

# Multiple Impacts In Dissipative Granular Chains Lecture Notes In Applied And

Have you ever wondered about the fascinating world of dissipative granular chains? These chains, consisting of small particles bound together, can exhibit multiple impacts, creating a cascade of energy dissipation. In this article, we will explore the lecture notes in applied and theoretical mechanics discussing the various phenomena observed in multiple impacts in dissipative granular chains.

## The Basics

Before diving into the details of multiple impacts, let's start with the basics. A dissipative granular chain is a one-dimensional array of particles in contact with each other. These particles can be either spherical or non-spherical, and they interact through contact forces. The chain is characterized by its stiffness, mass, and dissipation properties.

When a chain is subjected to an external force, such as a strike at one end, it starts to propagate waves along its length. These waves can take different forms, including solitary waves and dispersive waves, depending on the properties of the chain and the external force's magnitude.



## Multiple Impacts in Dissipative Granular Chains (Lecture Notes in Applied and Computational Mechanics Book 72)

by Ngoc Son Nguyen (2014th Edition, Kindle Edition)

★★★★☆ 4.5 out of 5

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Print length : 254 pages



## Multiple Impact Phenomena

Multiple impact phenomena occur when waves in a granular chain collide with each other. These collisions result in a complex interplay between the particles, leading to energy dissipation and the generation of new waves. Understanding these phenomena is crucial in various fields, including materials science, geotechnical engineering, and physics.

The lecture notes in applied and theoretical mechanics provide a comprehensive overview of the multiple impact phenomena observed in dissipative granular chains. They delve into the mathematical models and simulation techniques used to study these behaviors, shedding light on the underlying physical principles.

## Energy Dissipation

Energy dissipation is a fundamental aspect of multiple impact phenomena. As waves collide, energy is transferred and dissipated through particle interactions. This dissipation can take various forms, including friction, inelastic collisions, and viscoelastic effects. The lecture notes discuss the different mechanisms involved and their impact on the overall behavior of the chain.

The understanding of energy dissipation in dissipative granular chains has applications in designing shock absorbers, vibration dampers, and other mechanical systems aimed at attenuating excessive energy transfer.

## Wave Dispersion

Wave dispersion refers to the phenomenon where wave motion depends on the frequency or wavelength of the wave. In the context of granular chains, multiple

impacts can lead to the generation of dispersive waves, which have a varying speed depending on their frequency. The lecture notes delve into the mathematical models used to describe and predict wave dispersion in granular chains.

Wave dispersion has implications in fields such as seismology, where understanding how waves propagate through different mediums is essential in earthquake analysis and predicting ground motion.

## **Applications**

The lecture notes also highlight the practical applications of the knowledge gained from studying multiple impacts in dissipative granular chains. These applications are diverse and can be found in areas such as civil engineering, geophysics, and even musical instruments.

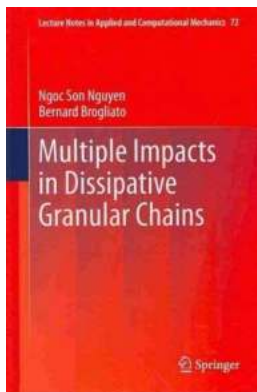
In civil engineering, understanding the behavior of granular materials under impact loads is crucial for designing structures such as retaining walls or foundations. By studying multiple impact phenomena, engineers can better predict how these structures will respond to dynamic loads and ensure their overall stability.

In geophysics, the knowledge gained from studying granular chains helps in understanding the propagation of seismic waves through different soil types. This understanding is vital in earthquake analysis and can aid in the development of measures to minimize damage caused by seismic events.

Even musical instruments benefit from the study of dissipative granular chains. By understanding how waves propagate and dissipate energy in strings and other vibrating components, instrument makers can improve their designs to achieve desired tonal qualities.

