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Sliding Mode Power System Stabilizer for Synchronous Generator Stability Improvement

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Abstract : Many modern synchronous generators in power systems are extremely weakly damped. The reasons are cost optimization of the machine building and introduction of the additional control equipment into power systems. Oscillations of the synchronous generators and related stability problems of the power systems are harmful and can lead to failures in operation and to damages. The only useful solution to increase damping of the unwanted oscillations represents the implementation of the power system stabilizers. Power system stabilizers generate the additional control signal which changes synchronous generator field excitation voltage. Modern power system stabilizers are integrated into static excitation systems of the synchronous generators. Available commercial power system stabilizers are based on linear control theory. Due to the nonlinear dynamics of the synchronous generator, current stabilizers do not assure optimal damping of the synchronous generator’s oscillations in the entire operating range. For that reason the use of the robust power system stabilizers which are convenient for the entire operating range is reasonable. There are numerous robust techniques applicable for the power system stabilizers. In this paper the use of sliding mode control for synchronous generator stability improvement is studied. On the basis of the sliding mode theory, the robust power system stabilizer was developed. The main advantages of the sliding mode controller are simple realization of the control algorithm, robustness to parameter variations and elimination of disturbances. The advantage of the proposed sliding mode controller against conventional linear controller was tested for damping of the synchronous generator oscillations in the entire operating range. Obtained results show the improved damping in the entire operating range of the synchronous generator and the increase of the power system stability. The proposed study contributes to the progress in the development of the advanced stabilizer, which will replace conventional linear stabilizers and improve damping of the synchronous generators.

Keywords : control theory, power system stabilizer, robust control, sliding mode control, stability, synchronous generator
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