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Vibration Characteristics of HTS Maglev System Levitated Above a Halbach Permanent Magnet Track

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As a novel type of rail transit system, high temperature superconducting (HTS) maglev has entered the research and development stage of engineering application. During the future practical engineering, the dynamics performance of HTS maglev system is very important. Because its vibration characteristics will affect the safety and comfort of vehicle operation. Although, lots of previous experimental studies have shown that the HTS maglev system is laterally-vertically coupled, the related researches are not sufficient. This lack of lateral-vertical coupling model will make it very difficult to analyze the vibration characteristics of HTS maglev system in a practical operation condition. Therefore, a lateral-vertical coupling dynamic model is established in this paper, and the response of the maglev system under forced vibration is analyzed. Firstly, we use a scaled-down maglev frame to carry out the free vibration experiment of the maglev system. Secondly, based on this mathematical model of two-dimensional force, a damping term is added to reflect the hysteresis, so as to establish a lateral-vertical coupling dynamic model. After comparing the simulation results of the dynamic model with the experimental results, the accuracy of the dynamic model is verified. Finally, this dynamic model is used to simulate the forced vibration of the maglev system, and the lateral-vertical coupling vibration characteristics of the maglev system under different working conditions are studied. Results show that the lateral-vertical coupling effect of the maglev system is significant, and the coupling vibration has strong nonlinear characteristics. This study is expected to provide relevant reference basis for the engineering application of HTS maglev.

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