FUZZY BASED LOAD FREQUENCY CONTROL IN TWO AREA SYSTEM

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***Abstract*— To use fuzzy logic controllers in the place of proportional, PI and PID controllers. This is due to the fact that gain constants in the case of conventional controllers remain same through out for changes in the load value. But Load can't be the same throughout, load deviates from time to time. So as to get rid of these disadvantages related to conventional controllers . fuzzy logic base controller has been considered for problems pertaining to load frequency control. rules are carried out with respect to the variation in load to diminish the error. In fuzzy logic controller, we take the help of triangular membership function in the formulation of the rule base, because triangular membership function gives easy way to make the rule base compared to other membership functions.**

Key words---Load Frequency Control, Fuzzy Logic

INTRODUCTION

For extensive level power systems which consist of of interconnected control regions, load frequency; then it's paramount to hold onto the frequency and entomb territory tie power close to the booked qualities. The input mechanical power is utilized to control the frequency of the generators and the variation in the frequency and tie-line power are detected, which is the extent of the alteration in rotor angle. A decently outlined power framework ought to have the capacity to give the satisfactory levels of power quality by keeping the frequency and voltage size inside middle of as far as possible.Changes in the power system load influences chiefly the system frequency, while the reactive power is less delicate to changes in frequency and is fundamentally reliant on vacillations of voltage size. So the control of the true and reactive power in the power system is managed independently. The load frequency control fundamentally manages the control of the system frequency and genuine power inasmuch as the programmed Voltage controller circle directs the progressions in the reactive power and voltage extent. Load frequency control is the premise of numerous progressed ideas of the vast scale control of the power system..

As the loading in a power system is not constant so the controllers for the system must be aimed to provide quality service in the power system. The power flow and frequency in an interconnected system is well regulated by AGC. The main purpose of the AGC is to retain the system frequency constant and almost inert to any disturbances. Generally two things are being controlled in AGC i.e. voltage and frequency. Both have separate control loops and independent of each other.Apart from controlling the frequency the secondary majors is to maintain a zero steady state error and to ensure optimal transient behavior within the interconnected Areas. The objective is to design a controller to apprehend preferred power flow and frequency in multi-Area power systems.

FUZZY LOGIC CONTROLER

Fuzzy set hypothesis and fuzzy rationale secure guidelines of a nonlinear plotting. Utilization of fuzzy sets gives a premise to a organized path for the requisition of indeterminate and inconclusive prototypes. Fuzzy controller is focused around a legitimate structure termed fuzzy rationale is very nearer in soul to human intuition and regular dialect than established intelligent systems. These days fuzzy rationale is utilized as a part of very nearly all parts of manufacturing and science. From those LFC is one. The primary objective of LFC in connected power networks is to secure the harmony among handling and utilization. In light of the multifaceted nature and multi-parameterized states of the power system, traditional controller strategies possibly will not give acceptable results. Then again, their strength and unwavering quality make fuzzy controllers helpful in understanding an extensive variety of control issues. The fundamental constructing units of a Fuzzy Logic Controller are a fuzzification unit, a fuzzy rationale thinking unit, a learning base, and a defuzzification unit. It is the procedure to change the convinced fuzzy control movements to a fresh controlmovement.

DESIGN OF FUZZY LOGIC CONTROLLER

The basic building block of a fuzzy logic controller consist of four parts namely fuzzification of input followed by fuzzy reasoning and rule base to make perfect decisions. Then this block is being followed by knowledge base which defines all variables and parameters. The last block is the defuzzification block whose main function is to convert the fuzzy outputs to definite crisp values.

