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FACTS Applications' in Enhancement of Power system Low Frequency Oscillations: A Review

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ABSTRACT: At the present time, FACTS technology has already been considered to bring a bright prospect for the modem power system. By the flexible and rapid control over the AC transmission parameters and network topology, FACTS can facilitate the power control, enhance the power transfer capacity, decrease line losses and generation costs, and improve the stability and security of the power system. This paper gives a general overview of its need, FACTS technological development and the opportunities FACTS enjoy. The main crux of this paper mainly focuses on the need for evolution of FACTS, its advancement in technology surpassing umpteen obsolete technologies and the opportunities it faces in the present day context. This paper presents a survey of literature on the various methods, algorithms and optimizationmethods applied to solve the low frequency oscillations problems. The purpose of this paper is to present an overview of the FACTS controller, Co-ordination of FACTS controller with PSS on different techniques and optimization methods on published literature from 2000 to the present.

Keywords: Low frequency oscillations (LFO), STATCOM, UPFC, FACT etc.

I. INTRODUCTION

In recent years, greater demands have been placed on the transmission network, and these demands will continue to increase because of the increasing number of non-utility generators and heightened competition among utilities themselves. Increased demands on transmission, absence of long term planning, and the need to provide open access to generating companies and customers, all together have created tendencies towards less security and reduced quality of supply. The FACTS technology is essential to alleviate some but not all of these difficulties by enabling utilities to get the most service from their transmission facilities and enhance grid reliability.FACTS is defined by as "a power electronic based system and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability.In simpler terms, FACTS is a static equipment used for the AC transmission of electrical energy. It is meant to enhance controllability and increased power transfer capability. It is generally a power electronics based device. The most interesting thing for transmission planners is that FACTS technology opens up new opportunities for controlling power and enhancing the usable capacity of present, as well as new and upgraded lines. These opportunities arise through the ability of FACTS Controllers to control the interrelated parameters that govern the operation of transmission systems including series impedance, shunt impedance, current, voltage, phase angle, and the damping of oscillations at various frequencies below the rated frequency. By providing added flexibility, FACTS Controllers can enable a line to carry power closer to its thermal rating.The FACTS technology is not a single high-power Controller, but rather a collection of Controllers, which can be applied individually or in coordination with others to control one or more of the interrelated system parameter.

Low frequency oscillations (LFO) in power system occur usually because of lack of damping torque to overcome disturbances in power system such as changes in mechanical power. Traditionally, power system stabilizers (PSS) are being used to damp these oscillations. Damping of power system oscillations between interconnected areas is very important for the system secure operation. Power system stabilizer (PSS) and flexible AC transmission systems (FACTS) devices are used to enhance system stability.

In large systems multi-machine, using only conventional PSS may not provide sufficient damping for inter-area oscillations. In these cases, FACTS power oscillation damping controllers are effective solutions [22]. Unified power flow controller (UPFC) is a well-known FACTS device that can control power flow in transmission lines. It can also replace PSS to damp low frequency oscillations effectively through direct control of voltage and power [26]. Thyristor controlled series compensator (TCSC) is a well-known FACTS device that can control power flow in transmission lines. It can also replace PSS to damp low frequency oscillations effectively by cancelling a portion of the reactance line impedance and thereby increase the transmittable power [32]. STATCOM is one of the most significant devices in FACTS technology which is used in parallel compensation, enhancing the transient stability, limiting the low frequency oscillations and etc. designing a proper controller is effective in operation of STATCOM. FACTs devices, such as Unified Power Flow Controller (UPFC), can control power flow, reduce sub-synchronous resonance and increase transient stability. So UPFC may be used to damp LFO instead of PSS. UPFC damps LFO through direct control of voltage and power.

II. BASICS OF FACTS

The main idea of FACTS can be explained by the basic equation for AC power transmission. Power transmitted between two nodes of the system depends on the voltages at both ends of the interconnection, the impedance of the line and the phase angle difference between both systems. Different FACTS devices can actively influence one or more of these parameters for power flow control and for improvement of voltage stability at the node of interconnection.

