FUZZY LOGIC CONTROLLER BASED UPFC FOR REACTIVE POWER COMPENSATION IN TRANSMISSION LINE

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ABSTRACT:

In this paper a concert of fuzzy logic controller based unified power flow controller and its comparison with control tool based on P at different phase variation is shown on the basisof results using MATLAB, so that effectiveness of fuzzy logiccontroller based UPFC can be boosted. To governor the real andreactive power flow, and also to improve the system constancy ina transmission line a cutting-edge and flexible scheme of FACTS devices are used in which UPFC is one of them. Controllerswhich are in the control mechanism have major properties onmonitoring power flow and improving the system constancy ofUPFC. MATLAB/Simulink results specify that when a threephase fault is applied for 0.2 sec on one of the transmission lines,for controlling real/reactive power flow using different controltools based on P & Fuzzy controllers, fuzzy based control toolshows better concert in power flow controlling. The study can beperformed with MATLAB/Simulink.

KeyWords: ***Unified power Flow Controller (UPFC), Fuzzy logiccontroller (FLC), Voltage-source Inverter (VSI), inductive energy storage***

I. INTRODUCTION:

Electrical power frameworks are muddled systems with several generators providing capacity to a huge number of burdens interconnected through transmission lines, transformers, and circulation systems. A streamlined structure, serves to show the chain of command in a power framework beginning from the creating plant, through the transmission framework, to the sub-transmission framework and down into the dissemination framework. As engines from the mechanical insurgency are supplanted with server farms of the advanced transformation, the nature of the electrical power turns into a critical worry for both the client and utility. VAR remuneration is characterized as the administration and control of receptive capacity to improve air conditioning framework execution. Inside the writing, there are distinctive composes and approaches utilized for receptive power compensation.The control appropriation framework fundamental capacities are to give electrical vitality to buyers as practical as could reasonably be expected, with a decent level of value and dependability. The dependability of the framework depends fundamentally on the unwavering quality of the segments that make up the framework.

bound together power stream controller (UPFC) is a standout amongst the most in fact promising gadgets in the adaptable air conditioning transmission frameworks (FACTS) family [1]–[4]. It has the ability to control voltage extent and stage point and can likewise freely give (positive or negative) receptive power infusions. Along these lines, the UPFC can give voltage bolster, control of genuine power stream, and different capacities. The UPFC has finished the change from inventive idea to effective application at the AEP Inez substation [1]. Since the UPFC requires a high capital expense to introduce, it can't be introduced in each conceivable transmission line. Along these lines, a need exists for building up a money saving advantage examination system to decide whether an UPFC would be valuable and, provided that this is true, the best area to introduce the UPFC. On a basic level, deciding the ideal area for an UPFC is basic. For every conceivable area, we put an UPFC in the power framework demonstrate and figure the cost reserve funds concerning a base case (with no new UPFC introduced). The working expense at each time and for every potential area is resolved utilizing an ideal power stream (OPF) program. In any case, the computational weight of assessing this yearly incentive for each conceivable line is tremendous on the grounds that an OPF issue must be settled for each line and at each time consistently. Thusly, a productive screening system is wanted to distinguish just the most encouraging areas so that at each point in time consistently, the comprehensive figuring’s portrayed above don't need to be done for each area that is a contender for introducing the UPFC. Rather, we illuminate just a single "base-case" OPF issue for each point in time. There are a few papers requiring numerous air conditioner OPF keeps running for ideally finding UPFCs [5]– [7].

In [5], a repetitive algorithm is proposed that requires running ac OPF with a UPFC in a transmission line and repeating this process for all possible UPFC locations. In contrast, [6] introduces a mathematical model installing each UPFC in all possible transmission lines and filters out ineffective UPFC locations once ac OPF converges. This process is repeated until the most promising locations are identified. A non-convex approach using a parallel-tabu-search to optimally allocate UPFCs is proposed in [7]. The algorithms mentioned in [7] are most commonly used for evaluation of such non-convex problems, but the problem formulation is one way of dealing with the "exponential explosion" of problem size for such problems. Since all three techniques use a brute-force method for optimally locating UPFCs requiring multiple ac OPF solutions, they cannot be practically used for a large loadflow case.

