Study On Series Compensated Load Frequency Oscillation in Two Area Power System Using Pid & Fuzzy Logic Controllers

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Abstract: In this study paper, a device called static synchronous series compensator (SSSC) is being used to reduce the synchronous oscillation in series capacitor compensated power systems of two area system in order to achieve an effective damping. This review paper shows a decentralized control technique for Load Frequency Control in a two area Power System by appreciating the performance of the methods in a single area power system. Various of modern control techniques in which PID controller and Fuzzy logic controller is adopted to implement a reliable stabilizing controller. An attempt has been made in observing the load frequency control problem in the power system consisting of two power generation unit (Hydro and Thermal power plant) and multiple variable load units. The strength and reliability of the various control techniques is examined through MATLAB simulations. An overhead transmission line needs controllable compensation of power transfer control and constant voltage regulation. This is achieved by using of FACTS devices. Static Synchronous Series Compensator (SSSC) is one of a series connected FACTS controller device which is used for providing reactive power compensation to a power system. It can also be used to reduce the equivalent line impedance and increases the active power transfer capability of the transmission line. In this review paper, series compensation provided by an SSSC system is considered.

Index Terms:Voltage Regulation, FACTS Controllers, Reactive Power Compensation, SSSC.

Introduction:
In electric power generation machines, there is massive number of disturbances like variation in voltage, instability, oscillations, loss of synchronism etc. So, in order to overcome these problems a device static series compensator is used. This device is connected in series with transmission line in order to improve the overall performance of the electric machine. The main objective of this compensating device is to maintain voltage balance, improve transient stability, load frequency oscillation, sub-synchronous damping and so on.

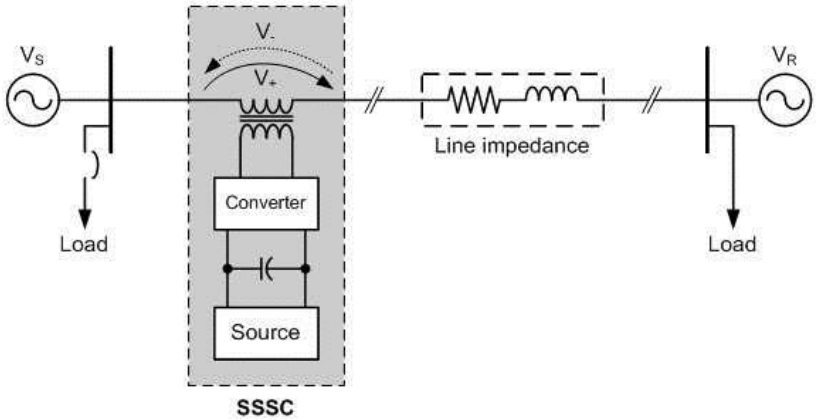


Fig: (SSSC Arrangement)

For a compensation of the PI, PID, Fuzzy Logic and neural network-controlled devices provided by the SSSC system in improving the control method. Since, LFC can be done by taking feedback signals of frequency to the system and controlled using integral control. However due to the fluctuation of the demand complete PID controller become popular. Moreover, PID controller is the cheapest and easiest to design and installed. Comparative results of Series Compensated Power System:

