An Analysis of Clattering Impacts of a Falling Rod

F. Badiu¹, Jianzhong Su¹*, Hua Shan¹, Jiansen Zhu² and Leon Xu²

¹Department of Mathematics, University of Texas at Arlington, Arlington, TX 76019, U.S.A.
²Nokia Research Center, 6000 Connection Drive, Irving, TX 75039, U.S.A.

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Abstract: This paper deals with both analytical and quantitative analysis of multiple impacts of a two-dimensional rod. The successions of clattering sequence of a rod dropping to the floor are modeled and analyzed to find out the impact responses as it collides with the ground. The model is described by a system of ordinary differential equations, with a classical contact problem. We conduct a comparison study of the cases where the effect of the gravity is neglected, versus the cases where the gravity is considered. This mathematical analysis can further provide useful information for durability study of the impact on mobile electronic device.

Keywords: Two-dimensional rod; clattering impacts; analytical and quantitative analysis.

Mathematics Subject Classification (2000): 70E18, 70F40, 70B10, 70G10.

1 Introduction

In a pioneering study of Goyal, et al. [1, 2], it was found that when a two-dimensional rod was dropped at a small angle to the ground, the second impact might be as large as twice of the initial impact under some assumptions. For its consequence in applications, their surprising result stirred some interest on this otherwise classical problem.

In the related literature, mathematical issues of one impact or first impact have been considered in a number of papers, see for example, [3–5] for rigid body collisions. Even in single-impact cases, the topic remains a focus of much discussion [6–8] as many theoretical contact dynamics issues involving frictions started to get resolved recently.

Recent attention has been directed to detect and calculate the micro-collisions that occur

*Corresponding author: su@uta.edu