In [5], a dull calculation is suggested that requires running air conditioning OPF with an UPFC in a transmission line and rehashing this procedure for all conceivable UPFC areas. Interestingly, [6] presents a scientific model introducing each UPFC in all conceivable transmission lines and sift through insufficient UPFC areas once air conditioning OPF meets. This procedure is rehashed until the point that the most encouraging areas are distinguished. A non-arched methodology utilizing a parallel-tabu-pursuit to ideally assign UPFCs is proposed in [7]. The calculations said in [7] are most regularly utilized for assessment of such non-raised issues, yet the issue plan is one method for managing the "exponential blast" of issue measure for such issues. Since every one of the three strategies utilize a beast constrain technique for ideally finding UPFCs requiring numerous air conditioner OPF arrangements, they can't be for all intents and purposes utilized for a huge loadflow case.

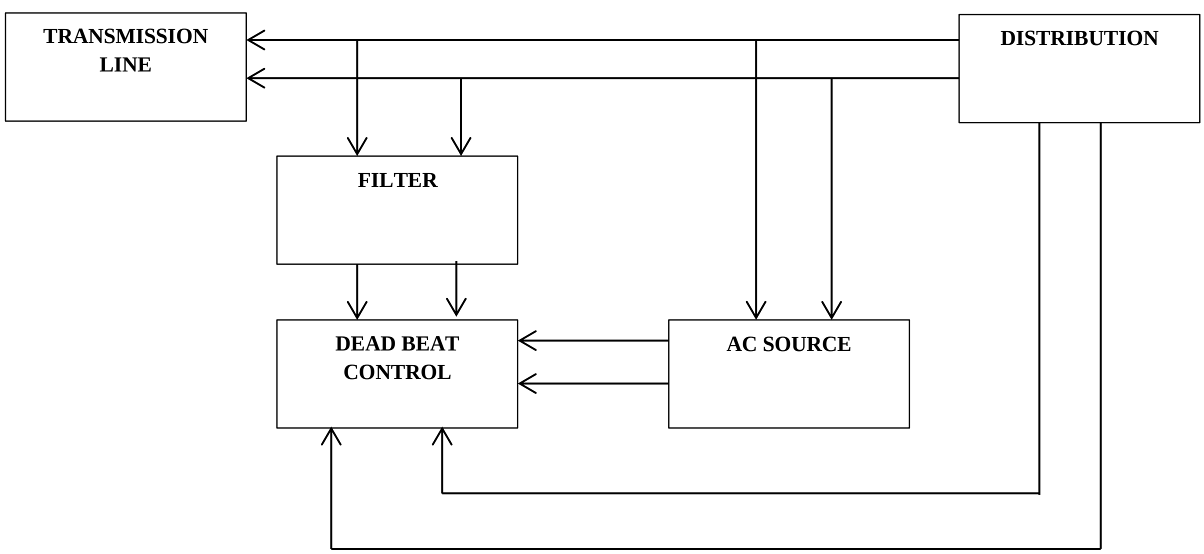

Fig.1. Block Diagram of Proposed System

A.Unified Power Flow controller

theunified **power flow controller** electrical device for providing fast-acting reactive power compensation on high-voltage electricity transmission networks. It uses a pair of three-phase controllable bridges to produce current that is injected into a transmission line using a series transformer. The controller can control active and reactive power flows in a transmission line.Unified Power Flow Controller (UPFC), as a representative of the third generation of FACTS devices, is by far the most comprehensive FACTS device, in power system steady-state it can implement power flow regulation, reasonably controlling line active power and reactive power, improving the transmission capacity of power system, and in power system transient state it can realize fast-acting reactive power compensation, dynamically supporting the voltage at the access point and improving system voltage stability, moreover, it can improve the damping of the system and power angle stability.

The UPFC uses solid state devices, which provide functional flexibility, generally not attainable by conventional thyristor controlled systems. The UPFC is a combination of a static synchronous compensator (STATCOM) and a static synchronous series compensator (SSSC) coupled via a common DC voltage link.