III. TAXONOMY OF APPROACHES

The taxonomy that is proposed to classify the current methods applied to FACTS is as follows: 1. Fuzzy logic, 2. Genetic algorithms, 3. Other methods

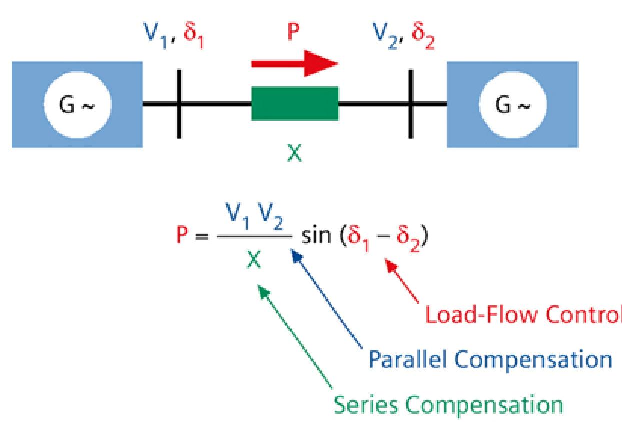
A linear optimal controller is designed to implement multiple variable series compensations in transmission networks of interconnected power systems. The proposed controller was utilised to damp interarea oscillations and enhance power system damping [1]. Tthe linearized Phillips-Heffron model of a power system installed with a unified power flow controller (UPFC) was presented. Two applications based on the Phillips-Heffron model were demonstrated:

(1) study on the effect of UPFC DC voltage regulator on power system oscillation stability; (2) selection of damping control signal for the design of UPFC damping controller" [3].

A STATCOM, UPFC, and convertible static compensator were discussed [4]. The installed FACTS controllers have provided new possibilities and unprecedented flexibility aiming at maximizing the utilization of transmission assets efficiently and reliably. Dingguo Chen *et.al.* [5] Investigated the power system stability issue involving the regular generator-angle transient stability and load-driven voltage instability. Transient stabilization of simplified power systems equipped with the flexible AC transmission system (FACTS) device, the thyristor-controlled series capacitor (TCSC), was studied with consideration of unknown loads. With some off-line time-optimal trajectories computed based on the switching-times-variation method (STVM), some techniques were developed to synthesize robust near-time-optimal neural controllers.

IV. FUZZY LOGIC

Mishra, *et.al.* [2] Presented a simple hybrid fuzzy logic proportional plus conventional integral controller for FACTS devices in a multi-machine power system. This controller was designed by using an incremental fuzzy logic controller in place of a proportional term in a conventional PI controller and provides a wide variation of controller gains in a nonlinear manner. This controller is well suited to series connected FACTS devices like UPFC, TCSC and TCPST, etc., in damping multi-modal oscillations in a multi-machine environment. The application of Takagi-Sugeno type fuzzy logic controllers was proposed for UPFC voltage source inverter control in a multi-machine power system environment in [6]. This type of fuzzy controller provides a wide range of control gain variation by including both linear and nonlinear terms in the consequent part of the fuzzy rule base. The TS fuzzy controllers were quite general in that they use arbitrary input fuzzy sets, any type of fuzzy logic, and the general defuzzifier.



A new fuzzy proportional action was introduced to enhance the performance of output feedback controllers. This fuzzy system has a simple structure and acts as a nonlinear function so that the gain of the controller was not constant but changes according to the error value [16].

Khatami *et.al.* presented a linearized Heffron-Philips model of a (single machine infinite bus) power system with a TCSC controller is developed. The designed fuzzy c-means clustering TCSC controller adjusts control signal by appropriately processing of the input signals, and provides an efficient damping [32]. In [26] a linearized Heffron-Philips model of a (single machine-infinite bus) power system with a unified power flow controller was developed. The designed fuzzy-based UPFC controller adjusts four UPFC inputs by appropriately processing of the input error signal, and provides an efficient damping. The results of the simulation show that the UPFC with fuzzy-based controllers is more effective in damping LFO compared to UPFC with PID controllers.

V. GENETIC ALGORITHMS

Optimal location of multi-type FACTS deviceswas investigated using a genetic algorithm [7] in a power system. In the paper the optimizations were performed on three parameters: the location of the devices, their types and their values. The system loadability is applied as a measure of power system performance. Four different kinds of FACTS controllers are used and modeled for steady-state studies: TCSC, TCPST, TCVR and SVC. Simulations are done on a 118-bus power system for several numbers of devices.

Genetic Algorithm (GA) was utilized to search for optimum controller parameter settings that optimize a given eigenvalue based objective function. Secondly, an optimal pole shifting, based on modern control theory for multi-input multi-output systems, was used. It requires solving first order or second order linear matrix Lyapunov equation for shifting dominant poles to much better location that guaranteed less overshoot and less settling time of system transient response following a disturbance [35-37]. Bati, Investigated the ability of STATCOM in damping power systems oscillations. The optimal pole shifting (OPS) technique using Genetic Algorithm would be applied in designing STATCOM damping controller. The dynamic interaction of STATCOMcontroller was analyzed [40].

