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Quenching chaos in a power system using fixed-time fractional-order sliding mode controller

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Abstract: The aim of this paper is to study the unwanted chaotic oscillation that can severely affect the reliable and safe operation of electrical power systems. The dynamical behavior of a benchmark three-bus nonlinear electrical power system model is explored using modern nonlinear analysis methods, where the Lyapunov exponents spectrum, bifurcation diagram, power spectral density and bicoherence are used to investigate the chaotic oscillation in the power system. The analysis shows the existence of critical parameter values that may drive the power system to an unstable region and can expose the system to bus voltage collapse and angle divergence or blackout. To eliminate the chaotic oscillation, a fractional-order fixed time sliding mode controller has been used to control the power system in a finite time that can be predetermined by the designer. The Lyapunov theorem has been used to prove the stability of the controlled power system. The results confirm the superiority, robustness, and effectiveness of the suggested control algorithm.

Keywords: *chaos, power stability, control, fixed-time stability, fractional order, sliding mode.*

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