1. Basic Two-area Power System:

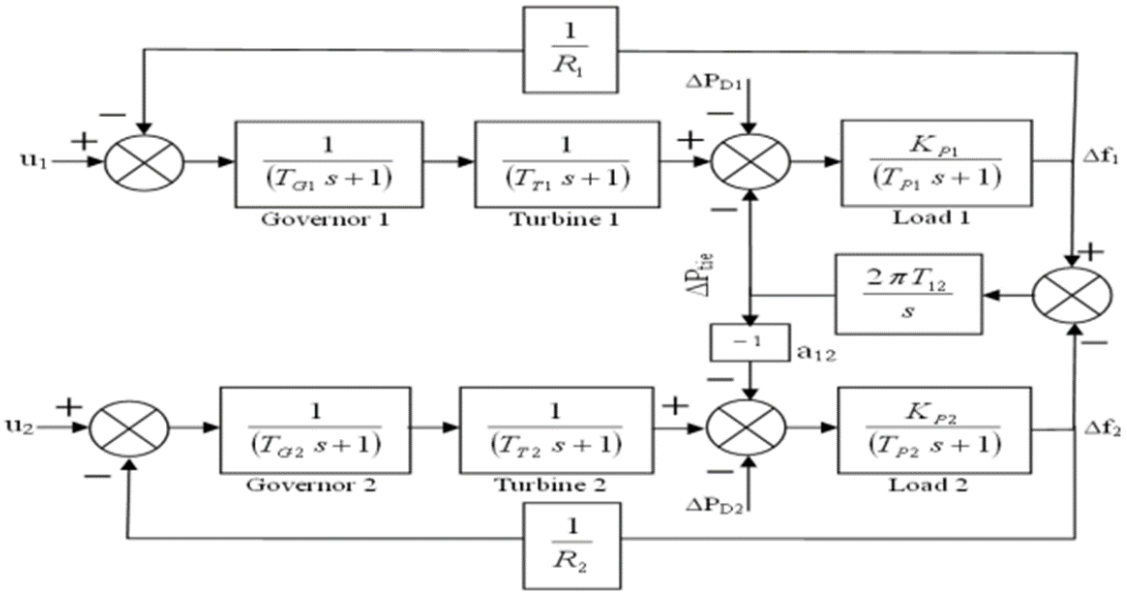


Fig: Mathematical Model of Two Area

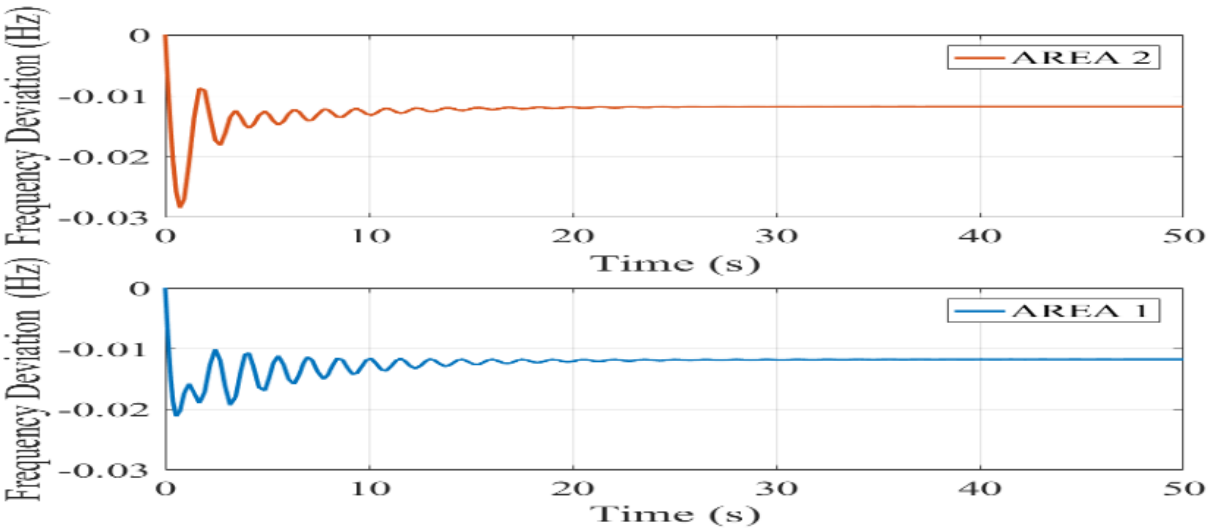


Fig: Disturbances in Area 2 and Area 1

2. SSSC compensated two area power system:

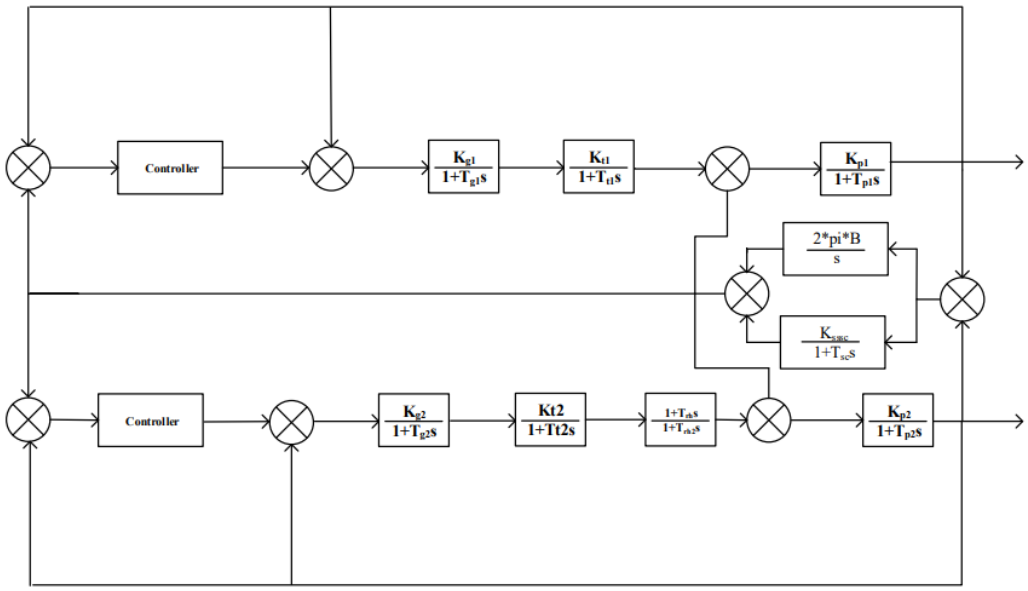


Fig: Mathematical Model of SSSC compensated Two Area Power System

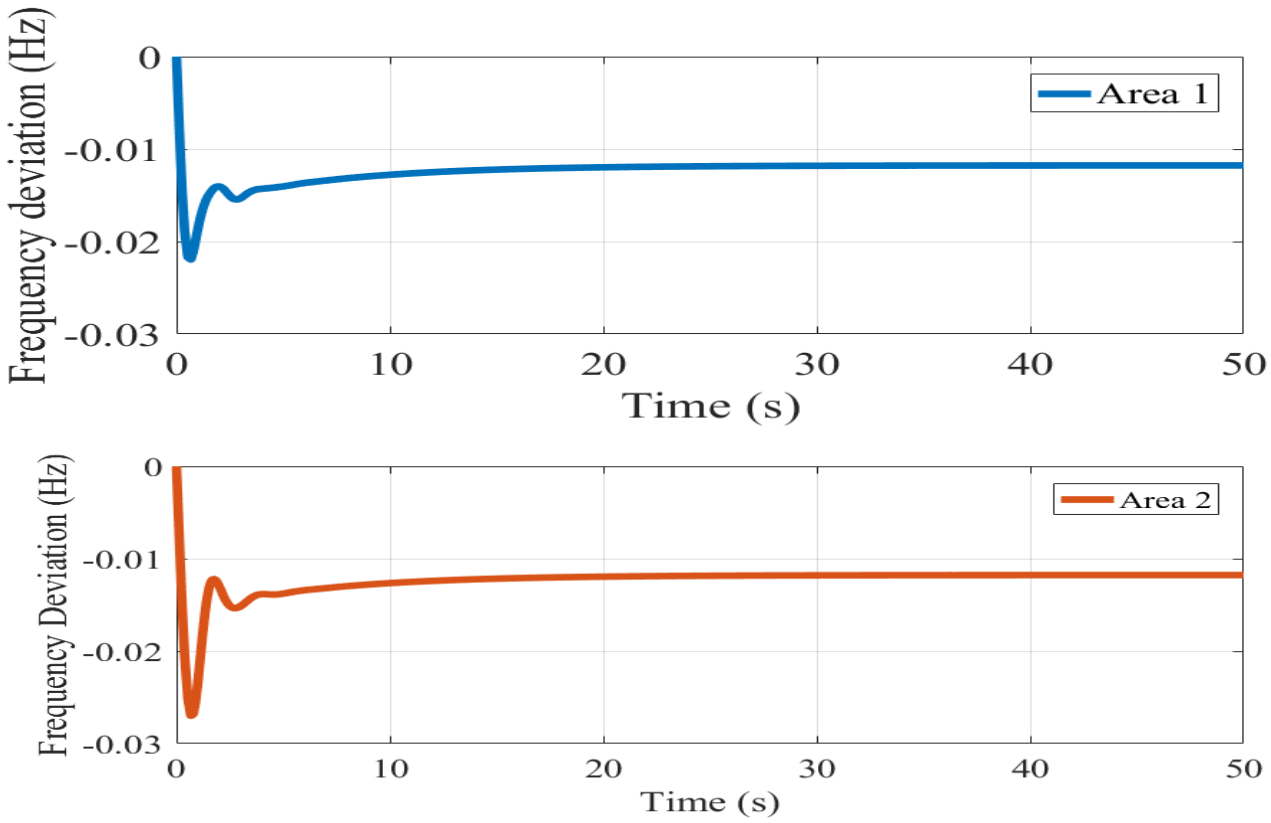


Fig: Disturbances in Area 1 and Area 2

3. Series compensated power system with PID Controller.

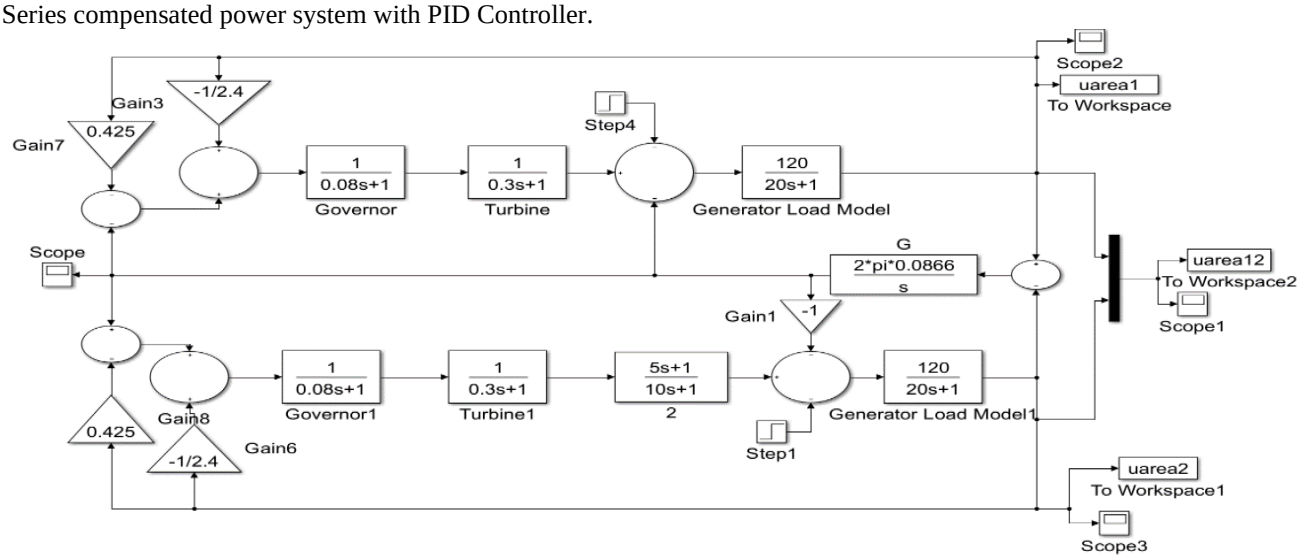


Fig: Simulink Model of SSSC compensated with PID controller Two Area Power System

ACE/ DACE	NB	NS	ZZ	PS	PB
