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Enhancement Of Power Transmission Stability By Improvement Of Power Factor & Reduction Of T.H.D In A Long Transmission Line Model Using UPFC With Fuzzy Logic Controller

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Abstract: ***In this thesis work research is carried on a long transmission line model compiled in the MATLAB for the enhancement of power with improved power factor and reduced harmonic distortion. UPFC (unified power flow controller) which is a FACT device is used in between the transmission line at the center of T model for compensation. UPFC is a mix venture of SSSC and STATCOM and is controlled using the implementation of fuzzy logic controller and the results shows that power factor and other parameters were improved with less distortion and there is a improved setting time and tie response specifications.***

Key words: UPFC, matlab, transmission line, settling time

I. INTRODUCTION & LITERATURE

Power framework comprise of different sorts of burdens, direct and non straight. As entire power framework have interconnected with each other if any variety runs over this steady framework the synchronization of the framework got irritated. Those aggravations might be for long or brief time of period. Amid those sudden or progressive changes in working condition the power framework can stay in balance working condition and to recover a worthy condition of balance in the wake of being subjected to those unsettling influence. This capacity of the power framework characterized as "control framework strength". control framework operation has been significantly worry to the security. Soundness of the framework is impacted by those different possibilities limitations. All in all, control framework strength is the capacity to react to an unsettling influence from its ordinary operation by coming back to a condition where the operation is again come to its typical working conditions.As the demand of electricity increasing day by day in the modern power system. But it's a well known fact that the demand of power is more than the availability of the power. Due to the limited amount of energy it is must for power system engineers to minimize the power system losses. Most of the power losses occur due to the uncertain fault contingencies which results in the voltage fluctuation, large harmonic distortion, and instability of the system. For the betterment of the power system all above mentioned factor have to be minimized. This research work is a step towards to achieve this goal. In recent years, various techniques like FACTs, adaptive self-tuning, variable structure, artificial neural network based PSS, fuzzy logic based PSS s have been proposed to provide optimum damping to the system oscillations under wide variations in operating conditions and system parameters. From last few years many research works have been done on the versatile FACT device UPFC. Literature review presented in this thesis gives the various information about the past work which has done with UPFC in transmission system. Most of the researchers have used UPFC with conventional controller which gives the good control result of power system. As per the various studies carried out on the control strategy of UPFC with conventional controller shows some failure for the nonlinear system. modern power system now a days have rapid growth of non linear loads. So it is most important task to make our controller more compatible to manage those entire nonlinear load. The concept of using Fuzzy logic controllers is the great way to deal with all the nonlinearities of the power system.as per the researches made on Fuzzy logic controller it gives the tremendous results over conventional one. Fuzzy logic controller work on the basis of membership function made. By using those membership functions various rules make for the control of UPFC.In this way the versatile UPFC became more compatible controller for the transmission system.

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	PARAMETER	SPECIFICATION	COMPONENT
1	LENGTH	800 KM	Transmission Line
	VOLTAGE	230 KV	Transmission Voltage
	RATING	20 MVA,230 KV	SSSC of each
	RATING	100 MVA,230 KV	STATCOM
	RATING	100 MW	Load
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	RATING	100 MW	Load

II. MODEL ANALYSIS AND RESULTS

A 230 kV ,100 MVA source is taken for a long transmission line of 800 km. the line resistance per unit length is considered as [0.01273 0.3864] ohms/km [N*N matrix] or [R1 R0 R0m] in per unit, the line inductance per unit length is [0.9337e-3 4.1264e-3] H/km [N*N matrix] or [L1 L0 L0m] and the line capacitance per unit length is [12.74e-9 7.751e-9] F/km [N*N matrix] or [C1 C0 C0m] for each 200 km length. In this long transmission line parallel R-L-C load is connected which is introduced in different steps as no load, half load and full load. UPFC is introduced in the middle of the line as the most nominal place in the T model of installation strategy

A. specification of Line parameter

SSSC, Specifications		
S.NO.	PARAMETER	SPECIFICATION
1	Converter rating	20 MVA
2	Voltage rating	500 KV
3	Frequency	50 Hz
4	DC link nominal voltage	40 KV
5	kp	3.75e-3
6	ki	0.1875
7	Numbers of controller	Five

