

Kinetic Theory Approach To Granular Gaseous Flows Soft And Biological Matter

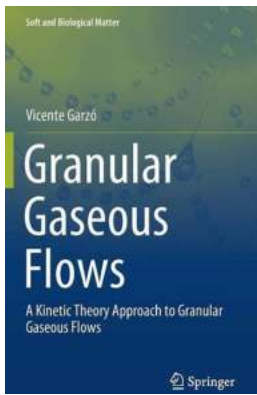
The Fascinating World of Kinetic Theory

When we think of gases, we often imagine particles moving chaotically in all directions. It may come as a surprise that a disciplined branch of physics called kinetic theory explores the behavior of gases, including granular, soft, and biological matter. Through a combination of mathematical models and experimental observations, scientists have been able to provide deep insights into the principles governing the movement of these unique substances.

Understanding Granular Gaseous Flows

Granular materials, such as sand or powders, exhibit interesting characteristics that set them apart from traditional gases. Unlike gas particles in a container, granular particles exhibit significant inter-particle collisions and interactions, leading to the formation of small-scale structures and complex flow patterns. The kinetic theory approach allows researchers to comprehend the dynamics of granular gaseous flows and investigate phenomena like segregation, clustering, and the emergence of patterns.

By constructing mathematical models based on the principles of kinetic theory, scientists can simulate the behavior of granular flows under various conditions. These simulations provide valuable insights into industrial processes involving granular materials, such as powder blending, particle transportation, and pharmaceutical manufacturing. The understanding derived from kinetic theory contributes to optimizing these processes, improving efficiency, and reducing costs.



Granular Gaseous Flows: A Kinetic Theory Approach to Granular Gaseous Flows (Soft and Biological Matter)

by Vicente Garzó (1st ed. 2019 Edition, Kindle Edition)

★★★★★ 5 out of 5



Unraveling the Secrets of Soft Matter

Soft matter refers to a class of substances with unique mechanical properties that lie between those of traditional solids and liquids. Examples of soft matter include gels, foams, colloids, and polymers. These substances are of great interest to scientists due to their relevance to a wide range of applications, including drug delivery systems, paints, and food science.

Kinetic theory provides researchers with a powerful framework to investigate the behavior of soft matter at the microscopic level. By considering the motion and interactions of individual particles in soft materials, scientists can gain a deeper understanding of their collective properties. This knowledge helps in designing materials with specific functionalities, such as softer fabrics, more efficient adhesives, and improved drug formulations.

Cracking the Code of Biological Matter

The application of kinetic theory goes beyond inanimate matter and extends to biological systems as well. Living organisms, with their intricate cellular structures and complex behaviors, defy simple physical explanations. However, by utilizing

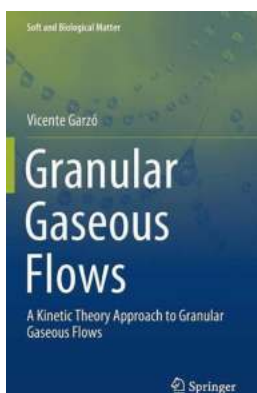
the principles of kinetic theory, scientists have been able to gain insights into various biological processes.

From modeling the collective motion of bird flocks to understanding the dynamics of cellular processes, kinetic theory has played a significant role in unraveling the secrets of biological matter. By considering organisms as collections of individual particles, researchers can gain an understanding of emergent behaviors and patterns, shedding light on biological phenomena ranging from microbial behavior to the spread of diseases.

Driving Innovations through Kinetic Theory

The kinetic theory approach to granular gaseous flows, soft matter, and biological matter has revolutionized multiple fields of research and influenced numerous industries. From optimizing industrial processes to developing innovative materials and understanding biological systems, this branch of physics has opened up a world of possibilities.

As our understanding of granular, soft, and biological matter continues to deepen, we can expect even more breakthroughs and advancements. The mathematical models and experimental techniques derived from kinetic theory provide scientists with a powerful toolkit to explore and manipulate these substances for the betterment of society.