NB	S	S	M	M	B
NS	S	M	M	B	VB
ZZ	M	M	B	VB	VB
PS	M	B	VB	VB	VVB
PB	B	VB	VB	VVB	VVB

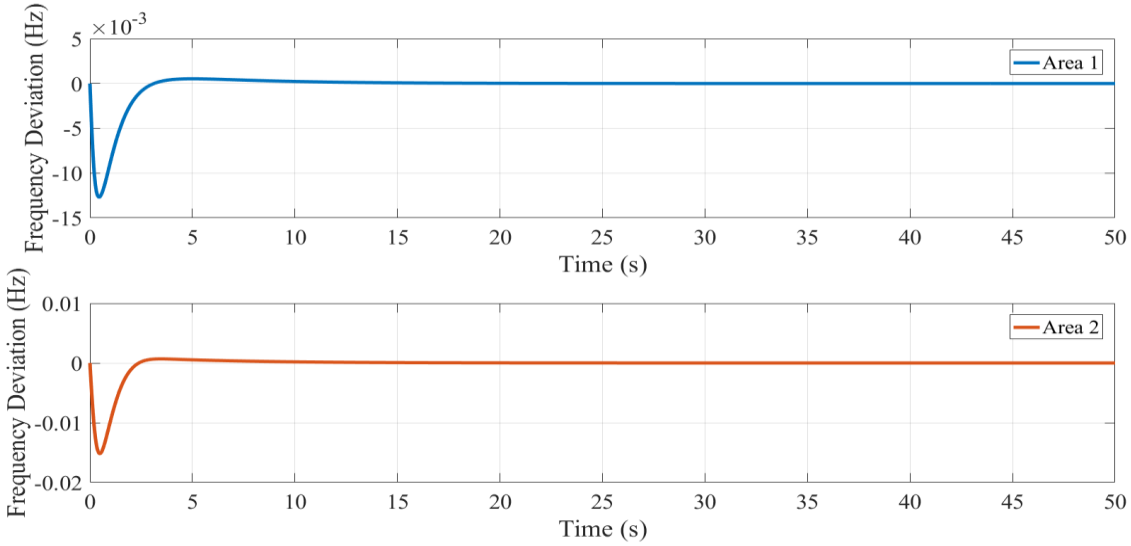


Fig: Disturbances in Area 1 and Area 2

It can be seen in basic two area power system the system is subjected oscillations. In order to remove variations, a series compensated device is integrated in two area power system which reduces the variation in the power system oscillation within the permissible limit. SSSC is used for damp the overshoot and accelerate frequency by adding SSSC in the middle of interconnected two area power system. This review paper shows a method for controlling frequency of the system by using PID controller as governor controller and adding SSSC to the tie line. The function of the controller is to reduce error signal, namely the deferent between signal settings and signal actually. The quicker the reaction system following the actual signal and the smaller the errors that occur, the better the performance of control systems are applied. PID controller until now a lot of industrial used it. This is because its use is easy, and can improve the performance of the system quickly. Output PID controller is the combination of output proportional control, the output of integral control, output differential control.

