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Fuzzy Logic based Load Frequency Control for Multi Area System

Deeksha Verma, Manish Chandrakar
Electrical Engineering, RSRRCET Bhilai, Chhattisgarh, India

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ABSTRACT

Power input to the machine must be continuously regulated to meet the active power, when the load on alternator increases the rotor slows down and results in reduction frequency, governors adjust the input to bring frequency to original level. To solve the frequency deviation problem we use fuzzy logic control. LOAD FREQUENCY CONTROL (LFC) is used to regulate the generator's output power within a specified area with respect to tie line power and change in the system frequency. In this paper Fuzzy Logic controller is used for load frequency control for multi area system & comparison between Fuzzy logic controller , as a power load demand varies randomly, in the case of any small load change suddenly in any of the areas, both tie line and frequency flow interchange also vary The main purpose of this paper is basically present an application of Fuzzy Logic Controller (FLC) based load frequency control in multi-area interconnected power system.

Keywords : Load Frequency Control, Fuzzy Logic Controller

I. INTRODUCTION

Power system is very large and complex electrical network which consists of generation, transmission and distribution network along with loads which are being distributed overall the network over a large geographical area. In the power system, the system load and consumers load keep changing time to time according to the needs of the consumers. So properly and good designed controllers are needed for the regulation of the system variations in order to maintain the power system's stability as well as guarantee its reliable operation.

The industries has very rapid growth further lead to the increased complexity of the power system .The voltage is greatly depends on the reactive power and Frequency is greatly depends on active power. So difficulty of control in the power system may be divided into two parts.

One is related to the control of the reactive power along with the regulation of voltage whereas the other is related to the active power along with the frequency. The active power control and the control of frequency are generally known as the Automatic Load Frequency Control (ALFC).

The Automatic Load Frequency Control (ALFC) basically deals with the regulation of the real power output of the generator and also its frequency (speed). The primary loop is fast where changes occur in one to several/few seconds. The primary control loop reacts to frequency changes through the speed governor and the

hydro (or steam) flow is managed accordingly to counterpart the real power generation to relatively fast load variations. Thus maintain a megawatt balance and this primary loop performs a course frequency control.

II. METHODS AND MATERIAL

FUZZY LOGIC AND FUZZY CONTROLLER

The fuzzy logic tool was first introduced in 1965, also by Lotfi Zadeh, and it may be a mathematical tool for handling the uncertainty. It offers to a soft computing partnership, the important concept of computing with words'. It provides some way to handle imprecision and data granularity. The fuzzy theory provides a mechanism for representing linguistic constructs like - "many," "low," "medium," "often," "few." Fuzzy Logic The theory of fuzzy logic are often seen as a generalization of classical logic theory, that the basic knowledge of classical (Boolean) logic is firstly given as a reference for the development of fuzzy logic theory. fuzzy logic has two different meanings. in an exceedingly narrow sense it's a logical system. In another sense it's synonymous with Fuzzy set theory, which refers to sets of objects that have indefinite boundaries &being a part of these sets is defined in percentage quantitative levels. So, an element could also be a part of a community, partially avoided evaluation, is complete or not the least bit. this can be expressed by the fuzzy theory. and within the first sense, fuzzy logic differs in concept and substance with traditional logic system. Fuzzy Logic system is characterized by the subsequent elements:

- Input membership function
- Fuzzy rules
- Output membership function

After defining such a system, the question is how we'll use this system, how we are going to put it into operation. What ways and methods are used to analyze the totality of data in the input of this technique so as to own one logical outcome on which to base decision making. Using these elements and their properties processes and actions in an exceedingly Fuzzy system will undergo several stages listed as follows:

·Enabling Entries.
·Fuzzy judgment.
·Composite Fuzzy output.
· Defuzzification.

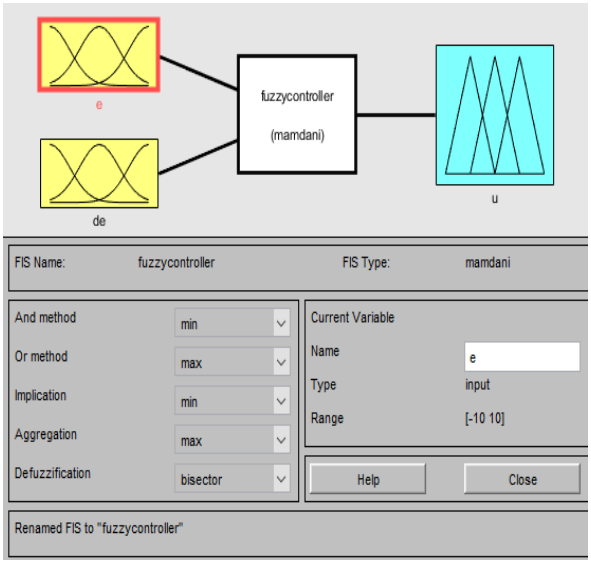

Fig 1-Fuzzy Logic Controller

Table 1 – Rule base for Load frequency control (LFC)

