Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **22 (2015)** 69-84

ANALYSIS OF GLOBAL SUBHARMONIC ORBITS OF A VIBRO-IMPACT QUASI-HAMILTONIAN SYSTEM WITH THE MELNIKOV'S METHOD

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Abstract. A global subharmonic Melnikov function (Type *III*) of a vibro-impact quasi-Hamiltonian system is derived. The function can be applied to determine the existence of global subharmonic motions. This function, together with the homoclinic and the local subharmonic ones (Type *I* & Type *II*), reveals lots of local/global features of the quasi-Hamiltonian system. The global subharmonic Melnikov function is validated by numerical simulations of a forced vibro-impact oscillator. Coexistence of multi-solutions is also found in some narrow parametric regions just above the critical lines determined by Melnikov functions.

Keywords. Melnikov function; global subharmonic orbits; vibro-impact; quasi-Hamiltonian system; coexistence of multi-solutions.

1 Introduction

Non-smooth dynamic systems often exhibit very different behaviors from smooth dynamic systems, such as grazing bifurcation, stick-slip bifurcation, finger-like chaotic attractors and so on. Non-smooth local bifurcations of piecewise smooth (PWS) dynamic systems have been widely investigated by researchers [1-7]. Some theories of controlling non-smooth bifurcations were reported [8, 9]. Several monographs on PWS systems can also be found in [16-18].

However, investigations on the global non-smooth bifurcations are still quite rare due to their even more complication. Shaw and Rand [10] firstly investigated bifurcations and subharmonic motions of a simple mechanical system by Melnikov's method. Du and Zhang [11] applied Melnikov's method to analyze homoclinic bifurcations of nonlinear impact oscillators. A first-order Melnikov function (Type *I*) for a non-smooth system was given in the paper. Xu et al. [12] gave a similar result for vibro-impact oscillators. Liang