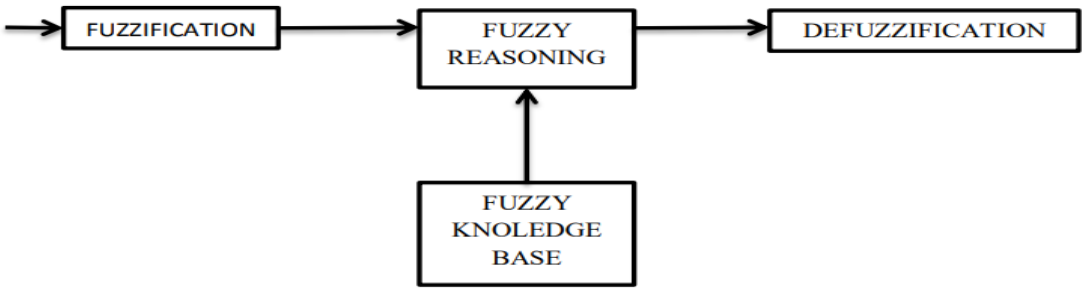
4. Series compensated power system with Fuzzy logic Controller:

Currently as there has been an increase in the interconnected systems as far as power systems are concerned. Load as well as power flow in tie-line are varying dynamically. So, there is a need of robust control of system frequency as well as tie-line power flow system. This robust control could be achieved by the help of fuzzy logic controllers in the place of orthodox system using proportional, PI and PID controllers. This is due to the fact that gain constants in the case of conventional controllers remain same throughout, 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, a lot many schemes have been put forth in literature. With regard to this work, fuzzy logic base controller has been considered for problems pertaining to load frequency control. They're queried 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. Then simulation is done by using MATLAB/Simulink software.

Table: Rule Base

Fuzzy logic controller has lot of applications in power system. FLC works on the basis of knowledge acquisition process. A fuzzy system has a membership function associated with each fuzzy set and here fuzzy IF-THEN rule is used for controlling the process. The horizontal range of membership functions is obtained by optimization of error generated by PID controller. In the given system the LFC comprises of sudden load variations in the power system which results in the frequency change and this frequency deviation should be in the permissible limits.