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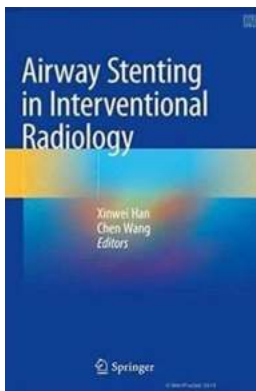
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This book addresses the study of the gaseous state of granular matter in the conditions of rapid flow caused by a violent and sustained excitation. In this regime, grains only touch each other during collisions and hence, kinetic theory is a very useful tool to study granular flows. The main difference with respect to ordinary or molecular fluids is that grains are macroscopic and so, their collisions are inelastic. Given the interest in the effects of collisional dissipation on granular media under rapid flow conditions, the emphasis of this book is on an idealized model (smooth inelastic hard spheres) that isolates this effect from other important properties of granular systems. In this simple model, the inelasticity of collisions is only accounted for by a (positive) constant coefficient of normal restitution.

The author of this monograph uses a kinetic theory description (which can be considered as a mesoscopic description between statistical mechanics and hydrodynamics) to study granular flows from a microscopic point of view. In particular, the inelastic version of the Boltzmann and Enskog kinetic equations is the starting point of the analysis. Conventional methods such as Chapman-Enskog expansion, Grad's moment method and/or kinetic models are generalized to dissipative systems to get the forms of the transport coefficients and hydrodynamics. The knowledge of granular hydrodynamics opens up the possibility of understanding interesting problems such as the spontaneous formation of density clusters and velocity vortices in freely cooling flows and/or the lack of energy equipartition in granular mixtures.

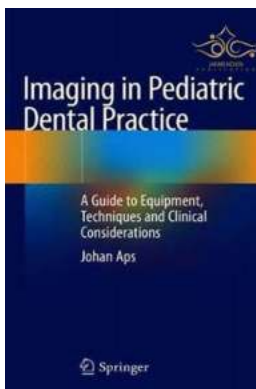
Some of the topics covered in this monograph include:

- Navier-Stokes transport coefficients for granular gases at moderate densities
- Long-wavelength instability in freely cooling flows
- Non-Newtonian transport properties in granular shear flows
- Energy nonequipartition in freely cooling granular mixtures
- Diffusion in strongly sheared granular mixtures
- Exact solutions to the Boltzmann equation for inelastic Maxwell models
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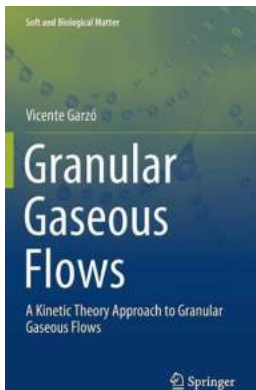
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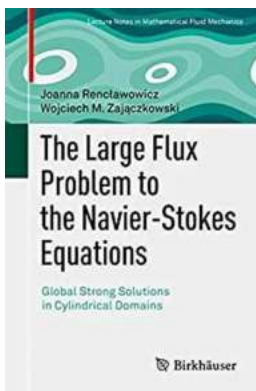
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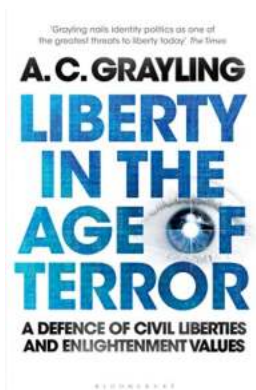
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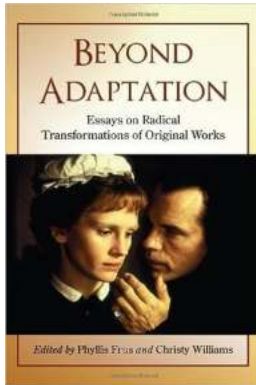
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