Controlling Chaos and Bifurcations of SMIB Power System

Experiencing SSR Phenomenon Using SSSC

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Abstract

This paper presents the effect of Static Synchronous Series Compensation (SSSC) on the bifurcations of heavily loaded Single Machine Infinite Bus (SMIB) power system experiencing Subsynchronous Resonance (SSR). In SSR phenomenon, the series compensation increases the power transfer capability of the transmission line. However, Hopf bifurcation is depicted at certain compensation levels. The system then routes to chaos via torus breakdown scenario in case of conventional compensation (variable series capacitor) scheme. In this study, the effect of replacing the conventional compensation with SSSC is highlighted. Varying the SSSC controller reference voltage changes the compensation degree. The results show that the operating point of the system never loses stability at any realistic compensation degree in case of SSSC which means that all bifurcations of the system have been eliminated. Time domain simulations coincide with the results of the bifurcation analysis. The robustness of the SSSC compensation scheme and its controller is verified by subjecting a single-phase to ground fault at the end of the transmission line. The results are compared with the case of conventional compensation. Additionally, the effect of the SSSC controller gain on the location of the Hopf bifurcation is addressed.