The main advantage of the UPFC is to control the active and reactive power flows in the transmission line. If there are any disturbances or faults in the source side, the UPFC will not work.The UPFC operates only under balanced sine wave source.

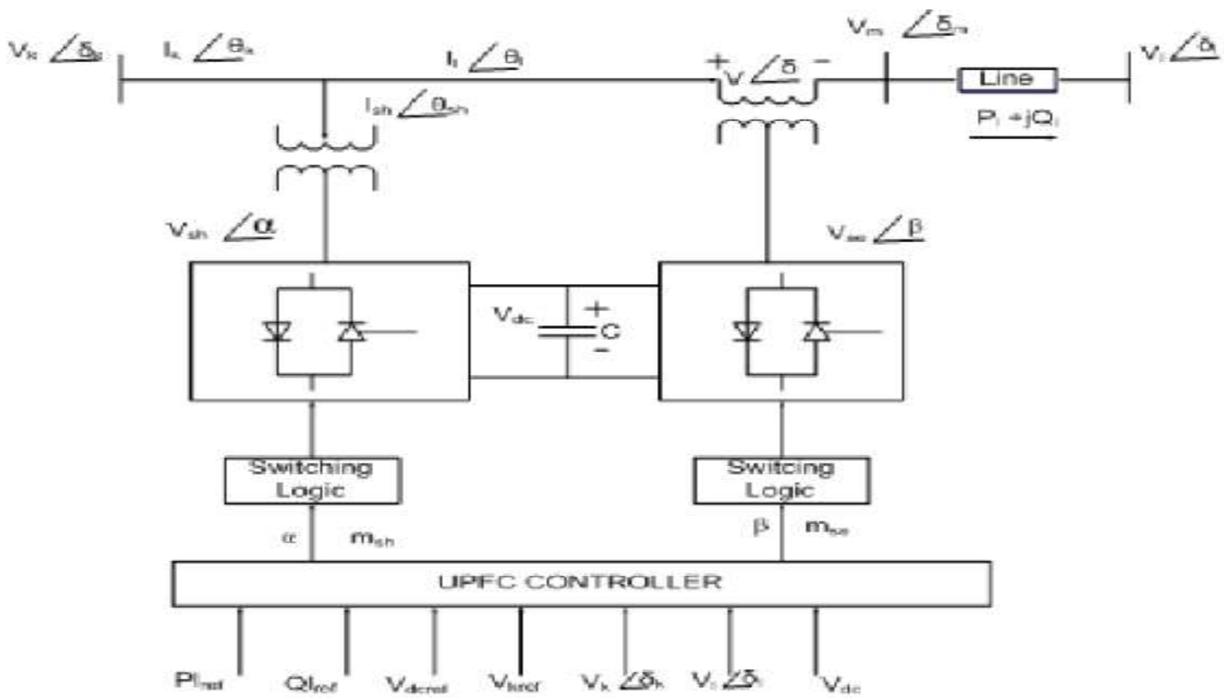

Fig.2.Block Diagram of UPFC controller

B. FUZZY LOGIC CONVERTER

The effectiveness of controllers on concertof UPFC and its competency on power flow control in thepower transmission line are simulated on MATLAB andresults are obtained via control mechanisms based on P andfuzzy based controller. The simulation results show anoverextended value of real/reactive and bus voltage when athree phase fault is applied on transmission line for 0.2 secduration. For designing Fuzzy based controllers, for decisionmaking “Takagi-Sugeno Inference System” and fordefuzzification “Mamdani” model is used in MATLAB.To create model of UPFC via different control mechanismMATLAB is used..

C. TRANSMIISSION LINES

Transmission lines are dual conductor lines that act as transverse electromagnetic mode wave guides for electromagnetic waves. Transmission line is used for the transmission of electrical power from generating substation to the various distribution unit.It transmits the wave of voltage and current from one end to another. The transmission line is made up of a conductor having a uniform cross-section along the line.