UPFC The unified power flow controller is one of the most versatile flexible AC transmission system devices, which can be used to control the active and reactive power flows in a transmission line by injecting a variable voltage in series and reactive current in shunt. To put flexible AC transmission systems (FACTS) devices into realistic use, components-based unified-power-flow-controller (UPFC) model was developed [8]. A novel tracker of differential (TD) and a nonlinear PID (NLPID) control system were proposed to be the main control of the UPFC.

Abido, *et.al* [10] investigated the Power system stability enhancement via robust coordinated design of a power system stabilizer (PSS) and a thyristor-controlled series capacitor (TCSC)-based stabilizer.. The coordinated design problem of robust excitation and TCSC-based controllers over a wide range of loading conditions and system configuration was formulated as an optimization problem with an eigenvalue-based objective function. The real-coded genetic algorithm (RCGA) was employed to search for optimal controller parameters. This study also presents a singular value decomposition (SVD) based approach to assess and measure the controllability of the poorly damped electromechanical modes by different control inputs.

VI. OTHER METHODS

system with a unified power-flow controller (UPFC), maximum power transfer capability is often achieved when the UPFC is operated at its rated capacity and conventional voltage and line-flow set point regulation is no longer possible.use of injected voltage sources to directly model a UPFC and impose the rating slimits in a Newton-Raphson load-flow algorithm was proposed . A dispatch strategy was proposed for a UPFC operating at rated capacity in which the power circulation between the shunt and series converters was used as the parameter to optimize the power transfer. Voltage-stability curves for two test systems are shown to illustrate the effectiveness of this proposed strategy [17].

The convertible static compensator (CSC), the latest generation of FACTS devices, several innovative operating concepts had been introduced to the historic development and application of FACTS. One of the novel concepts is the generalized unified power flow controller (GUPFC) or multi-line UPFC, which can control bus voltage and power flows of more than one line or even a sub-network. The GUPFC should have stronger control capability than the UPFC. A mathematical model for the GUPFC consisting of one shunt converter and two or more series converters is developed and implemented in a nonlinear interior point OPF algorithm. Numerical results with various GUPFC devices based on the IEEE 30 bus system and IEEE 118 bus system demonstrate the feasibility as well as the effectiveness of the GUPFC model established and the OPF method proposed [8]. Tuning, performance and interactions of PSS and FACTS controllers in a test power system was discussed [9]. The controllers are placed in the system to control electromechanical oscillations (Hopf bifurcations) and the corresponding gains are tuned to observe their effect on oscillatory modes and overall system performance.

Cai *et al* presented the simultaneous coordinated tuning of the FACTS (flexible AC transmission systems) POD power oscillation damping) controller and the conventional PSS (power system stabilizer) controllers in multimachine power systems. Using the linearized system model and the parameter-constrained nonlinear optimization algorithm, interactiosamong FACTS controller and PSS controllers wer e considered [11].

Coordinated control of PSS and FACTS devices to improve the inter-area mode oscillation at minimum cost was proposed. The approach presented enables us to allocate a set of TCSCs to improve the stability of interconnected power systems. The proposed approach determines the location of controllers by making use of eigenvalue analysis, active power sensitivity and linear quadratic regulator [12].

The inter-area mode low frequency oscillations by analyzing the phenomena in Nashville area of the Tennessee Valley Authority (TVA) system studied was studied. The active power is controlled to damp the low frequency oscillation while the reactive power is controlled to keep the local bus voltage at a constant level [13]. Nguyen, *et.al.* Presented an approach for designing coordinated controllers of power system stabilizers (PSSs) and FACTS devices stabilizers for enhancing small-disturbance stability. The control co-ordination problem is formulated as a constrained optimization with eigenvalue-based objective function without any need for the linear approximation by which the sensitivities of eigenvalues of state matrix to controller parameters are formed. The eigenvalue-eigenvector equations are used as the equality constraints in the optimization. The controller parameters bounds are formulated as the inequality constraints [14].

Using the linearized system model and the parameter-constrained nonlinear optimization algorithm, interaction samong FACTS controller and PSS controllers the simultaneous coordinated tuning proposed in multi-machine power systems [15].

