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Review on Improving the Electric Power Quality by Upfc Systems in Electrical Networks Using Matlab

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***Abstract*— In this Project we are going to utilize The (upfc) is the most adaptable among an assortment of adaptable AC transmission framework (FACTS) gadgets, which can be utilized for power stream control, improvement of transient dependability, damping framework motions and voltage guideline. In this paper, we propose another PI based methodology for the dynamic control of UPFC. With the new control methodology, not just the dynamic and responsive force stream control yet in addition the framework motions damping can be accomplished. The computerized reenactment results created in MATLAB conditions are introduced to confirm the proficiency of the proposed control calculation.**

Keywords: UPFC,FACTS,MATLAB etc.

1. INTRODUCTION

The ongoing deregulation of power systems around the world may not only bring cheaper electricity and better service to the customers but also present new technological challenges to the power industries and researchers. In a deregulated environment, the open access to the transmission networks requires adequate Available Transfer Capability (ATC) to guarantee economic transactions However, in a privatized electricity market, the major traditional ways to enhance ATC, such as rescheduling active power generations, adjusting terminal voltage of generators, and changing taps of on-load tap changer, etc, may not be centrally controlled by the transmission network owner or system operator. Construction of new transmission lines has always been an option, but it is subject to tougher and tougher environmental restrictions and sometimes social problems too. With the availability of the fully controlled semiconductor devices such as the Gate Turn-off Thyristor (GTO) and the Insulated Gate Bipolar Transistor (IGBT), and the invention of new topologies, i.e. the combination of multiple compensators, the hitherto most powerful and versatile group of FACTS devices, namely combined compensators, has been developed. Its representatives include the Famous Unified Power Flow Controller (UPFC) and the Interline Power Flow Controller (IPFC). The latter is the latest generation of FACTS devices. It is well known that heavily loaded lines and buses with relatively low voltages are factors that significantly limit

1. The power system is an interconnection of generating units to load centers through high voltage electric transmission lines and in general is mechanically controlled.

2. It can be divided into three subsystems: generation, transmission and distribution subsystems. Until recently all three subsystems were under supervision of one body within a certain geographical area providing power at regulated rates

3. A special arrangement of two SVSs, one connected in series with the ac system and the other one connected in shunt, with common dc terminals is called Unified Power Flow Controller (UPFC). It represents series - shunt type of controller.

With the advancement of interconnection of enormous electric force frameworks there have been unconstrained framework motions at low frequencies in the request for a few cycles for every moment. These low recurrence motions are overwhelmingly because of the absence of damping of mechanical method of the framework. Since power swaying is a supported unique function, it is important to differ the applied remuneration to check the quickening and decelerating swings of the upset machine. The idea of Flexible AC transmission framework (FACTS) conceives the utilization of strong state regulators to accomplish adaptability of intensity framework by quick and dependable control of intensity framework boundaries influencing power stream in transmission line, specifically voltage, impedance as well as stage point. Bound together Power Flow Controller (UPFC), a multifunctional Flexible AC Transmission framework (FACTS) Controller opens up new open doors for controlling force and improving the usable limit of present, just as new and updated lines. An UPFC advantageous damping regulator has been introduced in the UPFC control framework for damping the electromechanical mode motions.

In efficient plan of four option UPFC damping regulators are introduced. Notwithstanding, these UPFC damping regulator gains are planned based on ostensible working conditions and stay autonomous of framework working conditions and line loadings.