D. DISTRIBUTION

Electric power distribution is the final stage in the delivery of electric power; it carries electricity from the transmission system to individual consumers. Distribution substations connect to the transmission system and lower the transmission voltage to medium voltage ranging between 2 KV and 35 KV with the use of transformers.Distribution transformers again lower the voltage to the utilization Voltage used by lighting, industrial equipment or household applications.

E. FILTER

A filter is an AC circuit that separates some frequencies from others within mixed-frequency signals.Audio equalizers and crossover networks are two well-known applications of filter circuits.A Bode plot is a graph plotting waveform amplitude or phase on one axis and frequency on the other.

II. Simulation of proposed System

The proposed system is simulated in MATLAB/Simulink Simulation Software. The proposed system is as shown in the figure 3.

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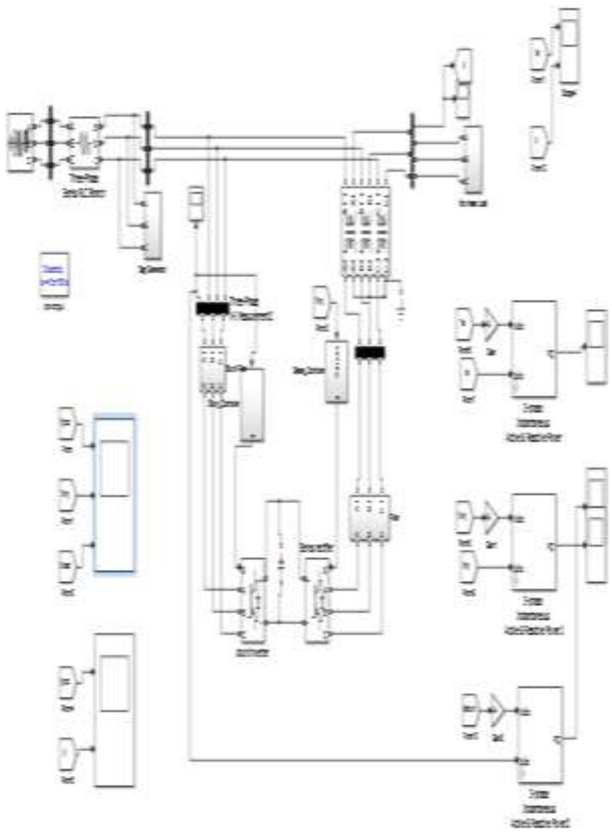

Fig.3.Simulation diagram of proposed system

The upfc controller is simulated in the simulation software. The proposed system has sag generation is include in the system to create sag. The proposed control system used Fuzzy logic controller which is used for UPFC controller. It is implemented in both series and parallel compensation. The Fuzzy logic controller is modeled as shown in the figure 4.

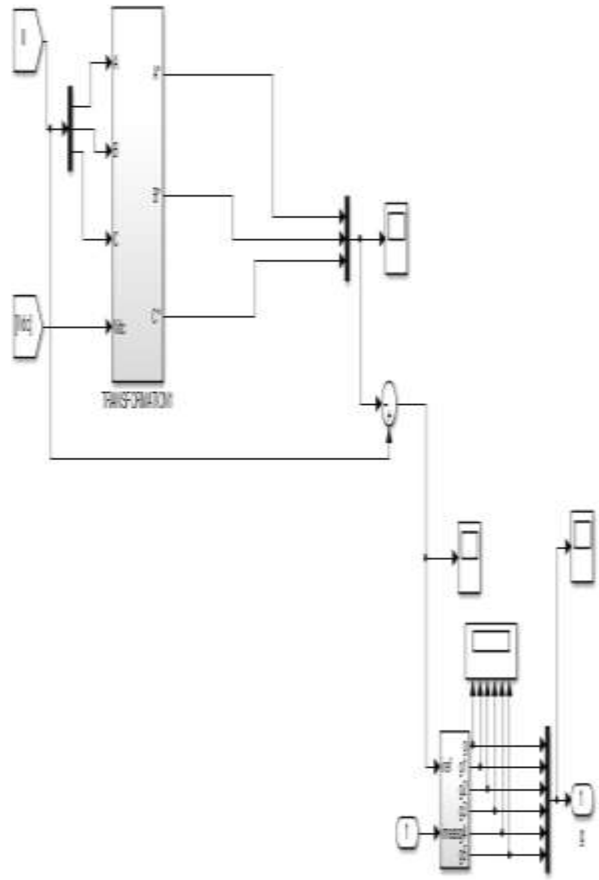

Fig.4.Fuzzy logic controller for parallel UPFC controller

The Fuzzy logic controller is also used in series compensation is modeled. The sag generation is as shown in the figure 5.

