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Adaptive Control of Magnetorheological Damper Using Duffing-Like Model

Authors : Hung-Jiun Chi, Cheng-En Tsai, Jia-Ying Tu

Abstract : Semi-active control of Magnetorheological (MR) dampers for vibration reduction of structural systems has received considerable attention in civil and earthquake engineering, because the effective stiffness and damping properties of MR fluid can change in a very short time in reaction to external loading, requiring only a low level of power. However, the inherent nonlinear dynamics of hysteresis raise challenges in the modeling and control processes. In order to control the MR damper, an innovative Duffing-like equation is proposed to approximate the hysteresis dynamics in a deterministic and systematic manner than previously has been possible. Then, the model-reference adaptive control technique based on the Duffing-like model and the Lyapunov method is discussed. Parameter identification work with experimental data is presented to show the effectiveness of the Duffing-like model. In addition, simulation results show that the resulting adaptive gains enable the MR damper force to track the desired response of the reference model satisfactorily, verifying the effectiveness of the proposed modeling and control techniques.

Keywords : magnetorheological damper, duffing equation, model-reference adaptive control, Lyapunov function, hysteresis
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