DESIGN & ANALYSIS OF CONTROLLERS FOR GENERATION CONTROL IN TWO AREA INTER-CONNECTED POWER SYSTEM

Vijay Anand Bharti, Payal Nene, Shradha Kathe, Prateek Nigam

Abstract: In this work Fuzzy-Tuned Controller is analyzed as the control structure in two areas interconnected P.S. and study is extended for transient response of anticipated system. In this research paper all prominent controllers& their response have been studied and tuned Fuzzy-PID controller with PSO technique provided better stability & dynamic response for the system compared other existing controller.

This research paper considers the possessions of fuzzy controller, integral controller& fuzzy-Proportional Integral Derivative (PID) controlleron an inter-connected three area power system in de-regulated surroundings. The structure is simulated by means ofMatlab Simulink together with controllers. The frequency variation replies are studied using Matlab &Simulink. The system performance is examined considering 1% step load perturbations in area.

Keyword:AGC,PID, Fuzzy-PID Controller, PSO technique, Area, Interconnected power system.

I. INTRODUCTION:

This is significant to realize, however, that such optimized dispatching would be less significant without a method of control over the generator units. In practice, the control of generated power was the main issue encountered in dealing with power system load flow analysis, but recently, the methods evolved for the controlling of generators & control of large interconnection played an important role in modern energy control centers [1]. In large scale power system, the generating units are operated with fixed mechanical output from the turbine and Automatic Generation Control is used for balancing the generation and load [2]. In power system, generator is operated with mechanical power through the steam turbine in thermal power system [3,4]. It can be represented as; a large rotating mass with two opposing torque i.e. the mechanical torque $t_m$and the electrical torque t_e. Thesetorques are opposed to each-other as shown in Figure 1.

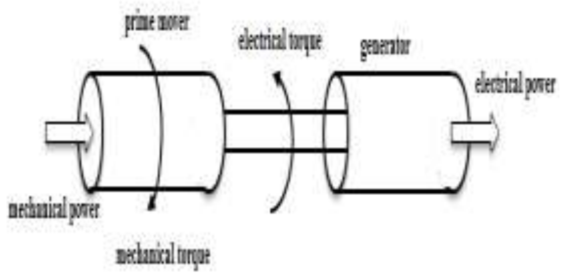

Figure IV: t_m& t_e in a generating unit.

In generator mechanical torquet_m, acts to increase rotational speed whereas electrical torque $t_e$slows it down. If mechanical torque $t_m$which is equals to electrical torque then rotational speed will be constant [5]. If load side increase then electrical torque is larger than mechanical torque and this is main reason entire rotating system will begin to slow down. So, this is a reason for unbalance between generation and load this balance between load and generation can be achieved by using AGC [6-7].

II. OBJECTIVES OF THE WORK

(i) Firstly, this is two unequal area interconnected thermal power system, and conventional controller (I, P, PI, PID controllers) and soft controller (Fuzzy-PID Controller) are used in this power system.

(ii) This all controllers like; conventional controllers and soft controller are used in two unequal control area system.

(iii) The controllers gain parameters are optimized using PSO Technique.

(iv) Gain parameters of controllers is optimized through PSO technique and compares their performance and their response, i.e.peak over-shoot time, settling time,peak under-shoot time and cost function.

After optimization, result has been occurred then compares between the controllers and find out which controllers provide better response to other controllers for two unequal areas interconnected system.

III. PROPORTIONAL CONTROLLERS

For a controller with proportional (P) control action, there is a continuous linear relation amid the output of controller (M) and error signal (actuating,(e)).

In terms of Laplace transform,

M(s) = k_p e(s), (4.2)

Where, k_p is known as proportional gain or proportional sensitivity.The disadvantage of this controller is that it pretends a permanent residual error known as off-set. A high value of k_p attenuate offset error but makes the controller exhibit ON-OFF characteristics.