STATCOM is a FACTS controller that is used in power systems to regulate the line voltage, enhance the power transmission capacity and extend the transient stability margin. STATCOM is conventionally realized by a voltage-source converter; however, being a current injection device, its performance can be improved when realized by a current-source converter (CSC) that can generate a controllable current directly at its output terminals [18].

Yang *et.al.* Presented a STATCOM based on the current-source converter topology. The nonlinear model of the current-source converter, which was the source of the difficulties in the controller design, has been modified to a linear model through a novel modeling technique. The proposed modeling technique was not based on thelinearization of a set of nonlinear equations around an operating point. Instead, the power balance equation and a nonlinear input transformation are used to derive a linear model independent of the operating point. This model acts as the basis for the design of a decoupled state-feedback controller [18].

Chandrakar *et.al.* presented the comparative performance of radial basis function network (RBFN) controlled voltage source converters (VSC) based flexible AC transmission system (FACTS) devices, such as static synchronous compensator (STATCOM), static synchronous series compensator (SSSC) and unified power flow controller (UPFC) in terms of increase in power handling capacity of the line, improvements in transient stability and damping of oscillations in the single machine infinite bus system (SMIB and multimachine system. The PI & radial basis function network (RBFN) based controllers are designed to coordinate local measurable control inputs to FACTS devices. The damping schemes namely, (i) power oscillation damping (POD) control, and (ii) conventional power system stabilizer (PSS) are tuned to coordinate with proposed RBFN controller [19].

This paper presents an approach for designing coordinated controllers of power system stabilizers (PSSs) and FACTS devices stabilizers for enhancing small-disturbance stability. The control co-ordination problem is formulated as a constrained optimization with eigenvalue-based objective function without any need for the linear approximation by which the sensitivities of eigenvalues of state matrix to controller parameters are formed. The eigenvalue-eigenvector equations are used as the equality constraints in the optimization. The controller parameters bounds are formulated as the inequality constraints. Simulation results show that the controller design approach is able to provide better damping and small-disturbance stability performance [20].

The main objective of this paper was to investigate the enhancement of power system stability via coordinated design of Thyristor Controlled Series Compensation (TCSC) and Power System Stabilizers (PSSs) in multimachine power system. The design problem of the proposed controllers was formulated as an optimization problem. Using the developed linearized power system model, the particle swarm optimization (PSO) algorithm is employed to search for optimal controllers' parameters settings that maximize the minimum damping ratio of all system eigenvalues. The proposed controller is evaluated on a multimachine power system. The nonlinear simulation results and eigenvalue analysis show the effectiveness of the proposed controller in damping power system oscillations [21].

Using objective function which maximizes the function, the total damping ratios of the system were optimized and dynamic stability of the system would be improved [22]. In this method all the operation conditions are considered. Simulation results for a large system and different operation conditions of the system shows that this method has a good efficiency and can be effective solution for this problem in a large system. This method can be effective for the coordinating of multi-controllers in large power systems.

An optimal procedure for designing co-ordinated controllers of power system stabiliser and flexible ac transmission system devices was developed for achieving and enhancing small-disturbance stability in multi-machine power systems. A constrained optimisation approach was applied for minimising an objective function formed from selected eigenvalues of the power systems state matrix. The eigenvalue-eigenvector equations associated with the selected modes form a set of equality constraints in the optimisation. There was no need for any standard eigenvalue calculation routines, and the use of sparse Jacobian matrix in the case of large system for forming the eigenvalue-eigenvector equations leads to the sparsity formulation [23].

In an optimal procedure for optimal control co-ordination of controllers of power system stabilizers (PSSs) and FACTS devices were developed for improving small-disturbance stability, particularly the stability of inter-area modes, in multi-machine power systems [24]. The control coordination problem was formulated as a constrained optimization by which the objective function formed from selected eigenvalues of the power systems state matrix was minimized.

Kumar *et.al* has been proposed a controllability index to find the optimal location of the FACTS controllers to damp out the inter-area mode of oscillations. Three types of FACTS controllers have been considered, which include static var compensator, thyristor-controlled series compensator and unified power flow controller. The proposed controllability index was based on the relative participation of the parameters of FACTS controllers to the critical mode [25].