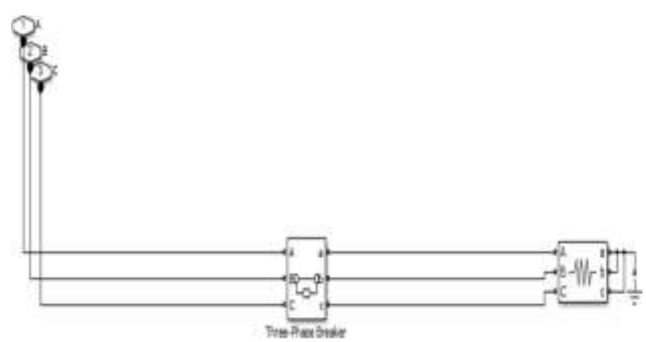

Fig.5.Sag generation simulation model

The non-linear load connected to the system is modeled as shown in the figure 6.

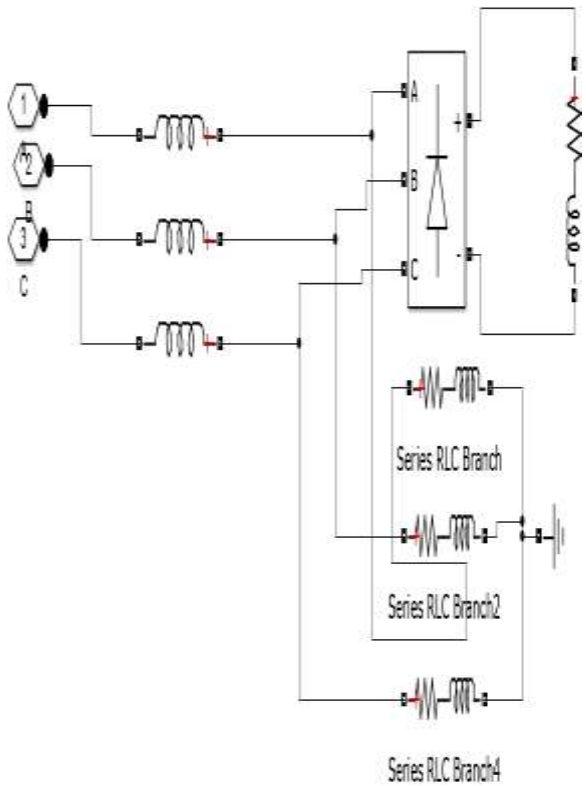

Fig.6.Non-linear load connected the grid

The system is modeled as shown in the proposed section. The output results are discussed in the next section.

III. Simulation output and results

The simulation is successfully simulated in the MATLAB/Simulink simulation software. The reactive power compensation is a much needed when the non-linear load is introduced in the circuit. The system is of 415 Volt AC. The transmission line is connected to a nonlinear load, thus a dip in voltage occurs at the point of common coupling.

The output voltage at the point of common coupling with the voltage injection and load voltage is as shown in the figure 7.