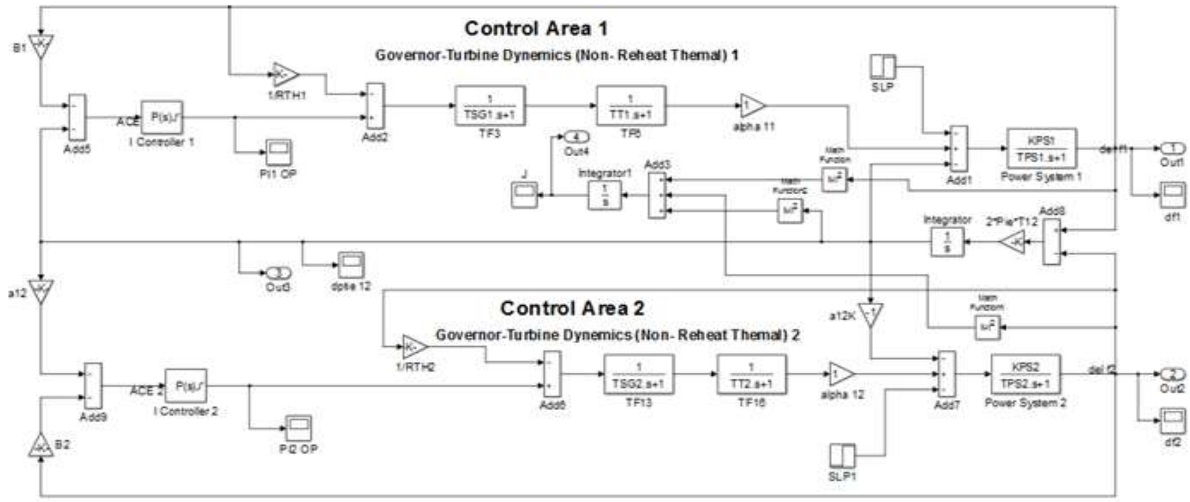

Fig 2:Transfer Function (TF)of Two Area Inter-connected Power System through P Controller.

We apply Proportional-Controller gain $K_{P1} and K_{p2}$ in Proportional-Integral-Derivative (PID) controller in Matlab-Simulink model of two unequal area inter-connected model and outcome wave-form and also analysis; the response of settling time and over-shoot time of area-1 & area-2 LFC and also studies about tie-line power and their response compared. The transfer function (TF) of two area inter-connected system with proportional controller is revealed in Fig2.

IV. SIMULATION RESULT

A. Comparisons between Results

Firstly, we will discuss here about the main objectives of this project. Two unequal area interconnected system is optimized through PSO technique and after that comparison between the controllers and find out which controllers provides better performance.

Now, we will discuss here, about their response and it can be studied in this form;

(i) Best cost
(ii) Overshoot time,
(iii) Undershoot time,
(iv) Settling time.

i. Best Cost

Table 1: Represents the Optimized Best Cost Values in Unequal System.

Controllers	I	P	PI	PID	Fuzzy-PID
Best Cost	0.000550	0.001050	0.000130	0.000006	0.000180

ii. Overshoot time

Table 2: Represents the Overshoot Time of Area1 & Area2 and Tie-Line Optimized Values.

Controllers	I	P	PI	PID	Fuzzy-PID
Area1	0.00800	0.00580	0.00565	0.00035	0.00153
Area2	0.00033	0.00149	0.00014	0.00007	0.00000
Tie-line	0.00013	0.00000	0.00000	0.00033	0.00029

iii. Undershoot time

Table3: Representsthe Undershoot Time of Area1 & Area2 and Tie-Line Optimized Values.

Controllers	I	P	PI	PID	Fuzzy-PID
Area1	-0.00230	-0.01150	-0.01350	-0.00080	-0.01500
Area2	-0.01300	-0.00502	-0.00410	-0.00024	-0.01300
Tie-line	-0.01130	-0.00128	-0.00132	-0.00434	-0.00085

For tie-line Fuzzy-PID Controller Provided well undershoot time.

iv. Settling Time

Table4: Represents the Settling Time of Area1 & Area2 And Tie-Line Optimized Values.

Controllers	I	P	PI	PID	Fuzzy-PID
Area1	15	69	19	15.5	11.5
Area2	14	66	30	16	9.5
Tie-line	13	66	30	16	17

B. Optimum Value For Area1

In Figure 3, this is the response and optimum value of all conventional and soft controllers.

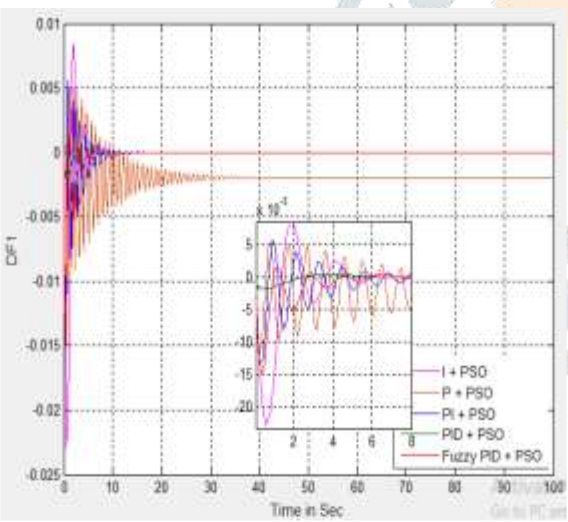

Fig3: Combination of all Controllers Optimized Values in Area1.

- **Overshoot Time -** In this work, two unequal areas are interconnected through Tie-line and the PSO technique is used for optimum values. The PID-Controller provideswell overshoot time in Area1 shown in Fig 3 and Table 2.

- **Undershoot time** – Undershoot time of frequency deviation in area-1 for different controller shown in Fig 3 & Table-3. According to this Table No 4 PID Controller is provided well undershoot time.

- **Settling time -** Settling time of frequency variation in area-1 for variouscontrollers shown in Table No 4 and Fig 3. According to this Table-4 Fuzzy-PID Controller (Df1=11.5) provides better settling time to other controller.