A simple approach of computing the controllability indices has been proposed, which combines the linearised differential algebraic equation model of the power system and the FACTS output equations. The placements of FACTS controllers have been obtained for the base case as well as for the critical contingency cases. The effectiveness of the proposed method is demonstrated on New England 39-bus system and 16-machine, 68-bus system. [25]

Jyothsna *et.al*. Presented A Multi-Objective Evolutionary Programming (MOEP) based approach to Static Synchronous Series Compensator (SSSC). The multi-objective optimization problem is formulated to the design problem of SSSC, in which the system transient stability is improved by minimizing several system behavior measure criterions. Then, MOEP was used to design the Flexible Alternating Current Transmission Systems (FACTS) controller parameters. The usefulness of the proposed control scheme was demonstrated with a three machine nine bus power system under different fault conditions. By minimizing the time-domain based multi objective function, in which the deviations in the oscillatory rotor angle, rotor speed and accelerating power of the generator are involved, stability performance of the system is greatly improved [27].

A new, simple approach for modeling and assessing the operation and response of the multiline voltage-source controller (VSC)-based flexible ac transmission system controllers, namely the generalized interline power-flow controller (GIPFC) and the interline power-flow controller (IPFC), was presented in this paper. The model and the analysis developed were based on the converters' power balance method which makes use of the - orthogonal coordinates to thereafter present a direct solution for these controllers through a quadratic equation [28].

Modeling of converter-based controllers when two or more VSCs are coupled to a dc link (e.g., unified power-flow controller (UPFC), interline power-flow controller, and a generalized unified power-flow controller) was presented. This approach also allows efficient implementation of various VSC operating limits, where one or more VSCs were loaded to their rated capacity [29].

Thukaram *et.al*. The dependence of the system voltage profile on reactive power distribution forms the basis for reactive power optimization. The technique attempted to utilize fully the reactive power sources in the system to improve the voltage profile and also to meet the reactive power requirements at the AC-DC terminals to facilitate the smooth operation of DC links. The method involved successive solution of steady-state power flows and optimization of reactive power control variables with unified power flow controllers using linear programming technique. The proposed method has been tested on a real life equivalent 96-bus AC and a two terminal DC system [30]. Nguyen*et.al.* Developed a new design procedure for online control coordination which leads to adaptive power system stabilisers (PSSs) and/or supplementary damping controllers of flexible ac transmission system (FACTS) devices for enhancing the stability of the electromechanical modes in a multimachine power system. The controller parameters are adaptive to the changes in system operating condition and/or configuration. Central to the design is the use of a neural network synthesized to give in its output layer the optimal controller parameters adaptive to system operating condition and configuration.

A novel feature of the neural-adaptive controller was that of representing the system configuration by a reduced nodal impedance matrix which is input to the neural network. Only power network nodes with direct connections to generators and FACTS devices are retained in the reduced nodal impedance matrix. The system operating condition is represented in terms of the measured generator power loadings, which are also input to the neural network [31]. Cheng *et.al* deals with the simultaneous coordinated tuning of the power system stabilizer (PSS) controllers and the flexible ac transmission system (FACTS) power oscillation damping controllers in power system. A new particle swarm optimization approach was proposed for the design of optimal PSS and FACTS power oscillation damping (POD) [33].

Xiaoyan *et.al.* Presented an application of probabilistic theory to coordinated design of power system stabilizers (PSSs) and FACTS controllers, taking static VAR system (SVC) as an example. The aim is to enhance the damping of multi electromechanical modes in a multimachine system over a large and pre-specified set of operating conditions. A probabilistic eigenvalue-based objective function for coordinated synthesis of PSS and SVC controller parameters are then proposed. The effectiveness of the proposed controllers was demonstrated on an 8-machine system [34].

A systematic approach for designing of Static var Compensator (SVC) based damping controllers for damping of low frequency oscillations in a power system investigated in [38]. Detailed investigation have been carried out considering two controllers like Power System Stabilizer (PSS) controller and Power Oscillation Damping (POD) controller under variation of mechanical disturbances (P_m) which provides robust performance for single machine infinite bus (SMIB) power system [38].

Authors presented a global tuning procedure for FACTS power oscillation damping (POD) and power system stabilizers (PSSs) in a multi-machine power system using real coded genetic algorithm. The stabilizer's gains were obtained through the minimization of an objective function based on the damping ratio. The proposed controllers were simultaneously designed and they have provided a coordinated control action and a satisfactory performance for the power system, as shown in the results [39].

Kanojia, S.Set.al. proposed the controllers, were designed to coordinate two control inputs: Voltage of the injection bus and capacitor voltage of the STATCOM, to improve the transient stability of a SMIB system and multimachine system. The STATCOMcontroller namely conventional PI controller. The power oscillations damping (POD) control and power system stabilizer (PSS) and their coordinated action with proposed controllers were tested. [41]

Belwanshi *et.al.* presented a new concept Fuzzy logic based supplementary controller is installed with Interline Power Flow Controller [IPFC] to damp low frequency oscillations. IPFC is a new concept of the Flexible AC Transmission system controller for series compensation with the unique capability of power flow of multiple transmission lines [42].

