

Accepted Manuscript

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PII: S0045-7825(15)00229-7

DOI: <http://dx.doi.org/10.1016/j.cma.2015.07.017>

Reference: CMA 10669

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date: 3 April 2015

Revised date: 14 July 2015

Accepted date: 16 July 2015

Please cite this article as: T. Detroux, L. Renson, L. Masset, G. Kerschen, The harmonic balance method for bifurcation analysis of large-scale nonlinear mechanical systems, *Comput. Methods Appl. Mech. Engrg.* (2015), <http://dx.doi.org/10.1016/j.cma.2015.07.017>

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The Harmonic Balance Method for Bifurcation Analysis of Large-Scale Nonlinear Mechanical Systems

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Abstract

The harmonic balance (HB) method is widely used in the literature for analyzing the periodic solutions of nonlinear mechanical systems. The objective of this paper is to exploit the method for bifurcation analysis, i.e., for the detection and tracking of bifurcations of nonlinear systems. To this end, an algorithm that combines the computation of the Floquet exponents with bordering techniques is developed. A new procedure for the tracking of Neimark-Sacker bifurcations that exploits the properties of eigenvalue derivatives is also proposed. The HB method is demonstrated using numerical experiments of a spacecraft structure that possesses a nonlinear vibration isolation device.

Keywords: harmonic balance, continuation of periodic solutions, bifurcation detection and tracking, Floquet exponents, quasiperiodic oscillations, detached resonance curves.

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