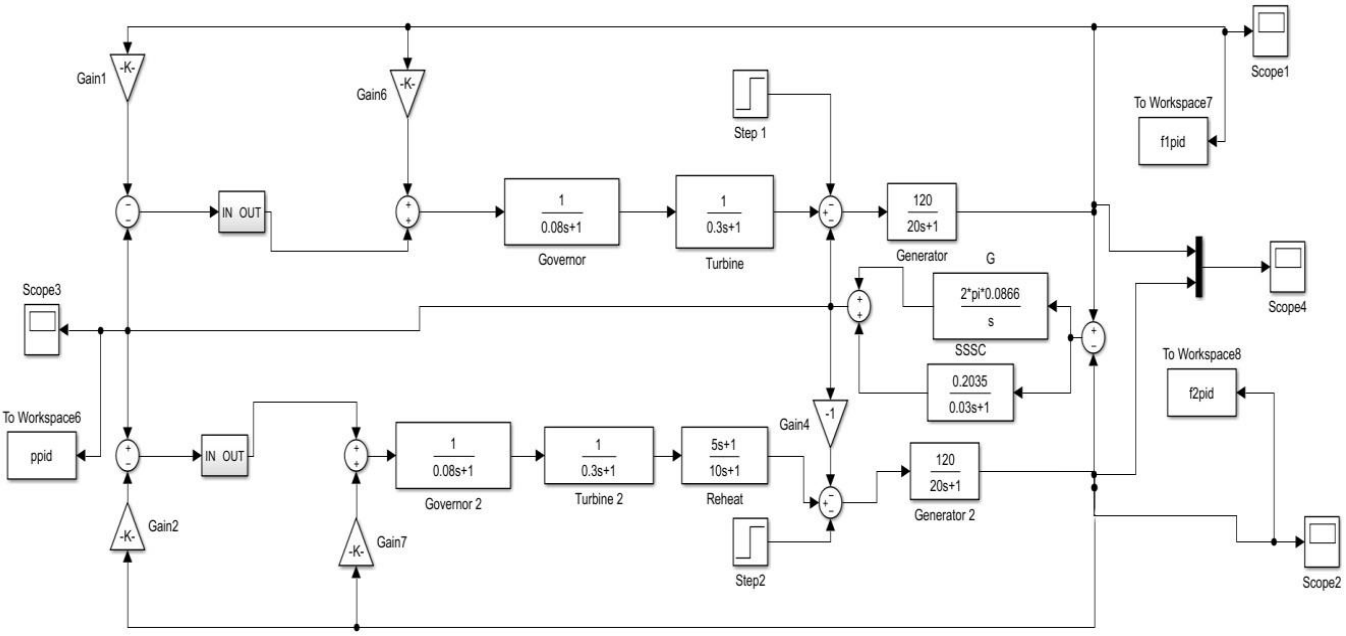


Fig: Simulink Model of Fuzzy Logic Based Two Area System

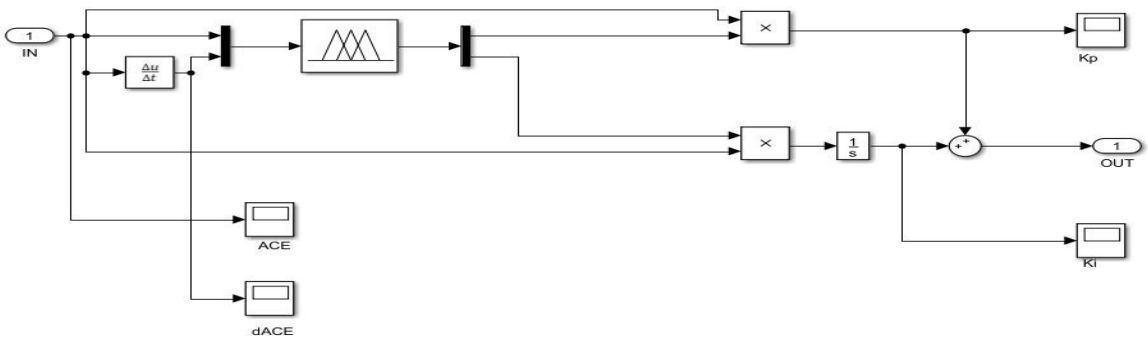
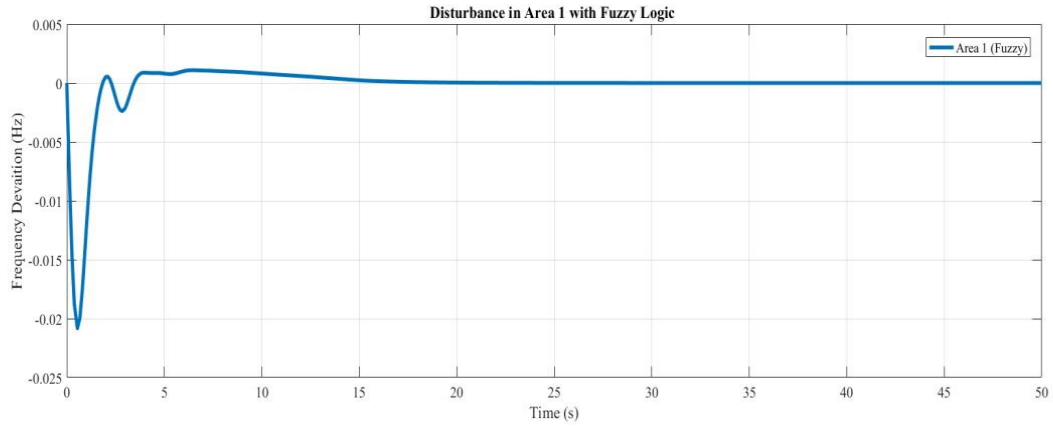
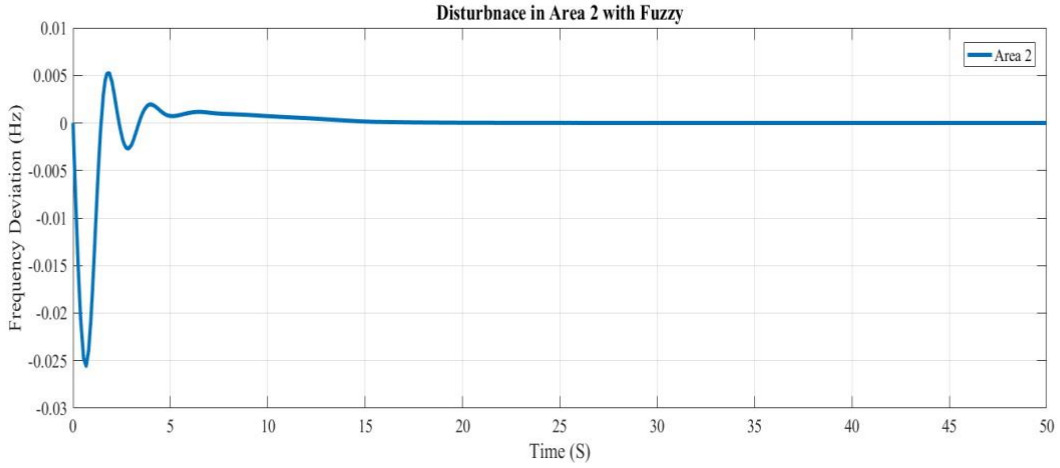