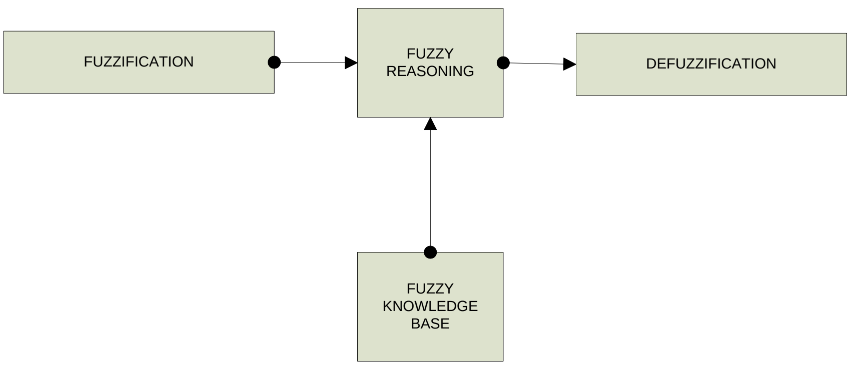

Figure 1 : Fuzzy Bock Diagram

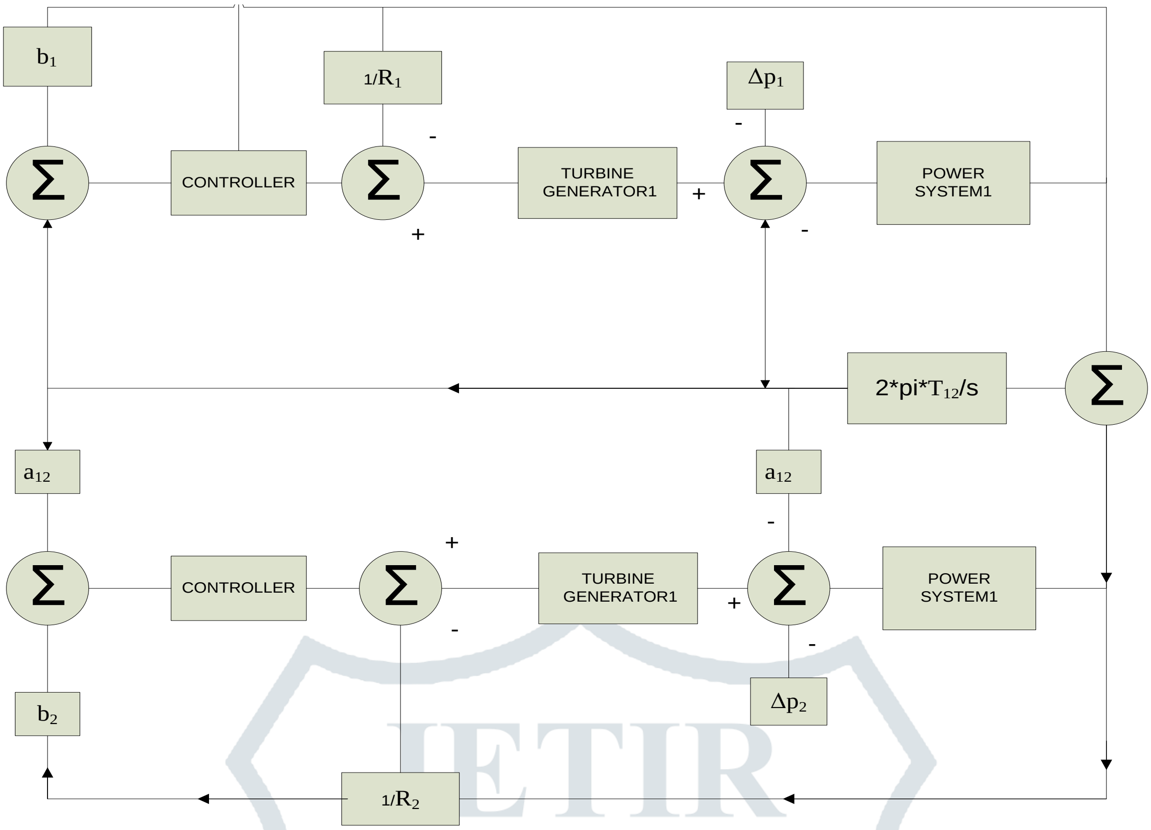

Figure 2 : Two Area Power System

SIMULATION:

For step increase in the load demand in area 1:-

As the first test case, at Area 1 a step increase in load is applied. Then the first Area frequency deviation f_1, the second Area frequency deviation f_2, tie line power and ACE deviation are shown in Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 9. In these Figures, it is quite evident that the performance of conventional PI controller is not satisfactory; the main problem arises due to its high settling time. To improve the system characteristic the proposed method is more suitable.

