Summary: In this paper, we pay attention to analyze the stochastic global stability and the bifurcation of the hydro-turbine generator. More specifically, the above research will be completed by introducing an analysis method of stochastic dynamics—stochastic averaging method. Initially, a mathematical model of the generator with a stochastic excitation will be established in Hamiltonian system. Then, utilizing the stochastic averaging method to derive the differential expression of the Hamiltonian function. Finally, the expression, whose physical meaning represent the mechanical energy, will be used to make a detailed analysis. The maximal Lyapunov exponent and stochastic bifurcation theory will respectively be adopted to research and discuss the stochastic global stability and the bifurcation. Research indicates that with the increasing of the rotation speed, the system will gradually change from absolute stability to absolute instability. Meanwhile, at a certain interval of rotation angle, the probability of the generator being disturbed by stochastic factors will suddenly increase. All of the above, provides a novel perspective on the research of the hydropower stations stability, which is significant to the safety and stable operation of hydropower stations.

MSC:
70K20 Stability for nonlinear problems in mechanics
70K50 Bifurcations and instability for nonlinear problems in mechanics
34C23 Bifurcation theory for ordinary differential equations
34F05 Ordinary differential equations and systems with randomness
60H10 Stochastic ordinary differential equations (aspects of stochastic analysis)

Keywords:
stochastic averaging method; hydro-turbine generator; Hamiltonian function; stochastic bifurcation

Full Text: DOI

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