Freq .dev n.	Rate of change of frequency deviation						
	Ln	Mn	Sn	Ze	Lp	Mp	Sp
Ln	Ln	Ln	Mn	Ln	Mn	Sn	Ze
Mn	Ln	Ln	Ln	Mn	Sn	Ze	Mp
Sn	Ln	Ln	Mn	Sn	Ze	Lp	Mp
Ze	Ln	Mn	Sn	Ze	Lp	Mp	Sp
Lp	Mn	Sn	Ze	Lp	Mp	Sp	Sp
Mp	Sn	Ze	Lp	Mp	Sp	Sp	Sp
Sp	Ze	Mp	Mp	Sp	Sp	Sp	Sp

III. RESULTS AND DISCUSSION

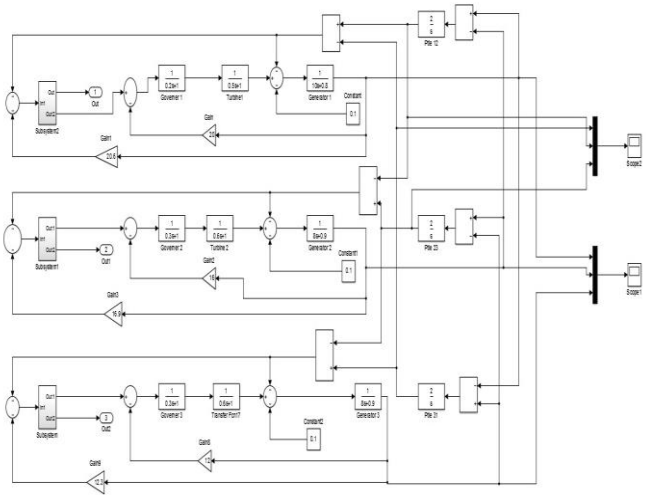

Fig. 2- Multi area power system

In this fig three areas/ plants are connected through tie line. All areas are working together, load on generator increases so frequency decreases then speed of rotor also decreases &Frequency is directly proportional to speed of rotor.

When load is increases in any one area, speed will decrease and frequency will also decrease so that is why frequency control is important.if we will not control the frequency then generator gets out of synchronism,we know that in all power system have same frequency (50 Hz),if any of one generators frequency is low or different than others generator then all system will loss synchronism so to control this frequency problem we will use fuzzy logic controller.

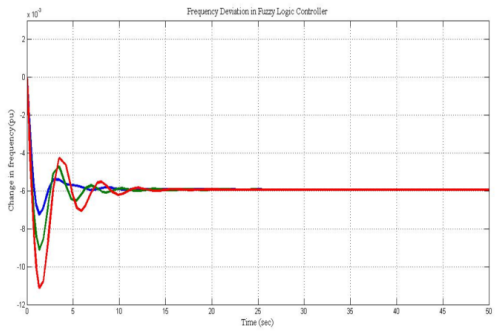

Fig 3 - Frequency Deviation for Multi Area using fuzzy logic control

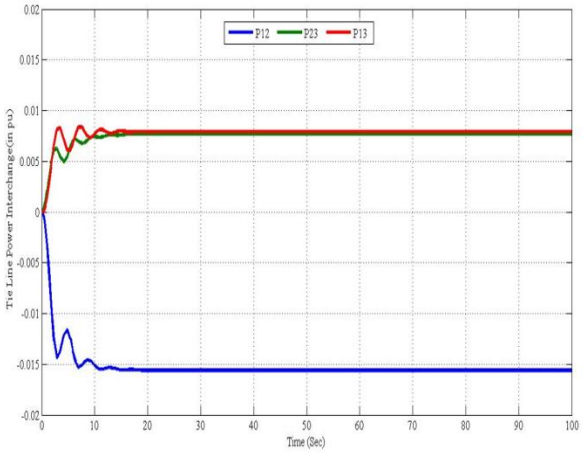

Fig 4 – Tie line power flow for fuzzy logic control

Table 2 - Fuzzy logic controller result

	Fuzzy Logic		
	Area-1	Area-2	Area-3
Frequency Deviation (in Per unit)	0.006		
Max overshoot	0.725%	0.9%	1.0%
Settling time	0.9 sec	11 sec	12 sec

IV. CONCLUSION

The thesis has chiefly investigated on the change in frequency as well as change in the tie line power due to the change in the load and also the techniques that may be used for obtaining the optimized values of various parameters for minimizing the changes.

Firstly a secondary control is being introduced for minimizing the deviations in frequency. This is usually vital in case of a single area system or an isolated system as the secondary control loop i.e. an integral controller ,Fuzzy logic, GA-PI is generally responsible for reducing the changes in the frequency deviations and maintains the system stability. Therefore without the presence of secondary loop the system losses its stability.In this paper we are using fuzzy logic

controller for control the frequency deviation for multi area system.

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