Likewise the regulator gains and subsequently the control structure is distinctive for the different decisions of UPFC control signals. Since damping of low recurrence motions might be one of the optional elements of the multifunctional UPFC dependent on its other significant control tasks, the broadly differing control structure as for the decision of control signals makes the continuous execution unyielding. This work proposes a versatile fluffy deduction framework (ANFIS) based UPFC advantageous damping regulator to superimpose the damping capacity on the control sign of UPFC for damping of intensity framework electromechanical motions. The versatile fluffy regulator is gotten by installing the fluffy derivation framework into the structure of versatile networks. The proposed ANFIS based damping regulator execution is inspected for the four decisions of UPFC control signals dependent on balancing record and voltage stage point of UPFC arrangement and shunt converters by reproductions on a linearized Philips-Hefron model of a force framework with UPFC. The viability of this regulator is upheld by the outcomes seen in reenactments, which show the capacity of the regulator in damping motions over a wide reach of loading conditions and system parameters with the four choices of alternative UPFC control signals when compared to constant gain damping controllers designed using phase compensation technique at selected operating point.ntegrating this approach to a multi-machine power system and through non- linear simulation the robustness of theproposed controller is validated.

II. LITERATURE REVIEW

1) Samiksha Thakare proposed "Improvement in Power Flow Control and Voltage Regulation using UPFC", 2019 Innovations in Power and Advanced Computing Technologies (i-PACT) IEEE XPLORE DOI: 10.1109/i-PACT44901.2019.8960151. FACTS is a flexible alternating current transmission system which is used to transfer AC power. FACTS technology is a way of improving power system controllability's and power transfer. There are various FACTS devices used for various purpose. In this paper, we are using UPFC. UPFC is a combination of STATCOM and SSSC. UPFC controls the power flow and regulate the voltage. This paper represents the various modes of operation using series and shunt converters. Unified Power Flow Controller (UPFC) is IGBT based voltage source converter which shows the step change..

2) Swati Bhasin ; Annapurna Bhargava ; Sandeep Verma ; Vandana Chaudhary, in paper titled Comparative Simulation Studies for Hybrid Power Flow Controller and UPFC based Controller for SMIB System," 2019 2nd International Conference on Power Energy, Environment and Intelligent Control (PEEIC) IEEE Xplore DOI: 10.1109/PEEIC47157.2019.8976670 Day by day increment in the necessity of the consumer side is observed so we use FACTS technology for utilising better functionality of the power system. HPFC is the useful device like UPFC that observed severally and selectively Performance characteristics over actual controllers. The main demerit of UPFC is so expensive from HPFC because of its full rating (MVA) of VSC's converter. So, the total cost of controller (HPFC) is reduces. This paper defines the study of performance improvisation in the power system by comparing the HPFC and UPFC. Here we used one topology of HPFC which is formed by two VSC's are connected in series and SVC is connected in shunt through the tie-lines. The outcomes of comparison on HPFC and UPFC are explained on SMIB system that observes the HPFC is economically better than other controllers with better performance..

3) Hyun-Jun Lee ; Young-Doo Yoon proposed in "Single-phase UPFC Topology with Autotransformer Structure for Smart Grid 2019 10th International Conference on Power Electronics and ECCE Asia (ICPE 2019 - ECCE Asia) IEEE Xplore," This paper proposes a topology for UPFCs. The proposed topology consists of N:2 transformer with a center-tap, a full-bridge converter and a half-bridge converter. While the conventional UPFC topology uses two three-phase transformers, which are called as a series transformer and a parallel transformer, the proposed topology uses three single-phase transformers. By using an autotransformer structure, the voltage ratings of the transformers and the switches in the power converter module can be decreased significantly. As a result, compared to the conventional UPFC topology, it is possible to reduce installation spaces and costs. Also, by adopting a full-bridge converter and a half-bridge converter structure, the proposed topology can be easily implemented with the conventional power devices and control techniques. Simulations and experiments were performed and, the results verify the effectiveness of the proposed UPFC topology