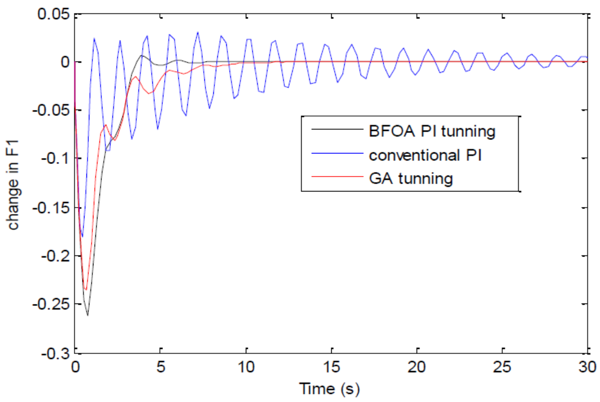

Figure 3 : Variation in frequency of Area 1 with 0.1 per unit variation in Area 1

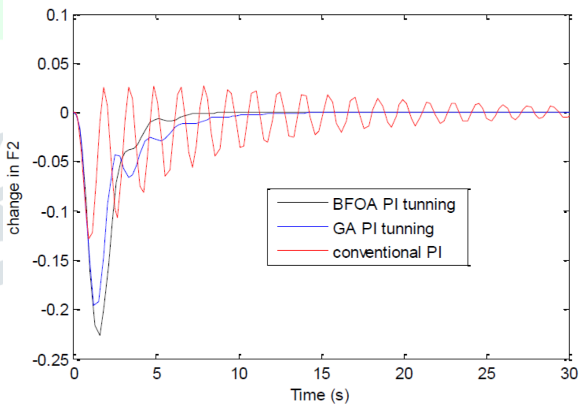

Figure 5: Frequency variation of Area 2 with 0.1 per unit variation in Area 1

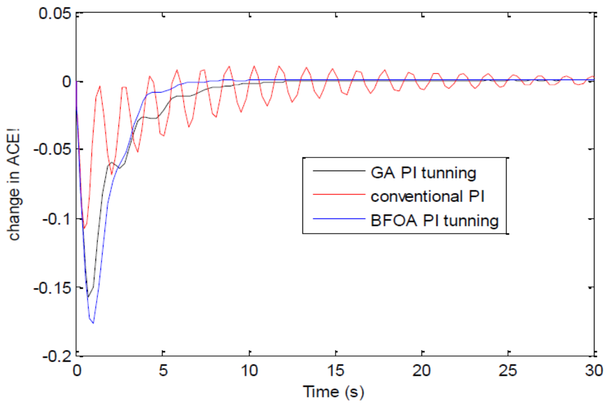

Figure 4: Variation of ACE1 with 0.1 per unit variation in Area 1

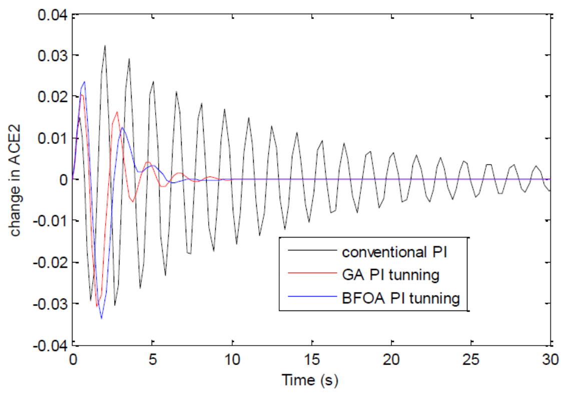

Figure 6: Variation of ACE2 with 0.1per unit variation in Area 1

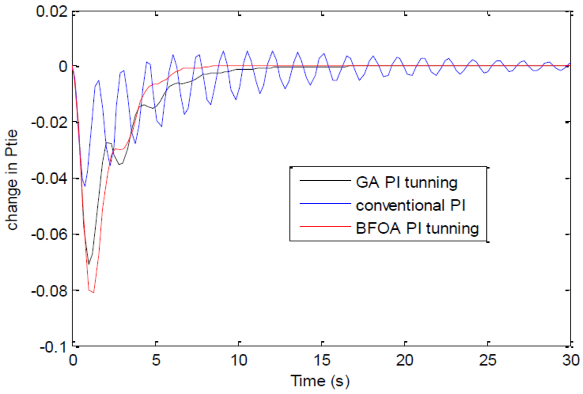

Figure 7: Variation of Ptie with 0.1per unit variation in Area 1

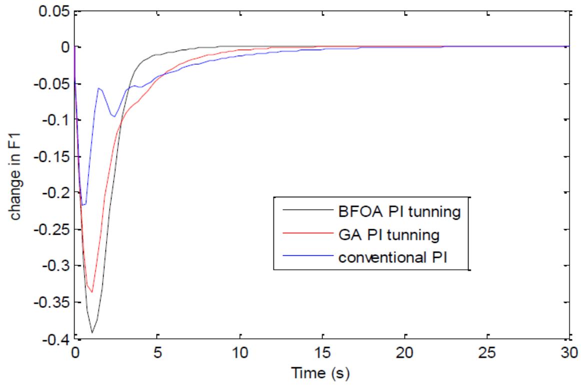

Figure 8: Effect on frequency of Area 1 with 0.1 per unit

IMPEMENTATION OF FUZZY BASED CONTROLLER