STATCOM, Specifications		
S.NO.	PARAMETER	SPECIFICATION
1	Converter rating	100 MVA
2	Voltage rating	500 KV
3	Frequency	50 Hz
4	DC link nominal voltage	40 KV
5	kp	0.1e-3
6	ki	20e-3

specification of STATCOM

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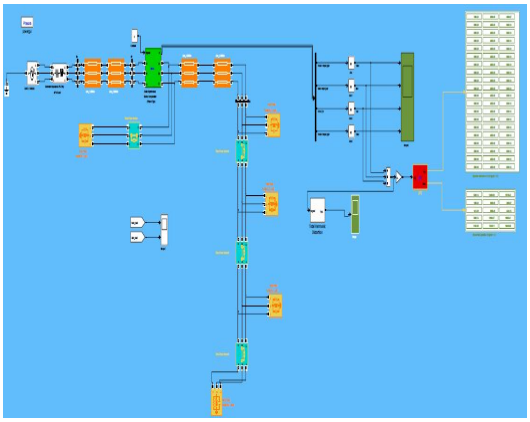
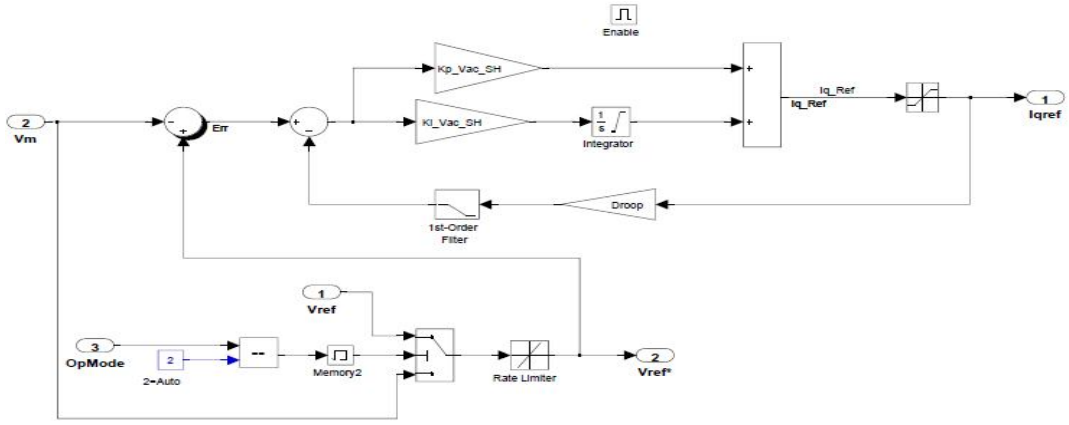
Modelling of Long transmission line model with UPFC PI controller



Simulink model of long transmission line

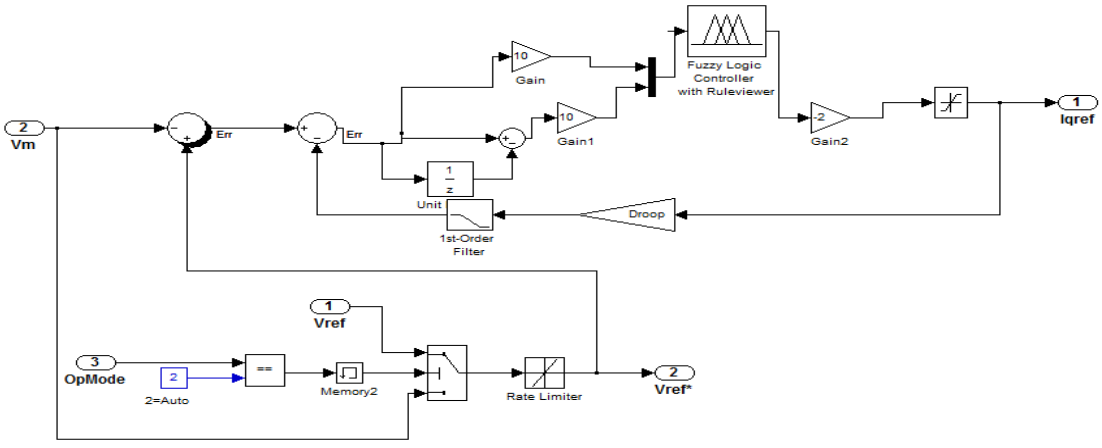
B. PI Controlled based AC voltage regulator

The below diagrams is the screen shots taken from inside AC voltage regulator.



