AN IPFC OUTPUT FEEDBACK DAMPING CONTROLLER DESIGN USING PARTICLE SWARM OPTIMIZATION

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ABSTRACT

In this paper, in order to investigate the dynamic performance of an Interline Power Flow Controller (IPFC) in enhancing the stability of a power system and in spite of being aware of the strong ability of the Particle Swarm Optimization (PSO) algorithm in finding the global optimum solution of a problem, a novel supplementary controller scheme for the IPFC is considered to be designed. With due attention to the simplicity and availability of the decentralized output feedback control methodology, it is take into account to be optimally designed using the PSO algorithm. For this purpose, the linearized Heffron-Phillips model of a Single-Machine Infinite Bus (SMIB) system is established and the Integral of Time multiplied Absolute value of Error (ITAE) is applied as an objective function to design an output feedback controller in order to evaluate the potential of various IPFC control signals upon the power system's different operating conditions. The results in time-domain simulation analysis reveal that the designed PSO based IPFC controller tuned by the proposed objective function has an excellent capability in damping power system low frequency oscillations and enhance greatly the dynamic stability of the power systems. Moreover, through analyzing some performance indices, it is obvious that the m_1 *(magnitude of injected voltage) based controller is superior to the other based controller.*

Keywords: IPFC, PSO, Output feedback Control, Power System Stability.

INTRODUCTION

Electromechanical oscillatory modes with light damping are a current phenomenon in the large interconnected power system. These oscillations commonly defined as the oscillations of the generator rotor angle which might be different due to the location of occurrence and the way of engendering. LFOs usually occur after a disturbance in power system and these oscillations emerging in power system variables such as bus voltage, line current, power flow and generator speed. Inadequate damping torque of some of the generators produce the Low Frequency Oscillations (LFOs) in order of 0.2 to 3 Hz. Traditionally, Power System Stabilizers (PSSs) are known as profitable solutions for power system damping enhancement by adding a supplementary control signal to the excitation system of the generators. However, PSSs suffer a drawback of being liable to cause great variations in the voltage profile and they may even result in leading power factor operation and losing system stability under severe disturbances, especially those of three-phase faults which may occur at the generator terminals (Keri et al., 1999). In recent years, Flexible AC Transmission System (FACTS) devices on the basis of ever-increasing progress in the field of power electronics used as a reliable alternative to increase the system controllability and enhance the power system capability. The Interline Power Flow Controller (IPFC) is one of the FACTS initiatives which can be employed for regulating power flow between parallel lines or in the transmission hallways. Nevertheless, giving the abilities like improving the voltage profile, dynamic and transient stability make IPFC be recognized as a versatile controller. When the IPFC is applied to the interconnected power systems, it can also provide significant damping effect on the tie line power oscillations through its supplementary control.

The basic performance of the IPFC is similar to the Static