4) Muhammad Noman Iqbal ; Anzar Mahmood ; Adil Amin ; Hirra Arshid, evaluated and analyzed in "Voltage Regulation and Power Loss Minimization by Using Unified Power Flow Control Device," 2019 International Conference on Engineering and Emerging Technologies (ICEET) IEEE Xplore DOI: 10.1109/CEET1.2019.8711866 The operation and growth of interconnected power systems has given rise to

many complexities. The power transfer capabilities are becoming limited day by day. It has become important to develop the strategies to cope with such problems and utilize transmission systems at their maximum thermal capacity. This thesis presents SIMULINK model of Unified Power Flow Controller (UPFC) device to analyze the operation of single and double line transmission systems of 132/220kV. UPFC model is a very important member of family of Flexible AC Transmission System (FACTS) devices. It is a microcontroller based solid state converter capable of controlling active and reactive power in transmission line and controls power flow and real power loss. This work will reveal the effects of installing UPFC model for single and double transmission line in MATLAB/Simulink to observe voltage regulation, power loss minimization and improvement in power transfer capability. Simulation results of three cases for single and double line transmission systems with and without UPFC device are examined in this work to observe the effects of installing this device in power system.

5) Salah Kamel ; Yousry Ibrahim ; Ahmed Rashad ; Loai S. Nasrat. in "Performance Enhancement of Wind Farms Integrated with UPFC Using Adaptive Neuro-Fuzzy Inference System" 2019 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE) IEEE Xplore DOI: 10.1109/ICCCEEE46830.2019.9070833,. The unified power flow controller (UPFC) is employed for stability improvement and voltage regulation of power systems. Adaptive Neuro-Fuzzy Inference System (ANFIS) has learning capability to solve and estimate the best solution of nonlinear functions. This paper studies the ability of ANFIS to estimate the best values of control gains of UPFC for enhancing the performance of a blended wind farm (BWF) during three phase fault. In BWF, the fixed speed squirrel cage induction generators (SCIG) and variable speed doubly fed induction generators (DFIG) are blended. The performance of BWF with ANFIS UPFC is compared with two cases, firstly BWF with UPFC controlled by artificial neural networks (ANN) (ANN UPFC), secondly BWF without UPFC. The root mean square error, RMSE, is used to measure the performance of the studied cases. The results show that the ANFIS UPFC can improve the performance of BWF. The system is achieved using the Matlab- Simulink software

III. CONCEPT

The basic components of UPFC are two voltage source inverters (VSIs) sharing a common dc storage capacitor which is connected to the power system through coupling transformers. One of the VSI is connected to power system via a shunt transformer, while the other one is connected in series through a series transformer. A basic UPFC functional diagram is shown in Fig. 1. The series inverter is operated to inject a symmetrical three phase voltage system (Vse), of controllable magnitude and phase angle in series with the line to control active and reactive power flows on the power system. So, this inverter will exchange active and reactive power with the line. The shunt inverter is operated in such a way that it demands the dc terminal power (positive or negative) from the line keeping the voltage across the storage capacitor Vdc constant. So, the net real power absorbed from the line by the UPFC is equal only to the losses of the inverters and their transformers. The remaining capacity of the shunt inverter can be used to exchange reactive power with the line so as to provide the voltage regulation at the connection point. The two VSI's can work independently of each other by separating the dc side. In this case the shunt inverter is operates as a STATCOM that generates or absorbs reactive power to regulate the voltage magnitude at the connection point. On the other hand the series inverter is operates as SSSC that generates or absorbs reactive power to regulate the current flow, and hence the power flow on the Power system. The UPFC has many possible operating modes. In particular, the shunt inverter operates in such a way that it injects a controllable current, Ish into the transmission line. The shunt inverter can be controlled in two different modes. A.VAR Control Mode: The reference input is an inductive or capacitive VAR request. The shunt inverter control translates the var reference into a corresponding shunt current request and adjusts gating of the inverter to establish the desired current. For this mode of control a feedback signal representing the dc bus voltage, Vdc, is also required. B. Automatic Voltage Control Mode: The shunt inverter reactive current is automatically regulated to maintain the transmission line voltage at the point of connection to a reference value. For this mode of control, voltage feedback signals are obtained from the sending end bus feeding the shunt coupling transformer.

