

بسم الله الرحمن الرحيم





شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار





بالرسالة صفحات
لم ترد بالأصل





بعض الوثائق الأصلية تالفة



Design and Tuning of Load Frequency Controllers

B11 VAK

by

Eng. Mokhtar Hussein Abdel Allah Osman

A thesis submitted to the electrical Power and Machines Department Faculty of
Engineering, Cairo University

In partial fulfillment of the requirement for the Degree of

MASTER OF SCIENCE



In

Electrical POWER AND MACHINES ENGINEERING

Faculty OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

DECEMBER, 2006

1022

1023

1024

1025

1026

1027

1028

1029

1030

1031

1032

Design and Tuning of Load Frequency Controllers

by

Eng. Mokhtar Hussein Abdel Allah Osman

A thesis submitted to the electrical Power and Machines Department Faculty of Engineering,

Cairo University

In partial fulfillment of the requirement for the Degree of

MASTER OF SCIENCE

in

Electrical POWER AND MACHINES ENGINEERING

Under supervised of



Prof. Dr. Mohammed Hesham Mohammed

Department of electrical power

And Machines Engineering,

Cairo University, Giza



Prof. Dr. Abdel Latif Mohammed Ragaaei El-Shafei

Department of electrical power

And Machines Engineering,

Cairo University, Giza

Faculty OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

DECMBER, 2006

12. 12. 1930. 12. 12. 1930.

12

12. 12. 1930. 12. 12. 1930.

12. 12. 1930. 12. 12. 1930.

12. 12. 1930. 12. 12. 1930.

12

12. 12. 1930. 12. 12. 1930.

12. 12. 1930. A

12. 12. 1930. 12

12

Design and Tuning of Load Frequency Controllers

by

Eng. Mokhtar Hussein Abdel Allah Osman

A thesis submitted to the electrical Power and Machines Department Faculty of

Engineering, Cairo University

In partial fulfillment of the requirement for the Degree of

MASTER OF SCIENCE

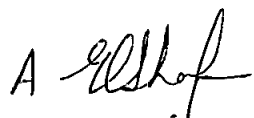
in

Electrical POWER AND MACHINES ENGINEERING

Approved by the Examining committee:

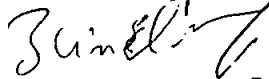
Prof. Dr. Abdel Latif Mohammed Ragaaei El-Shafei

(Advisor)



Prof. Dr. Hussein Magdi *Zemeldin*

(Member)



Prof. Dr. Hamdy Saleh Khaliell El Gohary

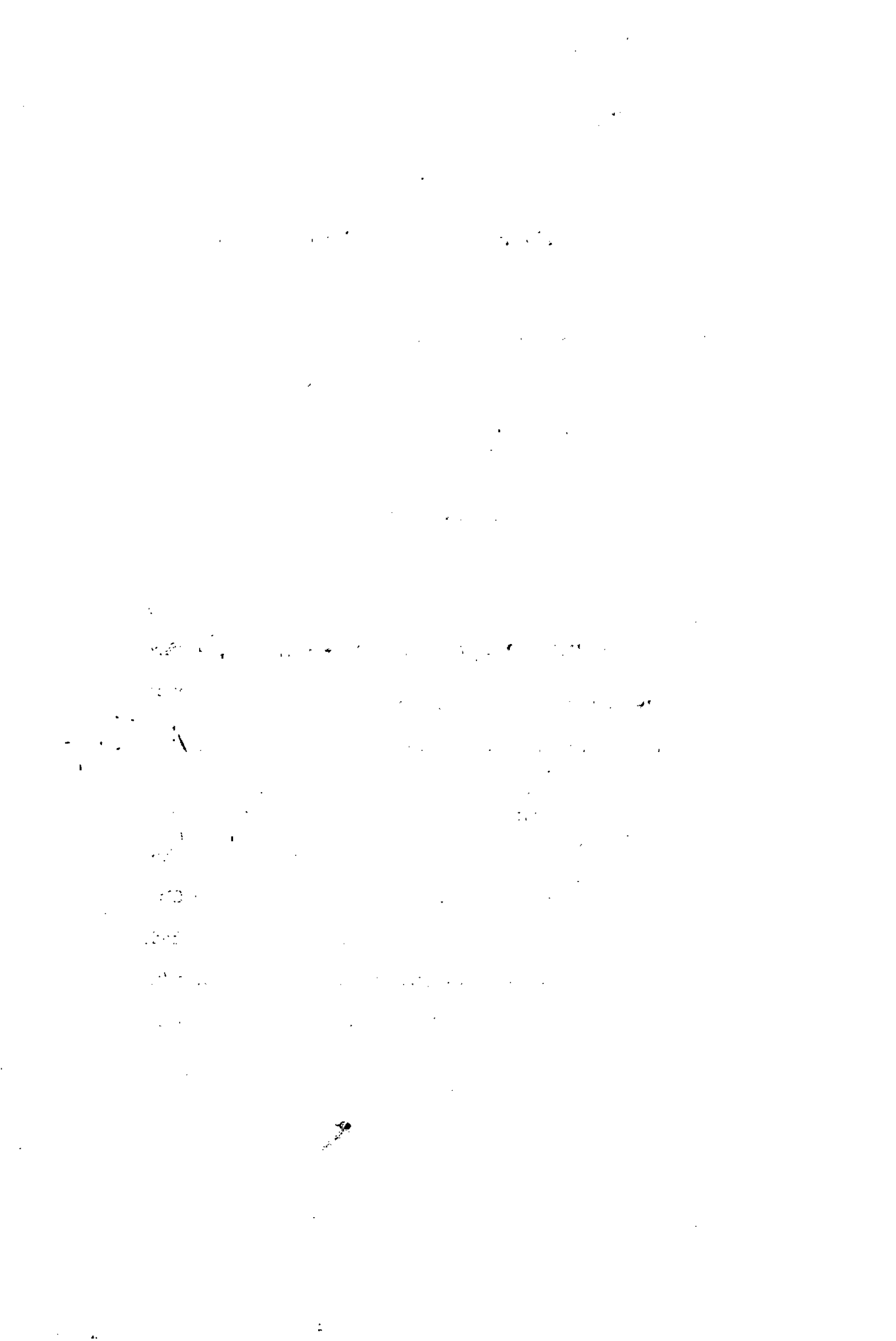
(Member)



