Dynamic Response of HTS Pinning Maglev System Under High Frequency Excitation

Li Wang, JiahuiLiu, Zigang Deng*

deng@swjtu.cn

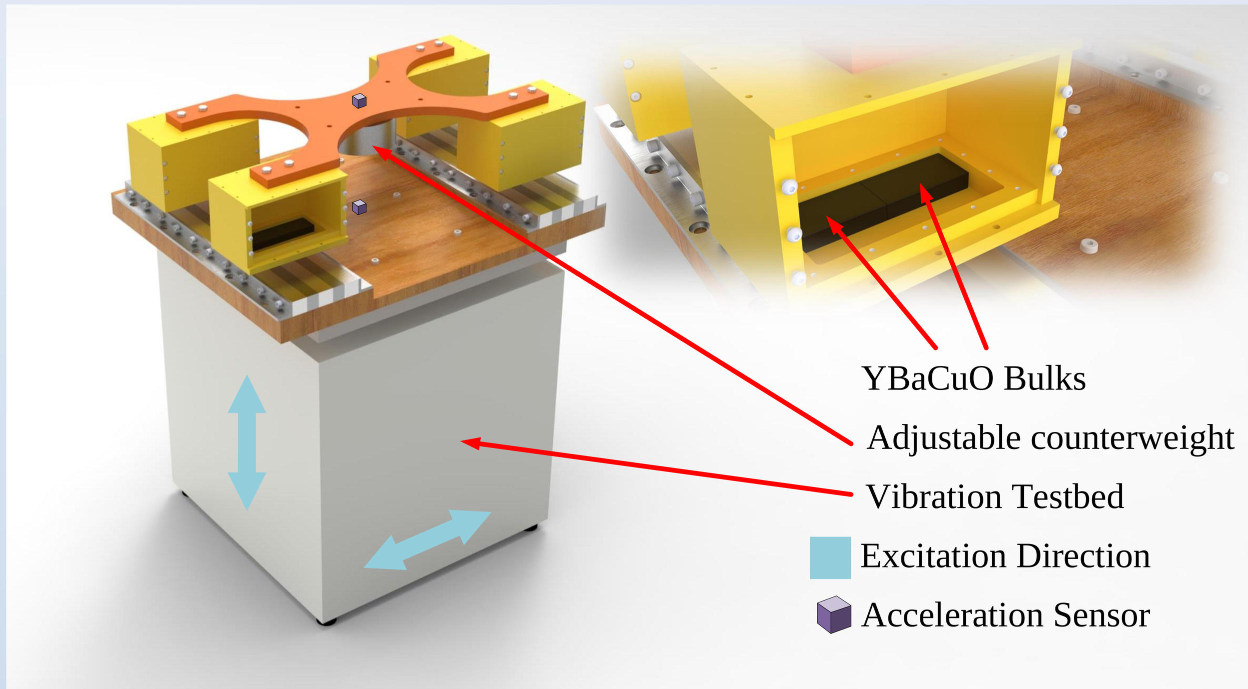
School of Mechanics and Engineering, Southwest Jiaotong University, Chengdu 610031, P.R. China

Applied Superconductivity Laboratory, State Key Laboratory of Traction Power, Southwest Jiaotong University, Chengdu 610031, P. R. China

