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Review on damping techniques of LFO in power system

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Abstract— Low Frequency Oscillations (LFO) occur in power system when the imbalance conditions take place during the system operations due to any cause it will give impact on the sensitive system parameters.LFO damping is important in electrical power system design and operation. Due to unexpected large power consumption in industries and other sectors, to make smoother operation between generation and expected demand, various damping techniques has been developed with time. For the reliable operation of a small power system various controllers are used for same purpose. So many methods are improved with time in order to obtain better results. In the recent past Power System Stabilizer (PSS) was used to damp LFO and also the FACTs device Unified Power Flow Controller (UPFC), can control power flow and may be used to damp LFO instead of PSS. UPFC damps LFO through direct control of voltage and power through various methods.

Keywords- Low Frequency Oscillations (LFO), Power system stabilizer (PSS), Unified Power Flow Controller (UPFC), neuro-fuzzy controller (ANFIS)

I. INTRODUCTION

Low frequency oscillations (LFO) are a frequent harmful phenomenon which increases the risk of instability for the power system. They limit the steady-state power transfer and change the operational system economics and security. Low frequency oscillations can cause over current in tie lines and loss of synchronism between systems and generator sets and destroy the stability of power systems. These LFOs are damped out conventionally by PSS and various other methods and also by applying artificial intelligent technique with UPFC.

The advantage of doing so is fast damping and thus better controlling achieved.

Two distinct types of oscillations are already identified:

1. Local mode oscillation (in the range of 1-2 Hz), which is associated with generators at a generating station swinging with respect to the rest of the power system, and
2. Inter-area mode oscillation (in the range of 0.2-1 Hz), which is associated with the swinging of many machines in one area of the system against machines in other areas.

LITERATURE SURVEY

Zhenhua Jiang, "Design of Power System Stabilizers Using Synergetic Control Theory" in this title nonlinear power system stabilizer based on synergetic control theory is illustrated. The synergetic control law provides asymptotic stability with respect to the required operating modes, invariance to the load variations, and robustness to variations of the input variables and power system parameters. The results are compared with the cases with a conventional PSS and without a PSS [5].

A. Majid Dejamkhooy , M. Banejad , Nasser Talebi, "Fuzzy Logic Based UPFC Controller for Damping Low Frequency Oscillations of Power Systems" Traditionally, power system stabilizers (PSS) are being used to damp these oscillations. 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. The designed fuzzy-based UPFC controller adjusts four UPFC inputs by appropriately processing of the input error signal, and provides an efficient damping [4].

Nasser Talebi, Ali Akbarzadeh, "Damping of Low Frequency Oscillations in Power Systems with Neuro-Fuzzy UPFC Controller". This paper present contributions to improvement in conventionalism of LFO damping trends. This paper throughs light on ANFIS controller technique. UPFC may be used to damp LFO instead of PSS. UPFC damps LFO through direct control of voltage and power. And adaptive neuro-fuzzy controller for UPFC is designed and simulated [3].
Jyh-shing roger jang, chuen-tsai sun, "neuro-fuzzy modeling and control". In this paper fundamental and advanced developments in neuro-fuzzy synergism in modeling and control technique is reviewed. The core part is adaptive network that unifies the both neural network and fuzzy models. Fuzzy models under adaptive framework is called ANFIS, which possess certain advantages over each individual technique. The design methods for ANFIS for both modeling and control is illustrated in this paper [2].

II. VARIOUS METHODS IN LFO DAMPING IN POWER SYSTEM

Various methods are there for LFO damping and some of them are presented in brief as follows:

3.1 Power System Stabilizer (PSS) (Power system stabilizer)

PSS was earliest proposed by American scholar FP Demello and C Conco2dri. The goal of using the stabilizer of the power system is that expand the stability limit of transmission of electrical energy through strengthening the damping of system vibration by generator excitation control. It can provide the additional excitation control of positive damping. The common parameters are angular velocity, power and frequency, and mainly consist by the magnification, reduction, and lead-lag links and other corrective connections. It takes the output and terminal voltage as the input of excitation system. PSS is designed approximate linearized pattern based on layout in a balance point of the system. It has a strong pertinence and easily realize and restrain the low frequency oscillation effectively. It has widespread application. [6]

3.2 Unified power flow controller (UPFC)

The (unified power flow controller) UPFC is the third generation equipment of FACTS of series connection which is advised by American EPRI. It makes an alternating voltage produced by a transverter thyristor joins and superimposes the phase voltage of the transmission line, and its amplitude and phase angle causing can continuously change, so as to realize the accurate adjustment of active power and reactive power of lines, and can improve the capacity of the transmission and damping vibration of the system. [6].
Advantages:
Use of this FACTS device reduce the oscillation settling time and reduces the chance of loss of synchronism in system.

3.3 ANFIS controller

This is the emerging control strategies of time. This controller has certain advantages over the sigmoidal neural network. There are number of control techniques for fuzzy and neural network according to different type of function used. Conceptually the adaptive network works on static mapping between input and output spaces. The error measure is done between desired output and the network's output and according to that the training is given to the network and according to learning rules it will work in future for the abnormal conditions. Here the term back propagation refers to that learning process is performed by supplying gradient information of network's output to its input. There are different types of learning process execution take place is explained like back propagation learning for recurrent learning, through time and real time recurrent learning and also the hybrid learning scheme is there.[2]
Advantages:
It gives better results by overcoming the deficiencies of individual fuzzy and neural network scheme.

III. CONCLUSION

In this paper, various techniques for LFO damping is explained.by studying various methods and from referring different papers of different authers we can conclude that the latest controller scheme gives more optimized results then the conventional methods we have studied above, yet the modeling such scheme is great task but as the results are better so it can be preferred for operation.

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