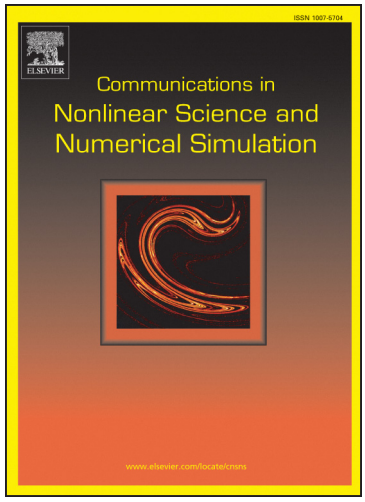

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Robust design optimization with an uncertain model of a nonlinear vibro-impact electro-mechanical system

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Abstract

In this paper, the robust design with an uncertain model of a vibro-impact electro-mechanical system is done. The electro-mechanical system is composed of a cart, whose motion is excited by a DC motor (motor with continuous current), and an embarked hammer into this cart. The hammer is connected to the cart by a nonlinear spring component and by a linear damper, so that a relative motion exists between them. A linear flexible barrier, placed outside of the cart, constrains the hammer movements. Due to the relative movement between the hammer and the barrier, impacts can occur between these two elements. The developed model of the system takes into account the influence of the DC motor in the dynamic behavior of the system. Some system parameters are uncertain, such as the stiffness and the damping coefficients of the flexible barrier. The objective of the paper is to perform an optimization of this electro-mechanical system with respect to design parameters (spring component, and barrier g) in order to maximize the impact power under the constraint that the electric power consumed by the DC motor is lower than a maximum value. This optimization is formulated in the framework of robust design due to the presence of uncertainties in the model. The set of nonlinear equations are presented, and an adapted time domain solver is developed. The stochastic nonlinear constrained design optimization problem is solved for different levels of uncertainties, and also for the deterministic case.

Keywords: electro-mechanical systems, vibro-impact, robust design optimization, nonlinear dynamics.

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