To achieve better performance fuzzy logic can be implemented in a more effective way for load frequency controller. The fuzzy controller comprise of two phases, first one fuzzy system unit where the Area control error (ACE) and its derivative are set as input parameters and then fuzzy rules are given and in accordance to the rules, the output was the control action. When many loads are considered, it's somewhat hard to set the load perturbation as an input parameter of fuzzy logic controller. Modifying the PI controller, frequency control is achieved in old fashioned power system and finest results are acquired, but in changing working condition this cannot give an optimal solution.

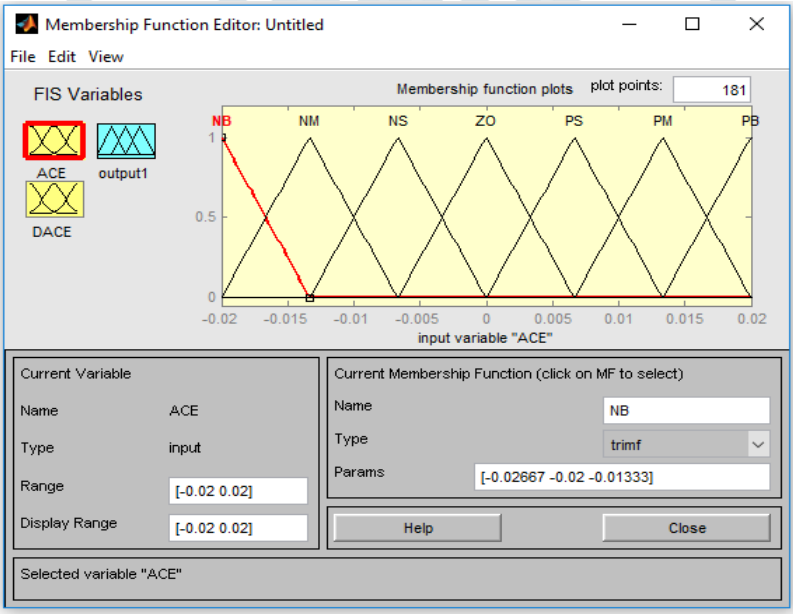

Figure 9:Membership function of input variable ACE.