Faculty OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

DECEMBER, 2006



Abstract

This dissertation deals with the problem of load frequency control. The aim is to maintain the scheduled system frequency and / or to establish interchange with other areas within its limits. The proposed control has been designed for a four area interconnected power system.

The starting point is the conventional PI controller but we will investigate a new approach in the control law by adapting a formulation for area control error which always guarantees zero steady state error and inadvertent interchange.

Tuning the gains of the PI controller is an on-going research point. Fuzzy systems are used to adapt the PI parameters. Also, we will investigate the possibility of replacing the conventional PI controller by a fuzzy controller. Furthermore, the fuzzy system itself may be needed to tune (scaling factor, the position membership function and the rule base). Tuning of fuzzy systems (scaling factor) will be done based on a genetic algorithm. Also, we will discuss the effect of the genetic algorithm parameters (e.g crossover, mutation, fitness function).

We will investigate generalized predictive controllers for our problem and will discuss the effect of GPC's parameters (control horizon, minimum output horizon and maximum output horizon). We will use the genetic algorithm to tune GPC's parameters (control horizon, minimum output horizon and maximum output horizon). Finally, we will hold a comprehensive comparison among all controllers considered in the thesis. We will use the PI controller as a reference to compare the controllers and show the level of performance for each controller.

Table Of Contents

Abstract.....	ii
Table Of Contents.....	iii
List Of Figures.....	vi
List Of Tables.....	xi
List Of Symbols.....	xii
Chapter 1 Introduction.....	1
1.1. Introduction.....	1
1.2. Literature Survey.....	2
1.3. The Research Plan.....	3
Chapter 2 Background.....	5
2.1. Introduction.....	5
2.2. Load Frequency Control Problem.....	5
2.3. Systems Models.....	6
2.3.1. Generator Model.....	6
2.3.2. Load Model.....	7
2.3.3. Prime Mover Model.....	7
2.3.4. Governor Model.....	8
2.4. Automatic Generation Control.....	10
2.4.1. AGC in a Single Area System.....	11
2.4.2. AGC in the Multiplier Area System.....	11
2.5. Introduction to Fuzzy Logic.....	15
2.5.1. Introduction.....	15
2.5.2. Operations On Fuzzy Sets.....	15
2.5.3. Fuzzy Classification.....	16

2.6. Genetic Algorithms.....	20
2.6.1. Theory of Evolutionary Computation.....	20
2.6.2. EC Paradigm Attributes.....	20
2.6.3. Implementation.....	21
2.6.4. Genetic Algorithms Introduction.....	23
Chapter 3 LFC Design.....	25
3.1. Introduction.....	25
3.2. System Model.....	25
3.3. Type Of Controller.....	31
3.3.1. Conventional PI Controller.....	31
3.3.2. Fuzzy Logic Tuner of a conventional PI controller.....	34
3.3.3. Fuzzy Control.....	41
3.4. Conclusions.....	47
Chapter 4 Control Tuning Using A Genetic Algorithm.....	48
4.1. Introduction To Controller Design Using Genetic Algorithm.....	48
4.2. Design Method.....	48
4.3. Genetic Controller.....	50
4.3.1. Genetic Algorithm to Tune Conventional Controller.....	50
4.3.2. Genetic Algorithm To optimize a fuzzy tuner of the PI controller.....	56
4.3.3. Genetic Controller To Tune Fuzzy Controller Only.....	58
4.4. Conclusions.....	62
Chapter 5 Generalized Predictive Control.....	63
5.1. Introduction to Generalized Predictive Control.....	63
5.2. The Theory Of Generalized Predictive Control.....	63
5.3. The Algorithm.....	66

5.4. Generalized Predictive Controller.....	67
5.4.1. Generalized Predictive Controller Only.....	67
5.4.2. Generalized Predictive Controller tuning with genetic algorithm.....	68
5.5. Conclusions.....	69
Chapter 6 Conclusions.....	70
6.1. Introduction.....	70
6.2. Results and Conclusions.....	70
References.....	76