Internal structure of AC voltage regulator

C. Internal structure of UPFC with Fuzzy logic controller



fuzzy logic implementation replacing PI controllerFuzzy logic controller

FLC have the following advantages over conventional controller.Veryrobust,Can be easily modified,Can use multiple inputs and outputs sources ,Much simpler than its predecessors (linear algebraic equations) ,Very quick and cheaper to implement

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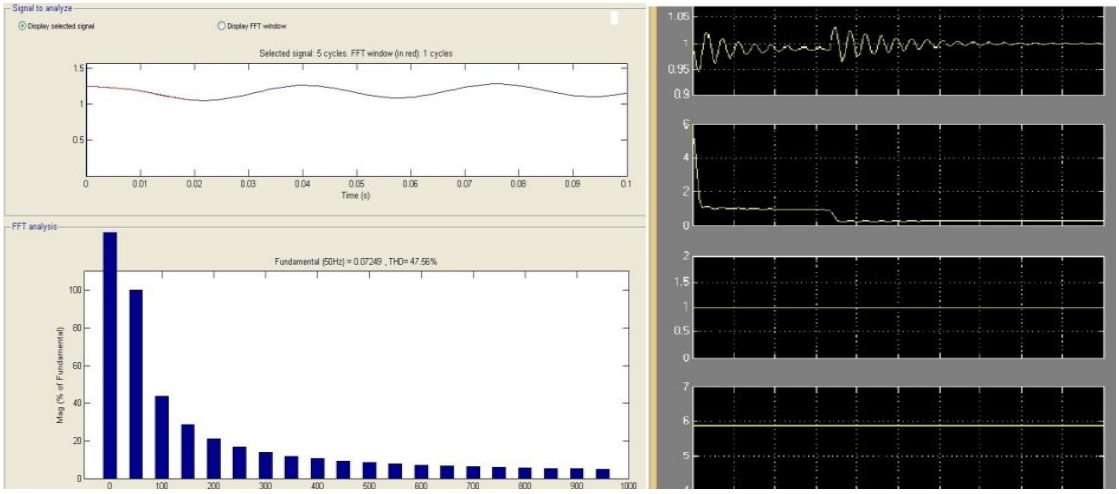
	NL	NM	NS	Z	PS	PM	PL
NS	PS	PL	PL	PS	NM	NS	NM
NM	PM	PL	PL	PM	Z	Z	Z
NL	PL	PL	PL	PL	Z	Z	Z
Z	PS	PM	PL	Z	NS	NM	NL
PS	PS	PS	NM	NS	NS	NL	NL
PM	Z	Z	Z	NM	NM	NL	NL
PL	Z	Z	Z	NL	NL	NL	NL