The lecture notes on multiple impacts in dissipative granular chains provide a comprehensive exploration of a fascinating phenomenon. From energy dissipation to wave dispersion, these lecture notes cover a broad range of topics essential in understanding the behavior of granular chains under dynamic loads.

By combining theoretical studies, mathematical models, and physical experiments, researchers have made significant progress in unraveling the complex nature of multiple impact phenomena. The knowledge gained from studying granular chains has important implications in various scientific and engineering fields, contributing to the development of innovative solutions and improving our understanding of the world around us.



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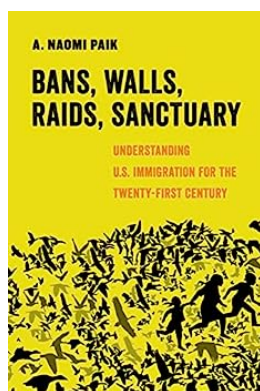
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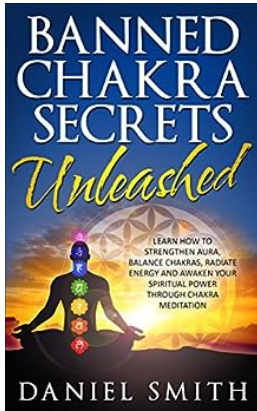
The extension of collision models for single impacts between two bodies, to the case of multiple impacts (which take place when several collisions occur at the same time in a multibody system) is a challenge in Solid Mechanics, due to the complexity of such phenomena, even in the frictionless case. This monograph aims at presenting the main multiple collision rules proposed in the literature. Such collisions typically occur in granular materials, the simplest of which are

made of chains of aligned balls. These chains are used throughout the book to analyze various multiple impact rules which extend the classical Newton (kinematic restitution), Poisson (kinetic restitution) and Darboux-Keller (energetic or kinetic restitution) approaches for impact modelling. The shock dynamics in various types of chains of aligned balls (monodisperse, tapered, decorated, stepped chains) is carefully studied and shown to depend on several parameters: restitution coefficients, contact stiffness ratios, elasticity coefficients (linear or nonlinear force/ indentation relation), and kinetic angles (that depend on the mass ratios). The dissipation and the dispersion of kinetic energy during a multiple impact are mandatory modelling, and are quantified with suitable indices. Particular attention is paid to the ability of the presented laws to correctly predict the wave effects in the chains. Comparisons between many numerical and experimental results are shown, as well as comparisons between four different impact laws in terms of their respective abilities to correctly model dissipation and dispersion of energy.



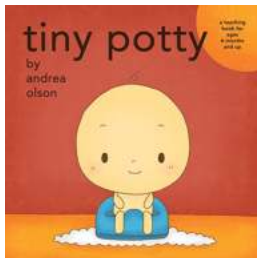
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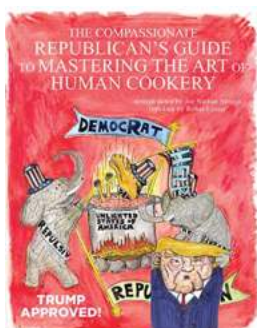
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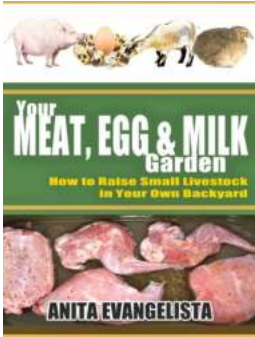
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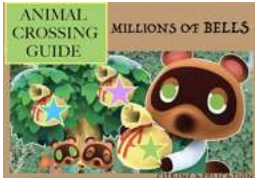
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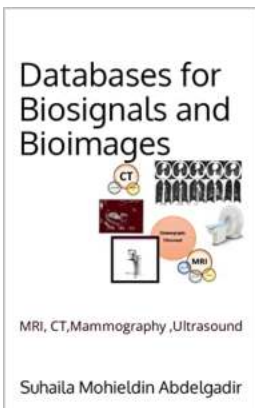
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