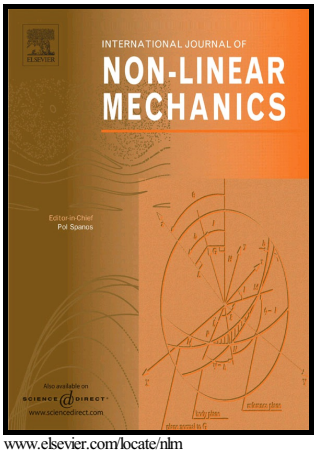

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Global Dynamics of a Harmonically Excited Oscillator with a Play: Numerical studies

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Abstract

In this paper a harmonically excited linear oscillator with a play is investigated. Direct numerical simulation and numerical continuation techniques were employed to study the system behaviour. To conduct the numerical analysis, the system differential equations were transformed into the autonomous form and were then solved using our newly developed in-house Matlab-based computational suite ABESPOL [1]. The results are presented in form of trajectories and Poincaré maps on the phase plane, bifurcation diagrams and basins of attraction. The bifurcation analysis was supported by a path following method. The influence of each system parameter (except gap) on the system dynamics was studied in detail. The bifurcations known as interior crisis and boundary crisis were observed and discussed in this work. Notably, the parameter regions where various types of grazing induced bifurcations occurred were detected and investigated.

Keywords: Non-smooth systems; Backlash; Clearance; Impacts; Numerical simulation; Path following; Bifurcation analysis.

1. Introduction

Mathematical models of non-smooth systems have been extensively studied over the past decades by both analytical and numerical methods. These studies have shown a rich dynamical behaviour. Using mapping techniques, Shaw and Holmes [2] investigated a periodically forced single degree-of-freedom piecewise linear oscillator with the discontinuity in the restoring force. By implementing the impact rule, the case of rigid impact was also analysed. The oscillator with a backlash or a play was studied at the same time by Li *et al.* [3] and by Kleczka *et al.* [4], where the former work used the rigid constraint

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