C. Optimum Value For Area2

In Fig 4, this is the response and optimum value of all conventional and soft controllers.

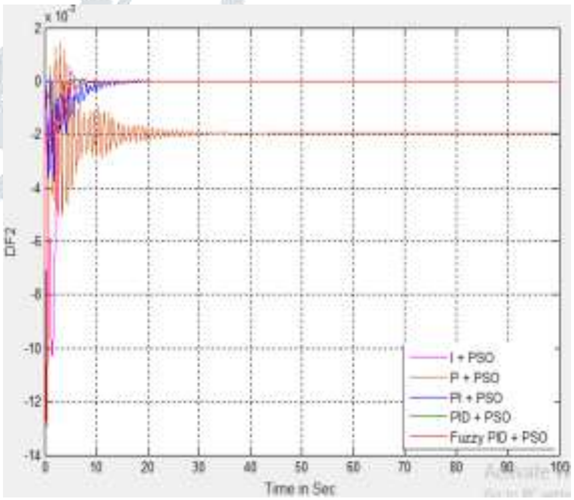

Fig 4: Combination of all Controllers Optimized Values in Area2.

- **Overshoot Time -** In this work, two unequal areas are interconnected through Tie-line and the PSO technique is used for optimum values. The PID-Controller provides well overshoot time in Area1 shown in Fig 4 and Table-2.

- **Undershoot Time -** Undershoot time of frequency deviation in area-2 for different controller shown in Figure 4& Table No 4. According to this Table-3 PID Controller provides well undershoot time.

- **Settling Time -** Settling time of frequency variation in area-2 for various controllers shown in Fig 4. According to this Table-4 Fuzzy-PID Controller (Df2=9.5) provides better settling time to other controller.

D. Tie-Line Power

In Fig 5, this is the response and optimum value of all conventional and soft controllers.

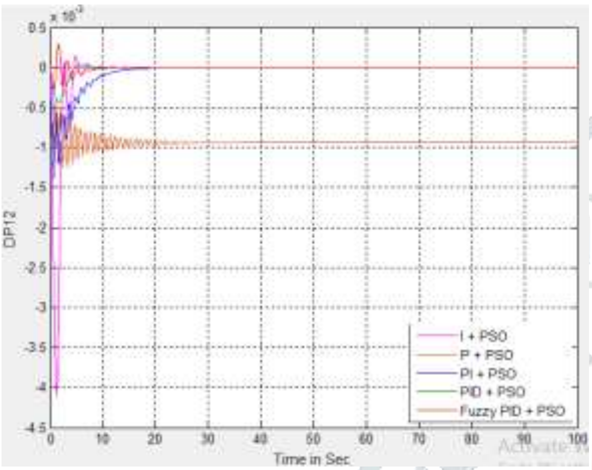

Fig 5: Comparison between all Controllers' Frequency Deviations in Power (Tie Line).

- **Overshoot Time**

In this work, two unequal areas are interconnected through Tie-line and the PSO technique is used for optimum values. The P & PI Controllers provides well overshoot time shown in Fig 5 and Table-2.

- **Undershoot Time**

Undershoot time of frequency deviation in area-2 for different controller shown in Fig 5& Table No 3. According to this Table No 4 Fuzzy-PID Controller provides well undershoot time.

- **Settling time**

Settling time of frequency variation in area-1 for various controllers shown in Table-4 and Fig 5. According to this Table-4 Integral Controller (Df1=13) provides better settling time to other controller.

- **Best Cost**

In this work, two unequal areas are interconnected through Tie-line and the PSO technique is used for optimum values. After optimization the PID-Controller provides Best Cost.

V. CONCLUSION & FUTURE SCOPE

This research supremacy ofprojectedblueprint approach has been revealed by evaluating the outcomes with fewtopicallyexecution appraisal of DE (Differential Evolution) streamlined PI controller for Automatic-Generation-Control of inter-connected power system. Prevalence of the proposed approach has been appeared by contrasting the outcomes and an as of late distributed Craziness' based PSO method for the similar inter-connected power frame-work. It is watched that the proposed DE upgraded PI controller beats the PSO streamlined PI controller and the best execution is acquired with DE improved PID controller. It is watched that the proposed approach can be connected to interconnected power frameworks with assorted wellsprings of age with various PID controllers for each creating unit.

The projected approach is moreover connected with a 3-unequal domain warm power-system considering non-linearity causes of Generation Rate Constraint and Governor-dead-band. Propagation occurs illustrate that execution of system has upgraded in regards to overshoot &settling time with suggested Teaching Learning Based Optimization algorithm stream-lined Proportional-Integral-Double-Derivative controller appeared differently in relation to Firefly Algorithm (FA) optimized Proportional Integral Derivative controller. Lastly, power examination is done to test healthiness of the suggested Proportional-Integral-Double-Derivative controller for more than 3-test structures.

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