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Analysis of Multi Machine Power System Transient Stability Using FACTS Device

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Abstract: *The focus of this thesis is a FACTS device known as the Unified Power Flow Controller (UPFC). With its unique capability to control simultaneously real and reactive power flows on a transmission line as well as to regulate voltage at the bus where it is connected, this device creates a tremendous quality impact on power system stability. These features turn out to be even more significant because UPFC can allow loading of the transmission lines close to their thermal limits, forcing the power to flow through the desired paths. This provides the power system operators much needed flexibility in order to satisfy the demands. A power system with UPFC is highly nonlinear. The most efficient control method for such a system is to use nonlinear control techniques to achieve system oscillation damping. The nonlinear control methods are independent of system operating conditions. Advanced nonlinear control techniques generally require a system being represented by purely differential equations whereas a power system is normally represented by a set of differential and algebraic equations. In this thesis, a new method to generate a dynamic modeling for power network is introduced such that the entire power system with UPFC can be represented by purely differential equation. This representation helps us to convert the nonlinear power system equations into standard parametric feedback form. Once the standard form is achieved, conventional and advanced nonlinear control techniques can be easily implemented. A comprehensive approach to the design of UPFC controllers (AC voltage control, DC voltage control and damping control) is presented. The damping controller is designed using nonlinear control technique by defining an appropriate Lyapunov function. The analytical expression of the nonlinear control law for the UPFC is obtained using back stepping method. Then, combining the nonlinear control strategy with the linear one for the other variables, a complete linear and nonlinear stabilizing controller is developed. Finally, an adaptive method for estimating the uncertain parameters is derived. This relaxes the need for approximating the uncertain parameters like damping coefficient, transient synchronous reactance etc., which are difficult to be measured precisely.*

Keywords: FACTS, Unified Power Flow Controller (UPFC), stability, transient

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