Near-resonant dynamics, period doubling and chaos of a 3-DOF vibro-impact system

Pawel Fritzkowski (pawel.fritzkowski@put.poznan.pl)
Poznan University of Technology: Politechnika Poznanska https://orcid.org/0000-0003-1374-2364
Jan Awrejcewicz
Lodz Technical University: Politechnika Lodzka

Research Article

Keywords: Vibro-impact dynamics, Resonators, Method of multiple scales, Periodic solutions, Stability, Chaos, Lyapunov exponents

DOI: https://doi.org/10.21203/rs.3.rs-171117/v1

Abstract

A mechanical system composed of two weakly coupled oscillators under harmonic excitation is considered. Its main part is a vibro-impact unit composed of a linear oscillator with an internally colliding small block. This block is coupled with the secondary part being a damped linear oscillator. The mathematical model of the system has been presented in a non-dimensional form. The analytical studies are restricted to the case of a periodic steady-state motion with two symmetric impacts per cycle near 1:1 resonance. The multiple scales method combined with the sawtooth-function-based modelling of the non-smooth dynamics is employed. The approximate analytical solutions allow for stability analysis of the periodic motions. Moreover, the frequency-response curves and force-response curves with stable and unstable branches are determined, and the interplay between various model parameters is investigated. The theoretical predictions related to the motion amplitude and the range of stability of the periodic steady-state response is verified via a series of numerical experiments and computation of Lyapunov exponents.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and accessed as a PDF.