might be used to simplify some of the topics covered. For example, one could use Fourier-transform techniques and Gaussian statistics to provide an alternative derivation for the significance of sequence-alignment scores from random-walk models. One could also use cumulant expansions or steepest-descent methods and the Cramèr function in a discussion of the rare events that lead to nonuniform convergence of a sum of random variables to the central limit. The discussion of maximum-likelihood estimation might be simplified to introduce readers to estimation theory and its importance as a statistical tool.

Introduction to Mathematical Methods in Bioinformatics is a strong description of the theory behind the standard methods of computational sequence analysis. The book serves as a springboard for considering current bioinformatics research problems—such as the analysis of gene chip data—whose solutions entail a mixture of mathematics, statistics, engineering, and physics. With some additional work on the reader's or instructor's part, the text may also serve as an introduction to computational biology in general.

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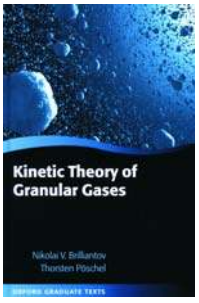
Kinetic Theory of Granular Gases

Nikolai V. Brilliantov and Thorsten Pöschel
Oxford U. Press, New York, 2004. $84.50 paper (329 pp.).
ISBN 0-19-853038-2

The subject of granular matter is a relatively new and expanding field of physics that has a longer history in the chemical and mechanical engineering communities. It deals with the structure and flow of mesoscopic to macroscopic particles—for example, dust, sand, beans, pills. Understanding the flow and packing of such objects is of great practical importance to the pharmaceutical and agricultural industries, for instance, and most recently to NASA's planned Moon and Mars programs. A collection of granular objects is also an intriguing physical system, with properties and mechanisms that are often counterintuitive and poorly understood beyond the phenomenological level. Recent intense theoretical and experimental activities have centered on identifying universal features and understanding, on some fundamental basis, the underlying physical laws. Researchers have distinguished two classes of states: static systems, for which inherent structures and force distributions are a primary issue; and wet- or dry-activated systems, for which fluid-like descriptions are relevant and pose an important problem.

Kinetic Theory of Granular Gases, by Nikolai V. Brilliantov and Thorsten Pöschel, addresses only dry-activated flows and is restricted to gases at low density. The low-density focus excludes many experimental conditions of current interest. However, it has the compensating advantage of admitting a more detailed and controlled analysis based on the Boltzmann kinetic equation as the presumed fundamental description. Significant advances have been made over the past decade for unfolding the content of the kinetic theory and comparing results with computer simulation and experiment. The theoretical tools and physical interpretation of that analysis are chronicled in Brilliantov and Pöschel's graduate text, which has an extensive list of references and is the first that I know of that specifically covers kinetic theory of granular gases.

The authors, who are among the leaders in the recent developments for rapid granular flow, have made a wide range of contributions using both theory and computer simulation. They



therefore have the experience and context for the thoughtful physical descriptions and interpretations that complement the mathematical analysis in each chapter. The book is intended as a self-contained graduate text. Interestingly, rather than being at the end of each chapter, the exercise problems are interspersed throughout, a style that encourages active involvement in a logical progression. Solutions are provided at the end of the text. Also, the authors offer explicit numerical routines, in Maple software, to provide a quantitative finale for the theoretical analyses. An appendix gives an event-driven algorithm for molecular-dynamics simulations and allows the student to explore granular media beyond the assumptions posed by the Boltzmann equation. The authors offer relevant theoretical results in two and three dimensions for readers to compare with simulations on smaller systems.

The only alternative introductions to such topics are edited collections from conferences or lectures. Two of the best collections are *Granular Gas Dynamics* (Springer-Verlag, 2003), edited by Pöschel and Brilliantov, and *Granular Gases* (Springer-Verlag, 2001), edited by Pöschel and Stefan Luding. However, those books are broader and more technical in scope, and lack the integrated pedagogy of a textbook.

The material in *Kinetic Theory of Granular Gases* is similar to that found in the classic texts on kinetic theory for normal gases—the origin of the Boltzmann equation, macroscopic balance equations, Navier–Stokes order transport coefficients, characterization of collision integrals, and so forth—but are presented in somewhat less detail and precision. Each chapter ends with a brief summary of its content and main results. In the first two chapters, the authors provide a rather complete discussion of the origin of inelasticity in the collision dynamics. Indeed, a main theme of the text is the importance of using "realistic" collision rules based on the physics of viscoelastic particles. Most of the theory and applications are developed for both idealized inelastic hard spheres (with a constant restitution coefficient) and viscoelastic spheres; yet the authors clearly believe the former is unphysical. The authors' approach of comparing two models for granular material is a unique strength of the text, but it can also generate potential confusion for the uncritical student who may lose track of which case is being discussed.

A second potential source of confusion is the introduction of approximations that are explained either incompletely or later on in the text. For example, the adiabatic approximation is introduced in chapter 13 and then replaced by a similar approximation at the end of chapter 14—but the authors do not contrast the two. Similarly, uncontrolled approximations for transport coefficients, such as neglecting the cooling rate or inserting some Enskog finite-density effects while ignoring others, are introduced in chapter 18 without indicating the associated limitations. Some brief qualifications are offered only at the end of chapter 23. Consequently, many results cannot simply be taken from the text unless the student reads the authors' derivations carefully.

Notwithstanding these few reservations, *Kinetic Theory of Granular Gases* is an admirable contribution by two experts of this rapidly evolving field. In addition to technical details,

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it provides important insights that are essential for graduate students thinking about the similarities and differences between normal and granular gases. The book fills a significant gap, and I expect it will be adopted for graduate courses in both physics and engineering programs.

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New Books

Astronomy and Astrophysics

The Formation of Stars. S. W. Stahler, F. Palla. Wiley-VCH, Weinheim, Germany, 2004. $89.95 *paper* (852 pp.). ISBN 3-527-40559-3

From Dust to Stars: Studies of the Formation and Early Evolution of Stars. N. S. Schulz. *Springer-Praxis Books in Astrophysics and Astronomy*. Praxis/Springer-Verlag, New York, 2005. $129.00 (390 pp.). ISBN 3-540-23711-9

High Energy Gamma-Ray Astronomy. F. A. Aharonian, H. J. Völk, D. Horns, eds. *AIP Conference Proceedings 745*. Proc. symp., Heidelberg, Germany, July 2004. AIP, Melville, NY, 2005. $213.00 (806 pp.). ISBN 0-7354-0229-9, *CD-ROM*

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