Talebi et al. presented the linearized model of synchronous machine (Heffron-Philips) connected to infinite bus (Single Machine-Infinite Bus: SMIB) with UPFC. and also in order to damp LFO, adaptive neuro-fuzzycontroller for UPFC was designed and simulated [43].

Abido *et. .al.* investigated the enhancement of power system stability via Thyristor Controlled Series Compensation (TCSC), in a two area interconnected power systems. The design problem of the proposed controllers was formulated as an optimization problem. Using the developed linearized power system model, the particle swarm optimization (PSO) algorithm is employed to search for optimal controllers' parameters settings that maximize the minimum damping ratio of all system eigenvalues [44].

Miotto *et.al.* presented an analysis of the dynamic performance of a multimachine power system in the presence of device Flexible AC Transmission Systems (FACTS) acting in conjunction with robust controllers. Model Power Sensitivity (PSM) was used to represent the multimachine power system. The design of the controllers Power System Stabilizers (PSS) and Power Oscillation Damping (POD) was performed so simultaneous and coordinated, and was based on robust control techniques. The method is structured in the form of linear matrix inequalities (LMIs). The controllers are found by solving the set of LMIs that describe the control problem [45].

Yong *et.al.* proposed a hybrid method to assess and select suitable control inputs for multiple HVDC and FACTS supplementary wide-area damping controllers (WADCs) of large-scale interconnected power system. This method can not only reduce the interaction among different WADCs, but also get good performance of damping multiple inter-area oscillations. The residue analysis method based on observability/controllability index was used to preselect the input signal candidates for each WADC. Then, the relative gain array (RGA) analysis, including the steady-state values and the dynamic behavior, was carried out to evaluate and determine the suitable input signals for multiple WADCs [46]. Rai, *et.al.* proposed phase-imbalanced series capacitive compensation concept has been shown to be effective in enhancing power system dynamics since it has the potential to damp power swings as well as subsynchronous resonance oscillations. In this paper, the series capacitive compensation concept is investigated for damping subsynchronous resonance oscillations using a static synchronous series compensator (SSSC)-based hybrid series-capacitive compensation scheme. In this scheme, the series capacitive compensation in one phase is created by using a single-phase SSSC in series with a fixed capacitor , and the other two phases are compensated by the fixed series capacitors (C) [47].

Simfukwe *et.al.* presented a method for the coordinated design of low-order robust controllers for stabilising power system oscillations. The design uses conic programming to shift under-damped or unstable modes into a region of sufficient damping of the complex plane and involves two stages. The first stage was a phase compensation design that accounts for multiple operating conditions with flexible AC transmission systems (FACTS) and power system stabilisers (PSS), unlike our earlier approach involving PSS only. The second stage was gain tuning. This was done effectively in a coordinated way using conic programming [48].

Atalik, et.al. a fully digital controller based on multiple digital signal processor (DSP) and field-programmable gate array (FPGA) boards has been proposed for parallel-operated cascaded multilevel converters (CMC) used in flexible AC transmission system (FACTS) applications. The proposed system was composed of a DSP-based mastercontroller in combination with a multiple number of slave DSP boards, FPGA boards, microcontrollers, a programmable logic controller (PLC), an industrial computer, and their peripherals in interaction. Intercommunication of these digital controllers was achieved mainly through fiber-optic links, via synchronous serial data link wherever a high-speed, full duplex communication was needed, and via asynchronous serial communication interface wherever relatively slow communication speed was required [49].

VII. CONCLUSION

This paper presents the review regarding different techniques to handle low frequency oscillation problem in power system. in start a short introduction to facts has been given. Low frequency oscillations (LFO) in power system occur usually because of lack of damping torque to overcome disturbances in power system such as changes in mechanical power. Traditionally, power system stabilizers (PSS) are being used to damp these oscillations. Damping of power system oscillations between interconnected areas is very important for the system secure operation. Power system stabilizer (PSS) and flexible AC transmission systems (FACTS) devices are used to enhance system stability. In large systems multi-machine, using only conventional PSS may not provide sufficient damping for inter- area oscillations. In these cases, FACTS poweroscillationdamping controllers are effective solutions. This paper has presented an overview of FACTS CONTROLLER, based on published literature from 2000 to the present.

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