

**COMPARATIVE STUDY of OPTIMAL POWER FLOW using
EVOLUTIONARY PROGRAMMING and IMMUNE
EVOLUTIONARY PROGRAMMING TECHNIQUE in POWER
SYSTEM**

**UNIVERSITI TEKNOLOGI MARA
MALAYSIA**

MOHD KHAIRIL IZWAN BIN MD DAIM

2003328136

**FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
MALAYSIA**

ACKNOWLEDGEMENT

In the name of ALLAH S.W.T, The most Beneficent, The most Merciful. It is with the deepest sense of the Al-Mighty Allah that gives me the strength and ability to complete this project. All good aspirations, devotions and prayers are due to ALLAH whose blessing and guidance have helped me throughout the entire project.

I would like to acknowledge and express my sincere gratitude towards my supervisor P.M Dr. Titik Khawa Abdul Rahman for her concern, valuable time of consultation and advice, guidance and patience in supervising my project from the beginning until the completion of this project thesis.

Last but not least, my special thanks to all my friends, Elmi, Hafizan, Azura and Zamzuhairi, for the valuable help and motivation given in completing this project. Most of all to my beloved family, especially my mother and my father who are dearest person in my life and greatest source of inspiration, thank you for the endless love and encouragement they have given and for being so understanding.

ABSTRACT

Optimal power flow (OPF) is one of the main functions of power system operation and control. This project presents a new technique for solving the optimal power flow problem, in a power system using an Evolutionary Programming and Immune Evolution Programming optimization technique. This study will utilize concept of Immune Evolutionary Programming (IEP) which is a combination of EP and AIS technique and compare the results to that obtained from Evolutionary Programming (EP) technique. The study explores two functions namely total loss minimization and total cost minimization as the objective function. Comparison was made in order to determine the base objective function to be used for the solving Optimal Power Flow (OPF) problem. The developed algorithm was tested against on IEEE 26 bus test system.

Keywords:

Evolutionary Programming (EP), Artificial Immune System (AIS), Immune Evolutionary Programming (IEP), Optimal Power Flow (OPF).

TABLE OF CONTENTS

	PAGE
DECLARATION	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
TABLE OF CONTENTS	v
LIST OF FIGURE	ix
LIST OF TABLES	x
SYMBOLS AND ABBREVIATIONS	xi
CHAPTER 1	
INTRODUCTION	
1.1 Background	1
1.2 Aim of the Project	3
1.3 Organization of the Thesis	3
CHAPTER 2	
OPTIMAL POWER FLOW	
2.1 Introduction	4
2.2 The Economic Dispatch Problem	6
3.2.1 Economic Dispatch without Losses	6
3.2.2 Economic Dispatch with Losses	8
3.2.3 Effect of Inequality Constraints	22
2.3 Control Variables	12
2.4 Objective Function	12
CHAPTER 3	
EVOLUTIONARY PROGRAMMING (EP)	
3.1 Introduction	25

3.2	Features of EP	25
3.3	Types of EP	26
	3.3.1 General Evolutionary Programming	28
	3.3.2 Fast Evolutionary Programming	28
	3.3.3 Selective Evolutionary Programming	29
3.4	Developing Object Orientation	29
3.5	Evolutionary Programming Algorithm	29
	3.5.1 Initialization	30
	3.5.2 Mutation	30
	3.5.3 Tournament/ Selection	32
	3.5.4 Convergence Test	32

CHAPTER 4

ARTIFICIAL IMMUNE SYSTEM (AIS)

4.1	Introduction	29
4.2	The Clonal Selection Theory	30
4.3	Reinforcement Learning and Memory	32
4.4	Somatic Hypermutation, Receptor Editing and Repertoire Diversity	33

CHAPTER 5

IMMUNE EVOLUTIONARY PROGRAMMING (IEP)

5.1	Introduction	36
5.2	Immune Evolutionary Programming Algorithm	36
	5.2.1 Initialization	36
	5.2.2 Mutation	37
	5.2.3 Selection	38
	5.2.4 Cloning Process	38
	5.2.5 Second Mutation	38
	5.2.6 Second Selection	38
	5.2.7 Convergence Test	39