Optimal location of facts devices for damping oscillations

Abstract

Damping of electromechanical oscillations between interconnected synchronous generators is necessary for a secure system operation. While local oscillations involving one or more generators swinging against the rest of the system are mainly influenced by a restricted number of local system parameter- the behavior of low frequency inter-area oscillations is generally determined by global parameters of larger parts of the power system. Power System Stabilizers (PSSs) applied on selected generators can effectively damp local oscillation modes; their limited influence on inter-area modes, however, lead to the fact that they may not be considered as the only solution to damp interarea oscillations. Flexible AC Transmission Systems are being increasingly used to better utilize the capacity of existing transmission systems. Flexible AC Transmission System (FACTS) is a technology based solution to help the utility industry deal with changes in the power delivery business. A major thrust of FACTS technology is the development of power electric based systems that provide dynamic control of the power transfer parameters transmission voltage, line impedance and phase angle [1]. The static var compensator (SVC), which is a shunt device, provides dynamically variable shunt impedance to regulate the series compensator (TCSC), which is a Series FACTS controller, is used to change the effective reactance of the line dynamically, thereby controlling the real power flow in the lines. The unified power flow controller (UPFC) is used to control the real and reactive powers simultaneously in a line by injecting a series voltage across the line. It also injects a shunt reactive current at one of the line-end buses to maintain the bus voltage at a specified value [2, 3].

FACTS devices are provided with supplementary controllers for damping out small signal oscillations [4-8], and the effectiveness of damping the oscillations depends on the location of FACTS controllers. Several methods [2–4] have been proposed for the placement of FACTS controllers. Previous studies [9–10] considered only static criterion like improving power transfer, available transfer capability (ATC), loss minimizations and did not consider any dynamic criteria for the placement of the FACTS controllers. A sensitivity based approach has been developed in some researches for determining the optimal placement of FACTS devices in electricity market having pool and contractual dispatches [11-13]. [11] Shows that few locations

of FACTS devices can be decided based on sensitivity factors and then optimal dispatch problem must solved for finding suitable placement of UPFC in a congested system. [15] Implements Genetic Algorithm to finding the best location for TCSC to maximizing total transfer capacity. Tuning of FACTS parameters has been proposed for improving damping of weakly damped inter-area modes. [16-17] proposed a method for selecting suitable feedback signal to FACTS controllers for improving the damping. Sadikovic and Korba [18] used residue, called location index for effective damping, to find suitable location for damping inter-area mode of oscillations, also in the work of [14] and [19], the method used only UPFC placement based on only single operating condition. No consideration of other FACTS devices.