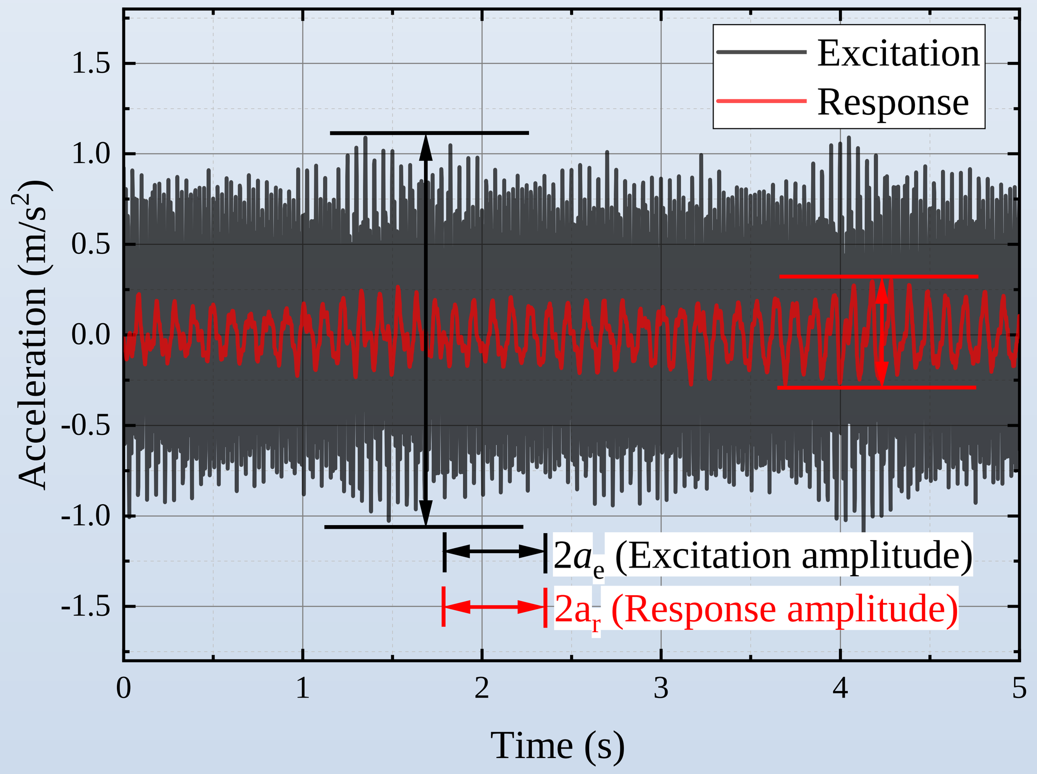
Abstract

The first full-size high temperature superconducting (HTS) pinning magnetic levitation (maglev) prototype train was launched in SWJTU, Chengdu, China. This prototype shows the basic load and low speed operation capacity of HTS pinning maglev train, and the next important issue should be on its dynamical performance under high-speed. In the same track condition, higher speed usually brings higher frequency excitation, which can be the major vibration cause of the HTS pinning maglev system. And this paper mainly studies the dynamic response of the HTS pinning maglev system under high frequency. Firstly, an experiment is designed to measure the vibration response signal under the external excitation in different directions. Secondly, the responses of the system in each direction under different excitation are compared. Finally, the vertical, lateral and coupling response of the system under high frequency in different field cooling height (FCH) are analyzed. The result verifies that the HTS pinning maglev can effectively isolate the high frequency vibration, but the lateral excitations can affect the dynamic performance of the system more than the vertical excitation. This study suggests the smoothness requirement of the operating line in high-speed, as well as providing references for future dynamic studies and design of HTS pinning maglev system.

