارنة بين ثلاثة متحكمات للبندول العكسي وهي : (متحكم تناسبي – تكاملي – تفاضلي) , متحكم منط قي غامض واخيراً المتحكم المرجعي التكيفي الغامض.

TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

CHAPTER TWO: THEORITCAL BACKGROUND AND LITERATURE REVIEW

CHAPTER THREE :MATHEMATICAL AND CONTROL SYSTEM DESIGN

CHAPTER FOUR: SIMULATION RESULTS

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

List of symbols

proportional gain

Derivative gain

Integral gain	
Integral time	
Mass of the cart	M
Mass of the pendulum	m
Moment of inertia for inverted pendulum	I
Pendulum angle with vertical	
Friction of cart	b
Force applied to the cart	F
Cart position coordinate	X
Length of pendulum to center of gravity	L
Damping ratio for reference model	ξ
Natural frequency for reference model	

List of a bbrivation

The Central Nervous System	CNS

Fuzzy Model Reference Adaptive Control	FMRAC
Inverted Pendulum	IP
Linear Quadratic	LQ
Membership Functions	MFS
Multi Input Multi Output	MIMO
Model Reference Adaptive control	MRAC
Proportional Derivative	PD
Proportional Integral Derivative	PID
Single Input Single Output	SISO
Self Tuning Regulators	STRs