IV. OBJECTIVES

In this paper, A comprehensive approach for optimum design of UPFC controllers (i.e. STATCOM control andSSSC control) has been presented for a single machine system. The adverse interaction between PSS and SSSC control has been compensated, by providing UPFC based damping controller and UPFC capability in transient stability improvement and damping LFO of power systems, an adaptive neuro-fuzzy controller for UPFC was presented. The controller was designed for a single machine infinite bus system. Then simulation results for the system including neuro fuzzy controller were compared with simulation results for the system including conventional UPFC controller. Simulations were performed for different kinds of loads. Comparison showed that the proposed adaptive neuro-fuzzy controller has good ability to reduce settling time and reduce amplitude of LFO so as to

1. Faster Steady State achievement
2. Improved Voltage Profile
3. To understand the design of a real power coordination controller for a UPFC
4 The interaction between the series injected voltage (Vse) and the transmission line current (Ise) leads to exchange of real power (Pse) between the series converterand the transmission line.
5 The interaction between the series injected voltage and the transmission linecurrent leads to real and reactive power exchange between the series converter and the power system.

V. PROTOTYPE

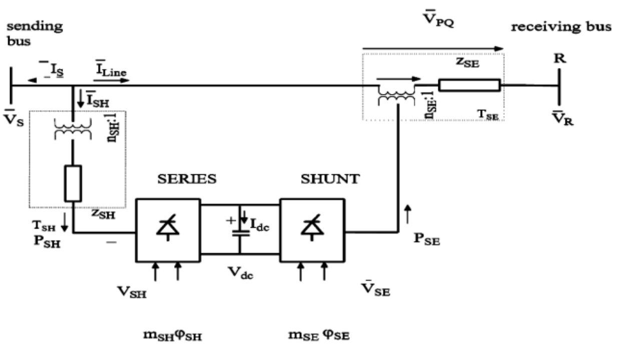

Fig.1. **Prototype of upfc**

As shown in fig. IV, To provide for proper coordination between the shunt and the series converter control system, a feed-back from the series converter is provided to the shunt converter control system. The feedback signal used is the real power demand of the series converter (Pse). The real power demand of the series converter (Pse) is converted into an equivalent D-axis current for the shunt converter (iDse). By doing so, the shunt converter responds immediately to a change in its D-axis current and supplies the necessary series converter real power demand. The equivalent D-axis current (iDse) is an additional input to the D-axis shunt converter control system as shown in Fig. 2

The real power demand of the series converter Pse is the real part of product of series converter injected voltage Vse and the transmission line current Ise. Vupfc, iDse represent the voltage of the bus to which the shunt converter is connected and the equivalent additional D-axis current that should flow through the shunt converter to supply the real power demand of the series converter

VI. Research Methodology/Planning of Work

• In power system transmission, it is desirable to maintain the voltage magnitude, phase angle and line impedance. Therefore, to control the power from one end to another end, this concept of power flow control and voltage injection is applied .Modeling the system and studying the results have given an indication that UPFC are very useful when it comes to organize and maintain power system.

• The proposed method algorithm provides a very good performance under various channel conditions, with a short observation time and at low signal-to-noise ratios, with reduced complexity. considered. The UPFC is modeled as two controllable voltage sources; Vser represents the series inverter and Vsh represents the shunt inverter . Two perpendicular components: one in-phase with the system bus voltage and the other in quadrature are used to represent both compensation voltages generated by each inverter of the UPFC The validity of the proposed algorithm is verified using signals generated and acquired by laboratory instrumentation, and the experimental results show a good match with computer simulation results.

VII. CONCLUSION

The proposed system has been implemented using MATLAB/ Simulink. In proposed Flexible alternating current transmission system model model, Unified power flow control device has been implemented over AC transmission line. This is found to be so efficient and effective. The implemented system model is able to match set reference reactive power. With this feature the implemented model enables stable voltage, control over reactive power, and impedance for better AC power transmission system**.**

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