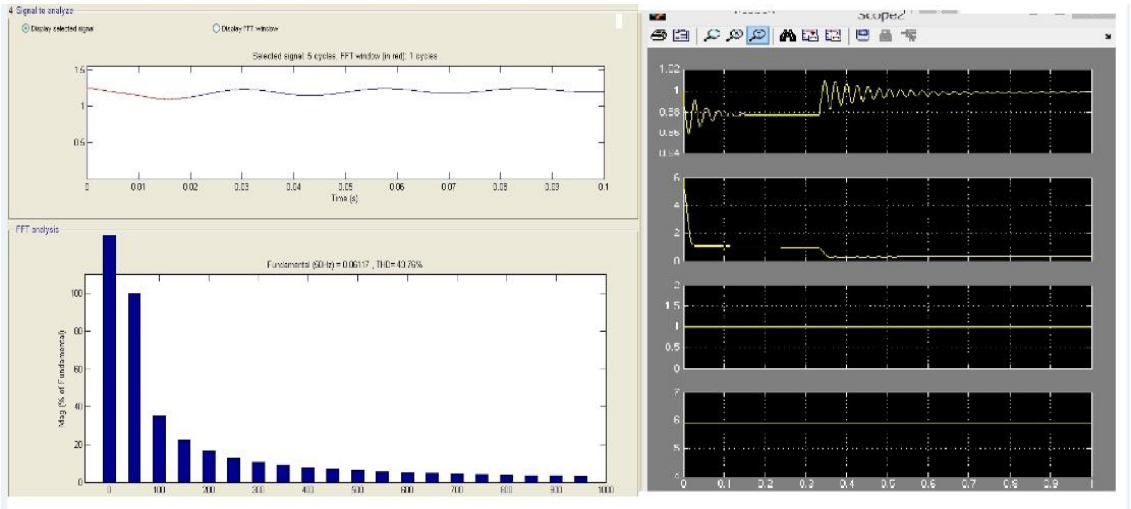
fuzzy logic rule table

III. RESULT ANALYSIS

A. FFT Analysis results of UPFC with PI controller model.



FFT Analysis results of UPFC with fuzzy logic controller model.



Comparative study of model results.

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UPFC Model with PI controller UPFC model with FLC

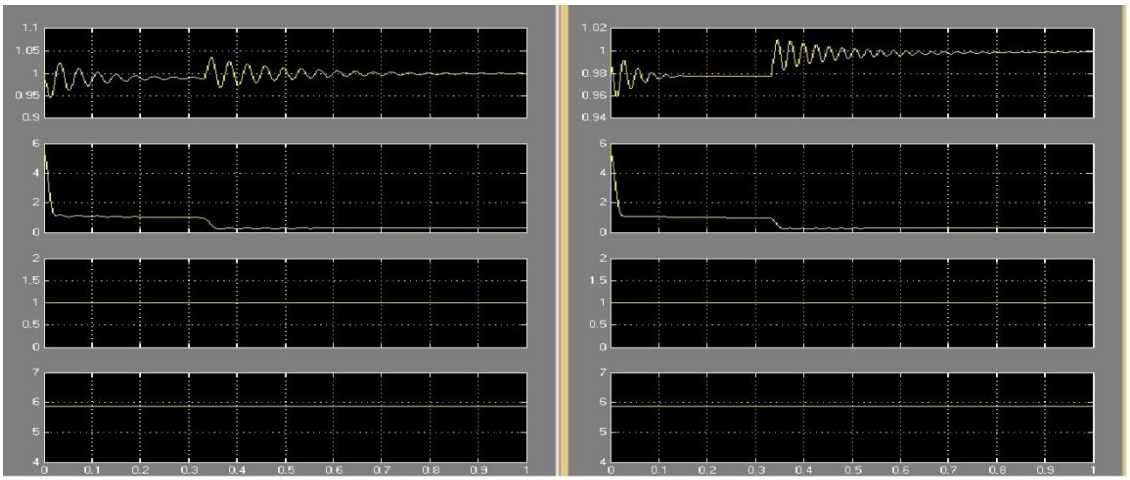

Figure 6.3 comparative result waveforms of the PI and FLC model.

Following analysis have been made on the basis of this comparative study of both models.

B. It can be clearly seen in fig 1 and 2 that the fast settlement of system is in fig 2 which is controlled by the approaches of fuzzy logic control. it shows the improvement of settling time parameter of time response as it increases damping ratio also.

C. In the total harmonic distortion window showing FFT analysis it is seen that previously the THD is reduced from 47.9 % to 43.67 %.THD is inversely proportional to power factor hence power factor is improved and also improving the transmission capacity of power with reduced losses.

D. steady state error is improved

E. Overshoots are reduced.

F. Fast response of the system.

IV. CONCLUSION

For the security and stability of the power system through long distance transmission line it is most required thing to have the intelligent controllers. The compensation provided by these intelligent versatile controllers has fast response and immediate control action during any sudden disturbance in the system. In this proposed work the same is done as the implementation of fuzzy logics are used in controlling the UPFC and it is seen that total harmonic distortions have been improved with fast settlement of the system.