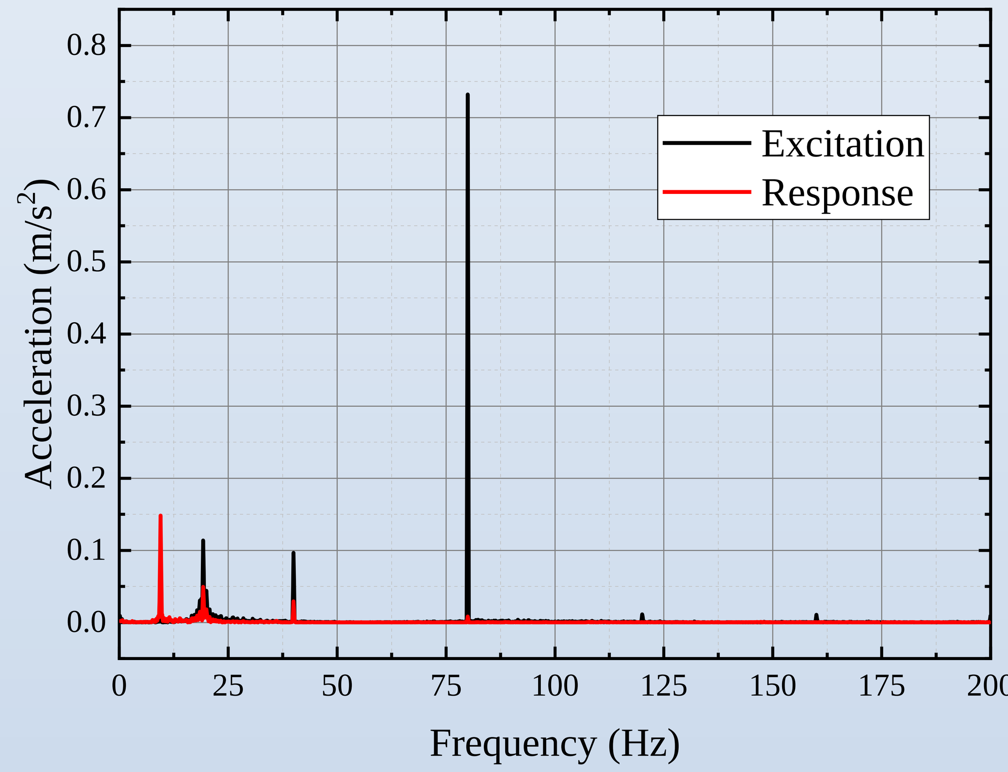
Experiment



Equipment of the experiment

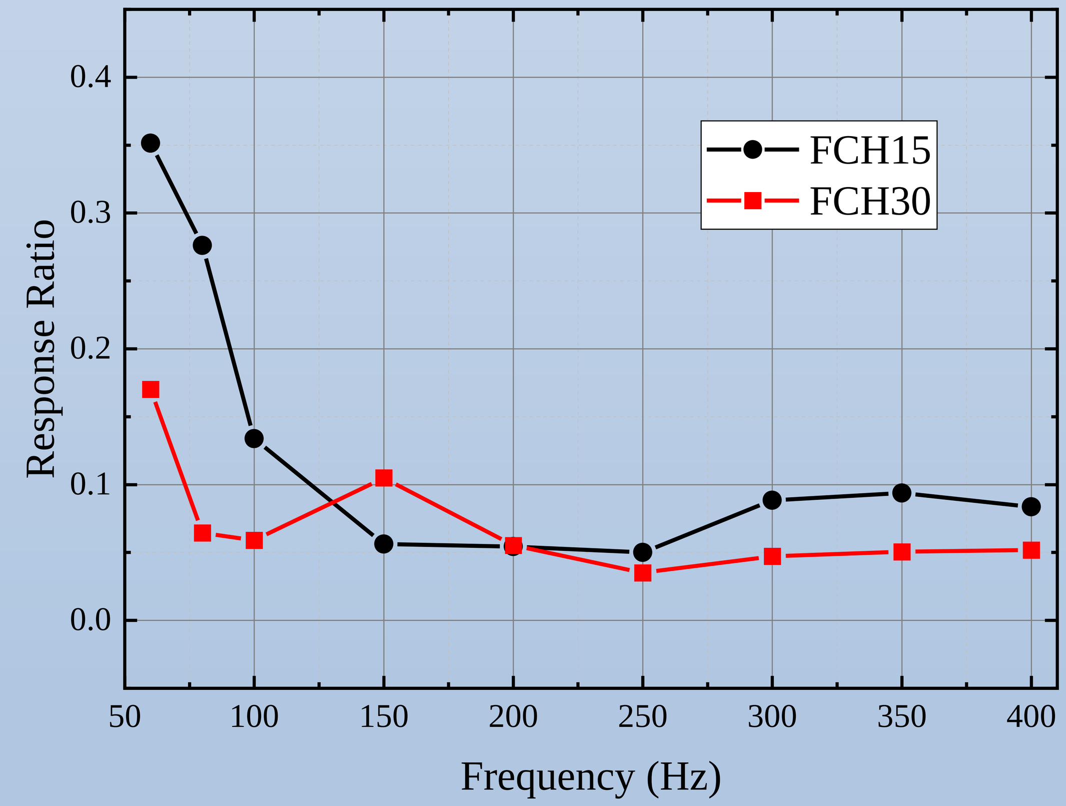


Response ratio: $\lambda_r = a_r / a_e$



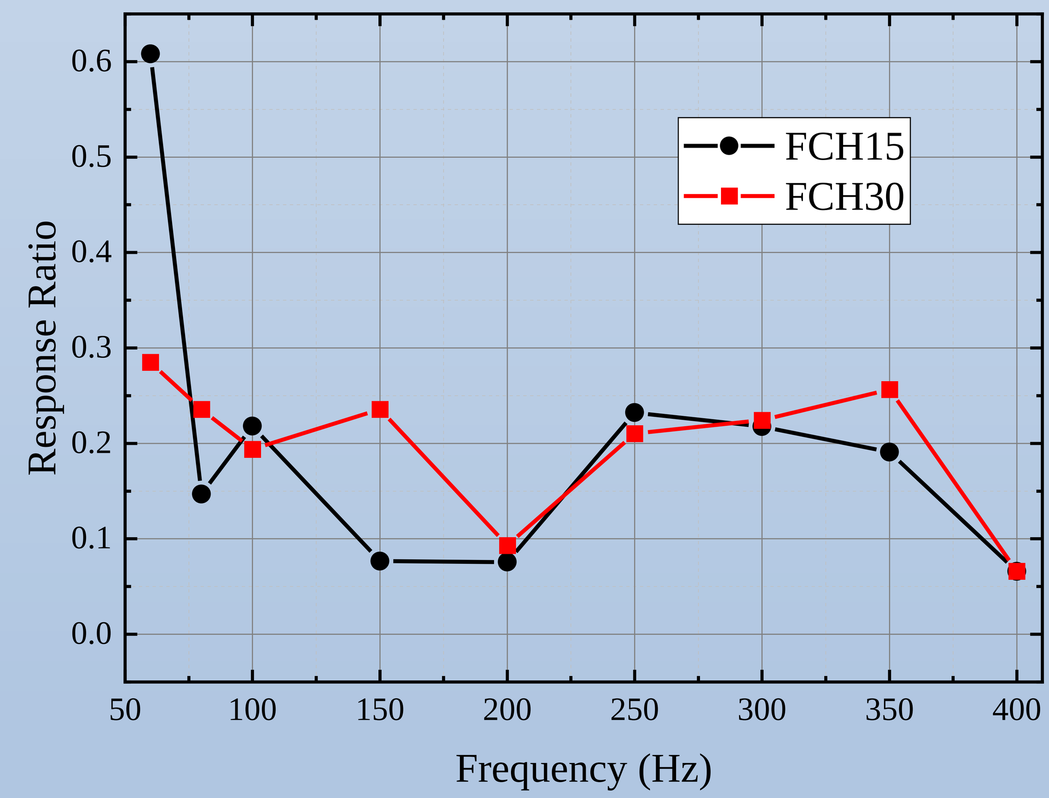
Frequency domain signal

Analysis and Results



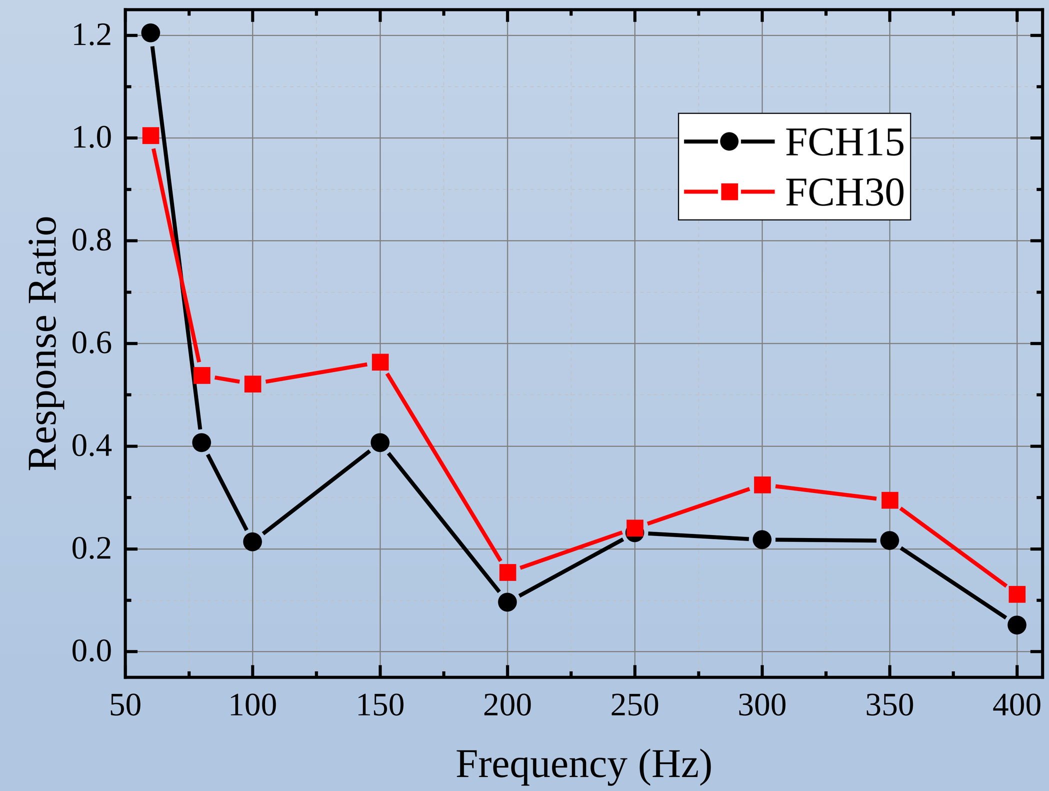
Vertical Response

(Vertical response under vertical excitation)



Lateral Response

(Lateral response under lateral excitation)



Coupling Response

(Vertical response under lateral excitation)

CONCLUSION:

(1) The dynamic response of the system under high frequency excitation is much smaller than that under low frequency excitation.

(2) The lateral high frequency excitation cases strong response than the vertical high frequency excitation.

(3) The vertical and lateral responses under the same excitation direction are stable and small once the excitation frequency passes 100 Hz, but the excitation frequency is 200 Hz of the coupling response to achieve the same condition.