随机动力系统磁流变阻尼最优控制策略

Optimal Control Strategy of Stochastic Dynamical System with MR Damping

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中文关键词:磁流变阻尼器　随机最优控制　广义密度演化方程　限界Hrovat控制算法　动态规划

英文关键词:Magnetorheological damper　stochastic optimal control　generalized density evolution equation　bounded Hrovat control algorithm　dynamic programming

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中文摘要

提出了基于广义密度演化方程的限界Hrovat半主动控制策略。以随机地震动作用下磁流变阻尼控制系统为研究对象，根据系统二阶统计量评价和跟踪实现目标主动最优控制力的控制准则，进行了磁流变液阻尼器的参数设计。数值结果表明在概率意义上，恰当设计的半主动控制器可以达到与主动控制器几乎相同的控制效果。同时，磁流变阻尼器表现出类似Bouc-Wen模型的动态阻尼性能，即强度退化、刚度退化和捏拢效应。

英文摘要

A bounded Hrovat semi-active control strategy providing the adequate performance control of general stochastic dynamical systems is proposed in the present paper. It hinges on the generalized density evolution equation recently developed to reveal the intrinsic relationship between the physical mechanism and probability density evolution of systems. An earthquake-excited system controlled by a Magnetorheological (MR) damper is investigated for illustrative purpose, of which two parameters are laid down, i.e. damping coefficient and maximum Coulomb force, according to the criterion of system second-order statistics evaluation and perfectly tracing the optimal active control forces. Numerical results reveal that the appropriately designed semi-active controller can achieve almost the same effect of the active controller in the probabilistic sense. The example further proves that the advocated semi-active control strategy could prompt the dynamic damping performance of the MR damper, behaving as a type-like Bouc-Wen model with the strength deterioration, the stiffness degradation and the pinch effect.

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