Fig: Sub System of Fuzzy Controller





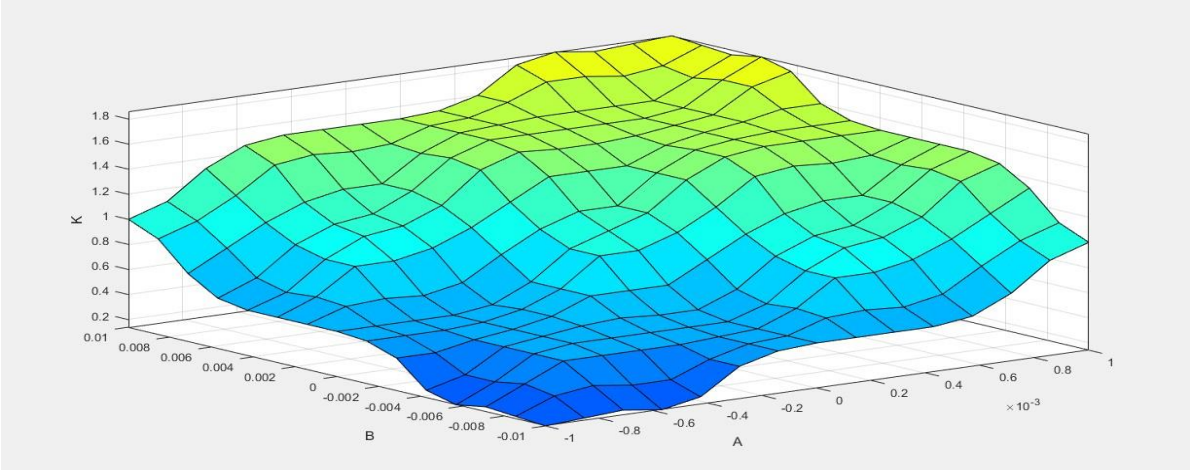
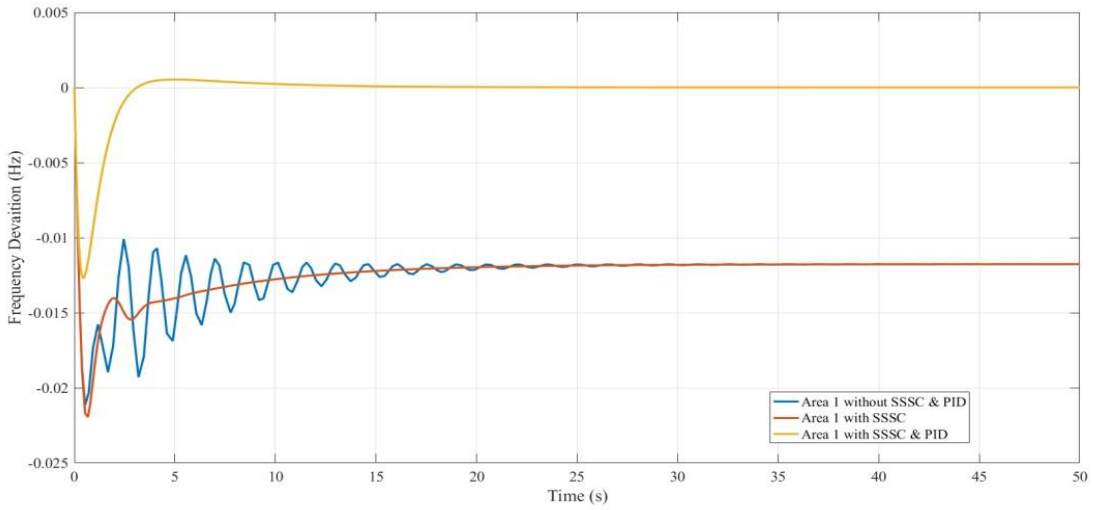