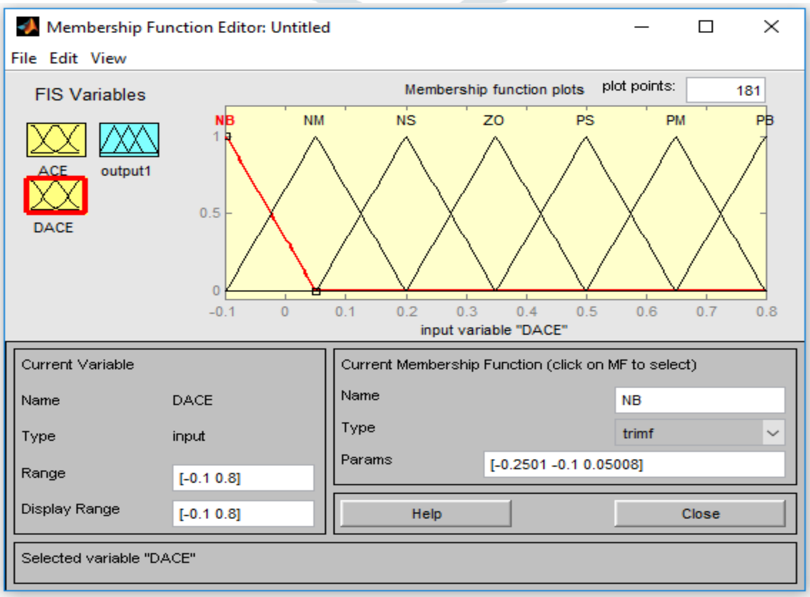

Figure 10:Membership function of variable ACE

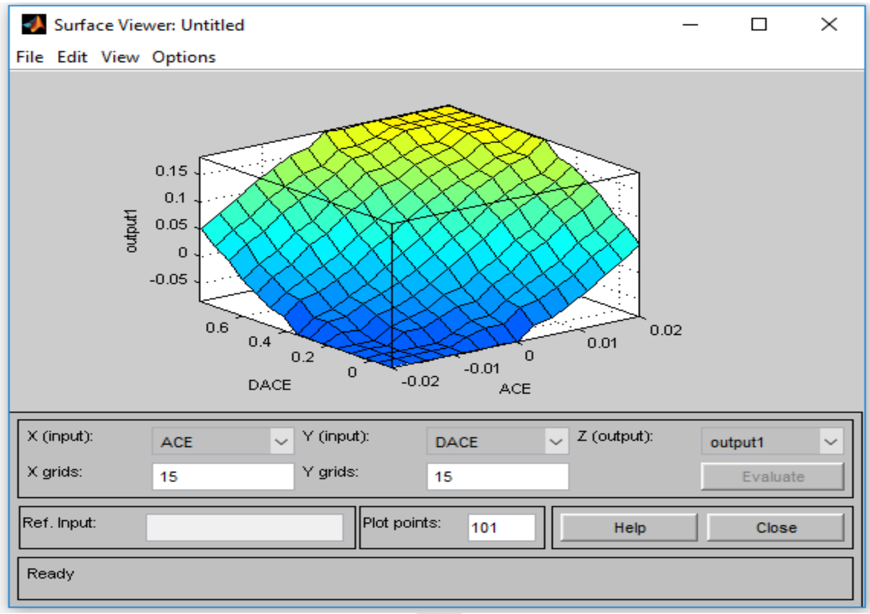

Figure 11 : Surface View

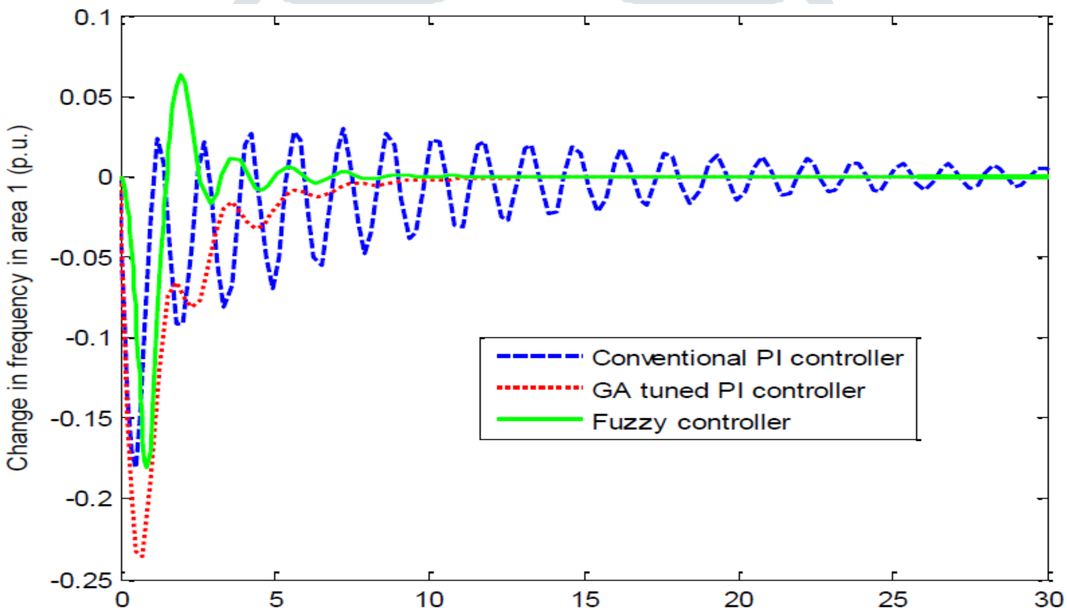

Figure 12: Comparison between controllers for settling a 0.1 per unit frequency variation in Area 1

