Controlling Chaos and Bifurcations of SSR Using TCSC

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Abstract

The effect of thyristor-controlled series capacitors (TCSC) on bifurcations of subsynchronous resonance (SSR) in power system is discussed. In this paper, the series capacitor of the first system of the IEEE second benchmark model of SSR is replaced by thyristor-controlled capacitor where the bifurcation parameter is now the firing angle of the thyristors. Varying the firing angle changes the equivalent series capacitance, which in turn controls the compensation factor of the transmission line. The dynamics of the damper windings, automatic voltage regulator (AVR), power system stabilizer (PSS) and turbine governor (TG) of the synchronous generator are included. It is well known that as the series compensation increases, the power transfer capability of the transmission line increases. However, the operating point of the system loses stability via supercritical Hopf bifurcation in case of conventional compensation. In this study where the compensation is done by TCSC, it is found that the operating point of the system never loses stability at any realistic firing angle and therefore all bifurcations of the system are eliminated at all practical values of the series compensation. Time domain simulations based on the non-linear dynamical mathematical model after step reduction in the infinite bus voltage and input power coincide with the results of the bifurcation analysis.