Fig: Surface View

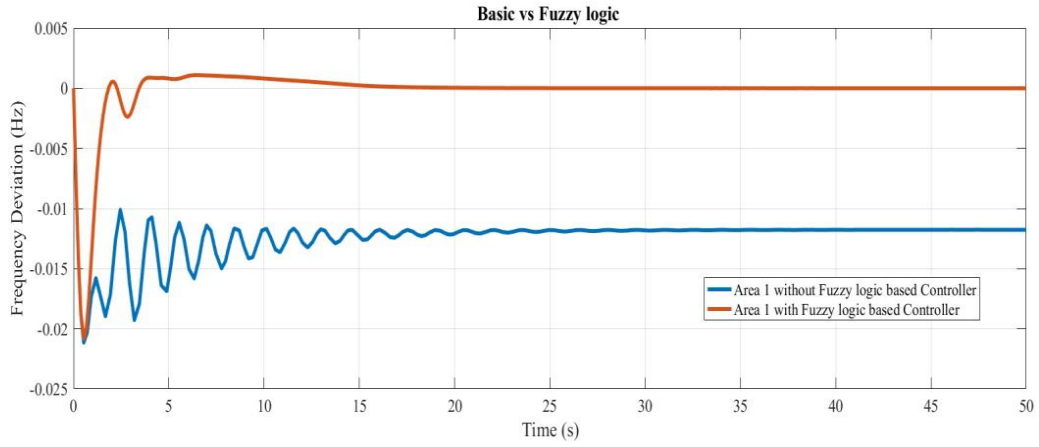
To achieve better performance fuzzy logic can be implemented in a more effective way for load frequency controller. The fuzzy controller comprise of two phases, first one fuzzy system unit where the Area control error (ACE) and its derivative ( ) are set as input parameters and then fuzzy rules are given 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.

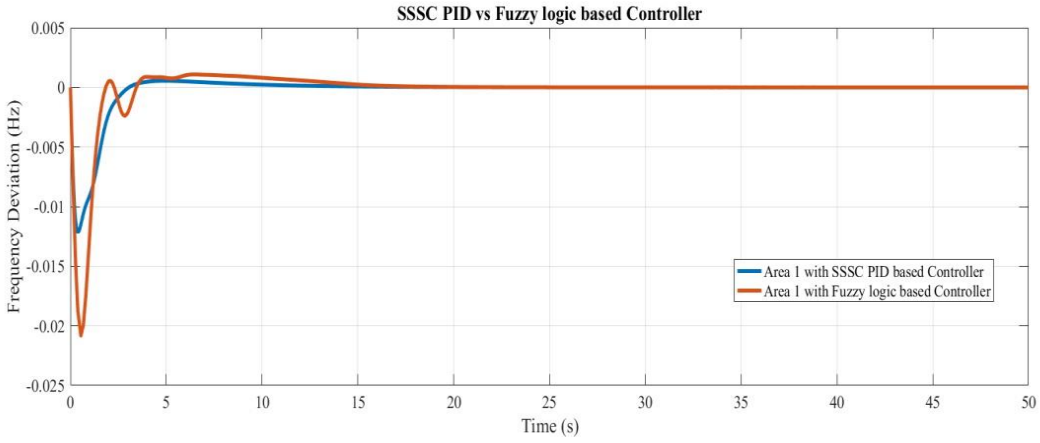
The fuzzy codes are written in the fis.file in MATLAB using AND function in the Mamdani inference using Triangular Membership function, efficient 1. The rules highly depend on the membership function; the rules are set in appropriate collection of input and output parameters.

Comparative results:



Basic Two area, Basic Two area with SSSC and compensated two area power systems based on PID





Conclusion

This study paper shows the application of PID and Fuzzy logic controlled SSSC to enhance the stability of load frequency of the system. From this case studies 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 PID or FLC when placed in both the areas for a step load change in Area 1 is that the variations in Δf1, Δf2and ΔPtie are completely non oscillatory. Comparable deductions can be drawn for equal step load changes in both the areas having PID or FLC. The retorts are generated with PID or FLC placed in both Areas. When PID or FLC are placed in both the areas the abnormalities are small and the oscillations die out easily. However, implementation of the fuzzy controller gives an improved result compared to conventional 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.

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