V. FUTURE WORK

From our experience on simulation studies we suggest that there are some possibility to implement Fuzzy logic can be optimized by using neuro FLC and neural network. One more possibility to connect some new modified FACTs controller like UIPC and Hybrid devices by replacing UPFC. These possibilities will improve the power system security and stability limits as well.

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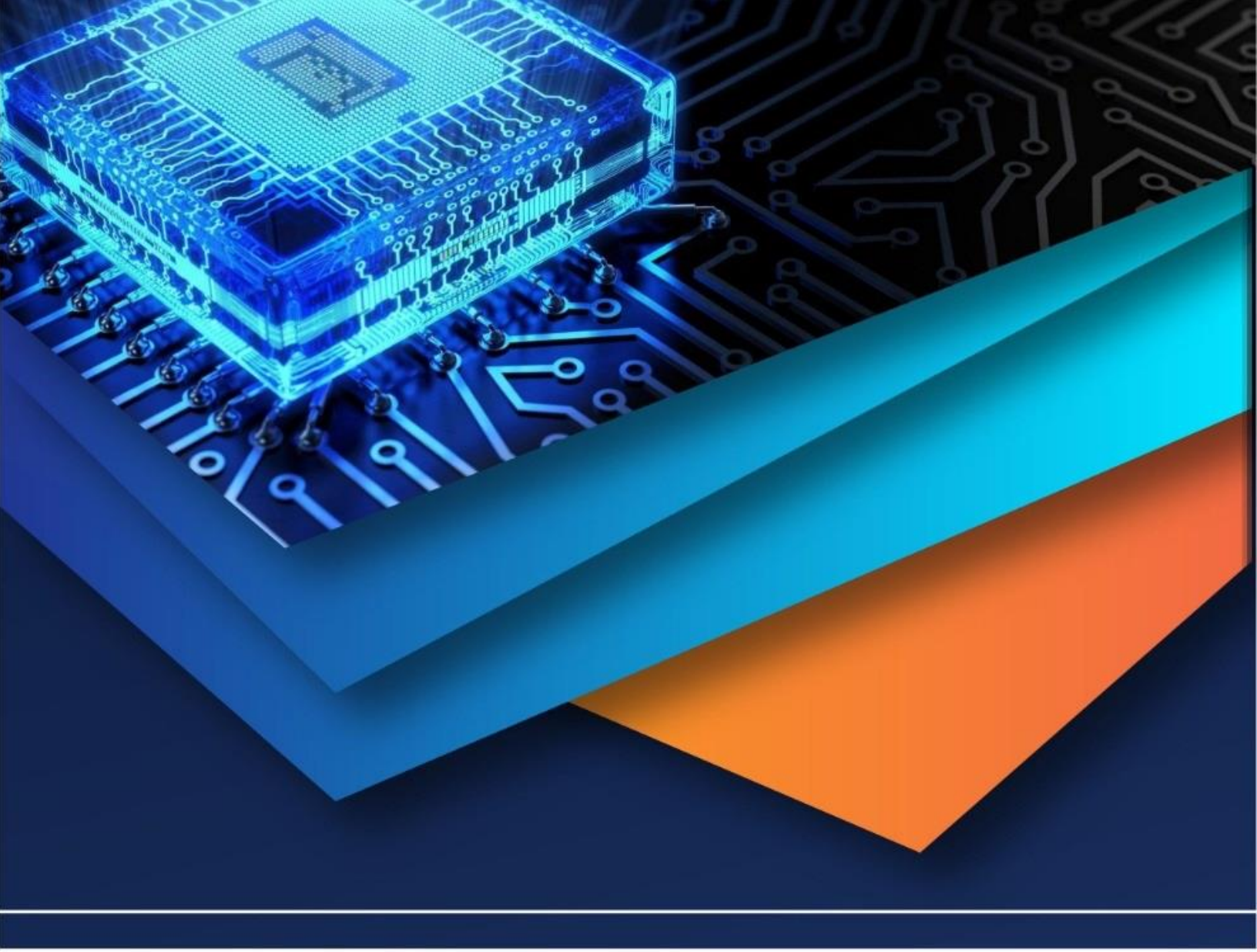

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