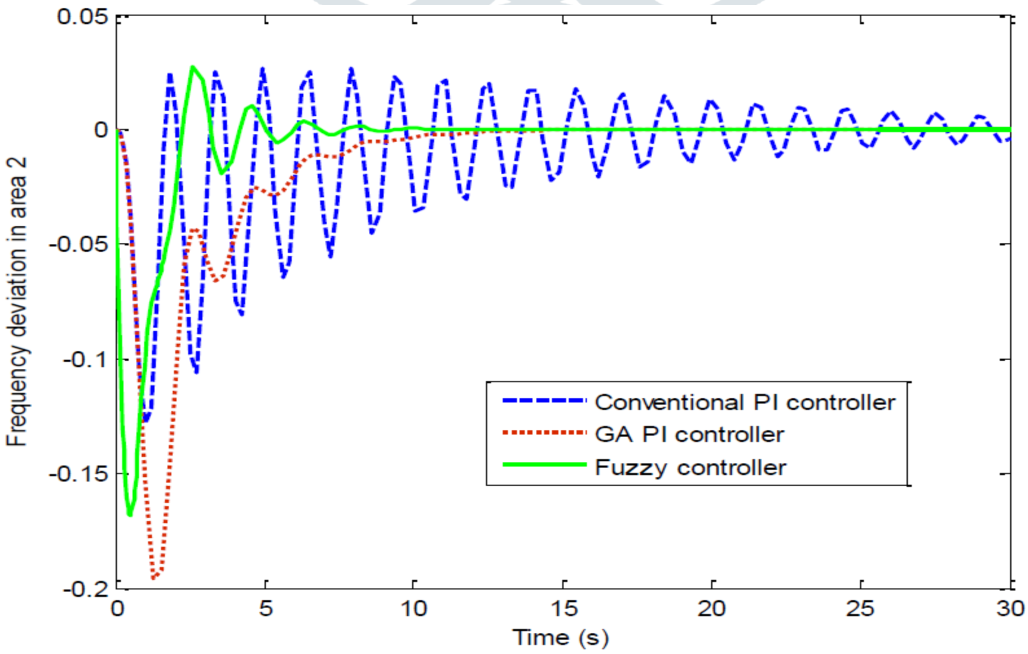

Figure 13 : Variation in frequency of Area 2 with 0.1 per unit variation in Area 1

		Conventional PI controller	**GA PI controller**	**Fuzzy based controller**
System modes		-13.7342 -13.6218 -0.086±4.1699i 0.9568±3.402i -1.8538 -0.2359 -0.2355	-13.1203 -13.1043 -0.5605±3.1716i -1.1751±1.9112i -1.1967 -0.4456 -0.4288	-13.2651 -0.4973 3.5221i -0.4973 3.5221i -1.6236 -13.2902 -1.2966 2.5127i -1.2966 2.5127i
Minimum damping ratio		0.021	0.174	0.1398
Controller constants	K_P	0.7005	-0.2346	--------
	K_I	0.3802	0.2662	--------
Settling time	***Area 1***	29.4190	8.6625	5.6135
	Area 2	29.8219	7.3804	5.6367

Table 1: Comparison Of Controllers

CONCLUSION

In instance of the uncontrolled studies it has been witnessed that as the load fluctuation is increased the area control errors are also aggregated. The effect of FLC when placed in both the areas for a step load change in Area 1 is that the variations in $\Delta f1$, $\Delta f2$ and $\Delta Ptie$ are completely non oscillatory. Comparable deductions can be drawn for equal step load changes in both the areas having FLC in area 1. The retorts are generated with FLC placed in both Areas. When FLC are placed in both the areas the abnormalities are small and the oscillations die out easily.. Altogether implementation of the fuzzy controller gives an improved result compared to conventional and GA PI controller. The settling time, rise time has decreased significantly. The transient is settling quite easily. It has been given away that the projected controller is effective and provides significant improvement in system performance

NOMENCLATURE

The values for the system parameters is listed below

$TP1 = TP2 = 20$ s, power system time constant;
$TT1 = TT2 = 0.3$ s, turbine time constant;
$T12 = 0.545$ p.u; tie line time constant;
$TG1 = TG2 = 0.08$ s; governor time constant;
Kp1 = Kp2 = 120 Hz/p.u MW; gain of power system;
$R1 = R2 = 2.4$ Hz/p.u MW; speed regulation constant;
B1 = B2 = 0.425 p.u MW/Hz; feedback bias control;
KP = Proportionality constant of controller;
KI= integral constant of controller;

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