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Dynamical Behavior and Singularities of a Single-machine Infinite-bus Power System

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摘要 This paper uses the geometric singular perturbation theory to investigate dynamical behaviors and singularities in a fundamental power system presented in a single-machine infinite-bus formulation. The power system can be approximated by two simplified systems S and F, which correspond respectively to slow and fast subsystems. The singularities, including Hopf bifurcation (HB), saddle-node bifurcation (SNB) and singularity induced bifurcation (SIB), are characterized. We show that SNB occurs at $P_{Tc}=3.4382$, SIB at $P_{T0}=2.8653$ and HB at $P_{Th}=2.802$ for the singular perturbation system. It means that the power system will collapse near SIB which precedes SNB and that the power system will oscillate near HB which precedes SIB. In other words, the power system will lose its stability by means of oscillation near the HB which precedes SIB and SNB as P_T is increasing to a critical value. The boundary of the stability region of the system can be described approximately by a combination of boundaries of the stability regions of the fast subsystem and slow subsystem.

关键词 Singular perturbation, saddle-node bifurcation, Hopf bifurcation, singularity induced bifurcation, power system stability, stability region

分类号

Abstract

Key words

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