Testing, Modeling, And Performance Evaluation Of An Axial Eddy-Current Damper With Nonlinear Damping Characteris-Tics For Structural Vibration Control

Cheng ZHI-PENG, Wang ZHI-HAO, Xu YAN-WEI, Cui KAI-QIANG

This paper investigates the nonlinear damping characteristics of an axial eddy-current damper (AECD) and its performance evaluation on a single-degree-of-freedom (SDOF) struc-ture subjected to harmonic excitations. First, an AECD prototype is developed to experimen-tally identify the nonlinear eddy-current damping characteristics. Subsequently, a magic for-mula model is proposed to characterize the relationship between the eddy-current damping force and velocity of the AECD, and its applicability in portraying the nonlinear eddy-current damping characteristics of the AECD is then evaluated by comparing with the electromagnet-ic finite-element model (FEM) and commonly used Wouterse's model. Moreover, through comparing the experimental and numerical frequency-domain responses of a SDOF structure with an AECD, the effectiveness of the magic formula model in evaluating the structural vi-bration control performance of the AECD with nonlinear damping characteristics is further verified. Finally, the control performance of the AECD for the SDOF structure subjected to harmonic excitations is numerically evaluated and compared with that of the conventional linear viscous damper (LVD). Results show that the eddy-current damping force of the AECD presents obvious nonlinear mechanical characteristics with the increase of the velocity, and the proposed magic formula model can adequately portray the nonlinear eddy-current damping characteristics of the AECD. Compared with the conventional LVD, the AECD demonstrates potential benefits for structural vibration control. Key Words: Structural vibration control, eddy-current damper, nonlinear damping, linear viscous damper, magic formula.