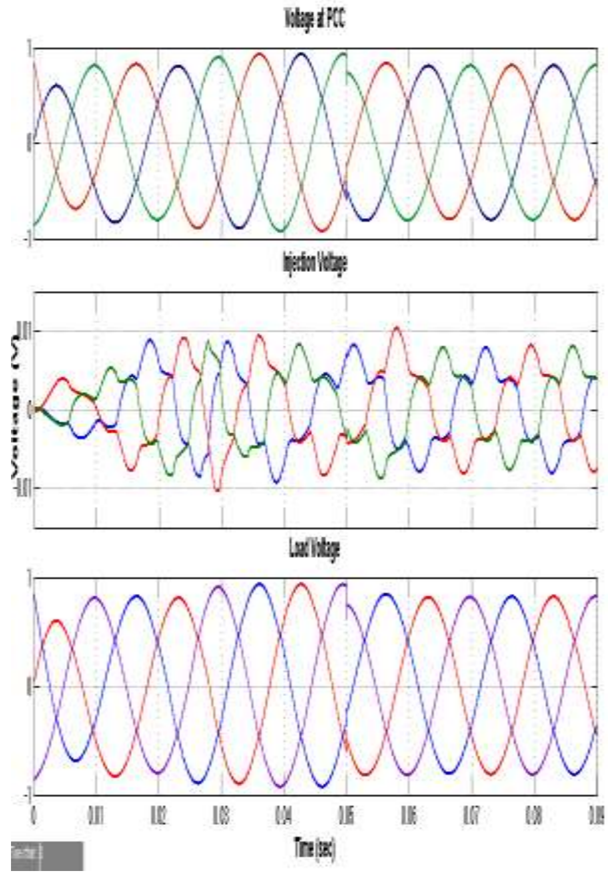

Fig.7. Grid voltage at PCC, injection voltage and Load voltage

The voltage measurement is measured at the load and at the point of common coupling is as shown in the figure 8.

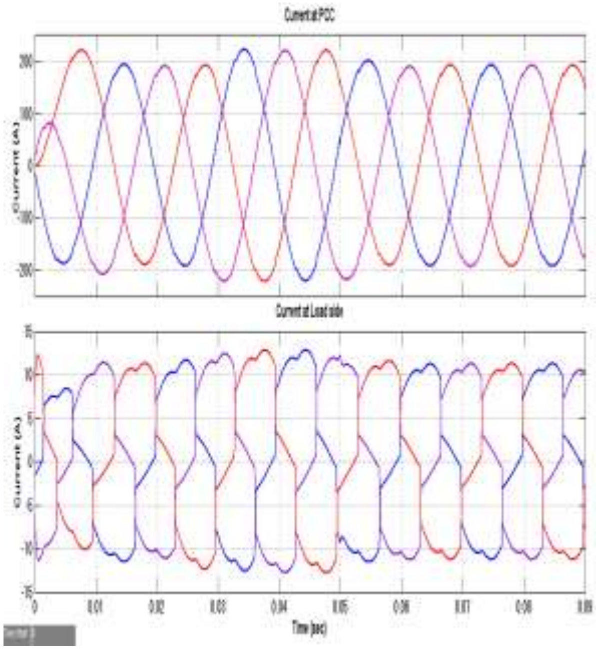

Fig.7. Grid current at PCC and Load voltage

Tabulation of Caparison with existing and proposed system

PARAMETERS	PROPOSED SYSTEM	EXISTING SYSTEM
Voltage At Point Of Common Coupling	0.9 P.U	0.7 P.U
Voltage Injection	0.01 P.U	0.007 P.U
Voltage At Load Side	0.9 P.U	0.7 P.U
Current At PCC	220 Amps	220 Amps

Parameters	**Proposed system**	**Existing system**
Nominal System Voltage	320 V	320
Nominal System Power	0.18 MVA	0.18 MVA
Sag Voltage Dip	288 V	250 V
Real Power Consumption	250 KW	250 KW
Sag Power Consumption	225 KW	160 KW
Loss in Power Due to Sag	25 KW	90 KW
Reactive power consumption	140 kVAR	190 kVAR
Loss in Voltage Due to Sag	32 V	70 V

Conclusion

A new method for compensation in Transmission line is simulated using UPFC compensator with Fuzzy logic controller is proposed in this project. The system simulated in the above section can conclude that the sag due to variable load is enhanced in voltage at point of common coupling which in turn give good load voltage output characteristics.

Thus using UPFC with Fuzzy logic controller the voltage is gained about 50 V at 415 volt AC voltage system. The above results can be verified from the simulation diagram generated in the MATLAB simulation software.

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