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# A PROCEDURE FOR PREDICTING RESPONSES OF VIBROIMPACT SYSTEMS UNDER RANDOM EXCITATIONS

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**Abstract.** This paper presents a solution procedure for stationary responses of the single-degree-of-freedom inelastic vibroimpact systems under random excitations with a rigid barrier at the equilibrium position. First, the nonsmooth coordinate transformation, as well as an additional impulsive term, is introduced to simplify the vibroimpact system to one without velocity jump. Then, the stationary solutions of joint probability density of displacement and velocity for the simplified system are derived analytically by means of the equivalent nonlinear system method. Finally, responses of the original vibroimpact system are obtained by using the inverse transformation of nonsmooth coordinate transformation. Solutions of several nonlinear vibroimpact systems under different random excitations are discussed in accordance with the proposed procedure. The effectiveness of the analytical solutions is verified by performing appropriate Monte Carlo simulations. Besides, the effects of random excitation intensities on the responses are investigated.

**Keywords.** Vibroimpact system, Random excitation, Impulsive damping, Equivalent nonlinear system method, Response analysis.

**AMS (MOS) subject classification:** 34F05; 35B20; 37H10; 60G60; 70L05.

## 1 Introduction

As is well known, nonsmooth systems are the most common dynamical systems in the field of mechanics, engineering and physics due to the existence of nonsmooth factors such as impacts, collisions, gaps, dry frictions [1, 2, 3, 4]. Vibroimpact system is a typical nonlinear nonsmooth system [5] and thereby has gradually gained increasing attention. It has been used in a great many of construction and mining devices, as well as in ocean engineering, power engineering and nuclear engineering [6]. Specifically, vibroimpact system is a kind of mechanical system in which certain masses collide with each other or with rigid barriers [7]. Its differential equation of motion is supplemented by impact conditions. That is, before and after the instant of impact, there