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KEY=MATERIALS - OSCAR KYLEIGH

Mathematical Modeling in Mechanics of Granular Materials

Springer Science & Business Media This monograph contains original results in the field of mathematical and numerical modeling of mechanical behavior of granular materials and materials with different strengths. It proposes new models helping to define zones of the strain localization. The book shows how to analyze processes of the propagation of elastic and elastic-plastic waves in loosened materials, and constructs models of mixed type, describing the flow of granular materials in the presence of quasi-static deformation zones. In a last part, the book studies a numerical realization of the models on multiprocessor computer systems. The book is intended for scientific researchers, lecturers of universities, post-graduates and senior students, who specialize in the field of the deformable materials mechanics, mathematical modeling and adjacent fields of applied and calculus mathematics.

Mathematics and Mechanics of Granular Materials

Springer Science & Business Media Granular or particulate materials arise in almost every aspect of our lives, including many familiar materials such as tea, coffee, sugar, sand, cement and powders. At some stage almost every industrial process involves a particulate material, and it is usually the cause of the disruption to the smooth running of the process. In the natural environment, understanding the behaviour of particulate materials is vital in many geophysical processes such as earthquakes, landslides and avalanches. This book is a collection of current research from some of the major contributors in the topic of modelling the behaviour of granular materials. Papers from every area of current activity are included, such as theoretical, numerical, engineering and computational approaches. This book illustrates the numerous diverse approaches to one of the outstanding problems of modern continuum mechanics.

Views on Microstructures in Granular Materials

Springer Nature This contributed volume provides an up-to-date overview of the mechanics of granular materials, ranging from sparse media to soils. With chapters exploring state-of-the-art theoretical, experimental, and applied trends in the study of granular matter in various states, readers will be motivated to learn about the current challenges and potential avenues of exploration in this active area of research. Including a variety of perspectives, this volume will be a valuable reference for audiences in a number of fields. Specific topics covered include: X-ray tomography techniques for analyzing sand Evaluation of effective stress in unsaturated soils Hyper-plasticity Wave propagation in granular systems Partly saturated porous media Multi-scale approaches to the dynamics of sparse media Views on Microstructures in Granular Materials is an ideal resource for PhD students and researchers in applied mathematics, solid-state physics, civil engineering, and mechanical engineering.

Mathematical Modeling in Mechanics of Granular Materials

Springer This monograph contains original results in the field of mathematical and numerical modeling of mechanical behavior of granular materials and materials with different strengths. It proposes new models helping to define zones of the strain localization. The book shows how to analyze processes of the propagation of elastic and elastic-plastic waves in loosened materials, and constructs models of mixed type, describing the flow of granular materials in the presence of quasi-static deformation zones. In a last part, the book studies a numerical realization of the models on multiprocessor computer systems. The book is intended for scientific researchers, lecturers of universities, post-graduates and senior students, who specialize in the field of the deformable materials mechanics, mathematical modeling and adjacent fields of applied and calculus mathematics.

Mathematical Models of Granular Matter

Springer Science & Business Media Granular matter displays a variety of peculiarities that distinguish it from other appearances studied in condensed matter physics and renders its overall mathematical modelling somewhat arduous. Prominent directions in the modelling granular flows are analyzed from various points of view. Foundational issues, numerical schemes and experimental results are discussed. The volume furnishes a rather complete overview of the current research trends in the mechanics of granular matter. Various chapters introduce the reader to different points of view and related techniques. New models describing granular bodies as complex bodies are presented. Results on the analysis of the inelastic Boltzmann equations are collected in different chapters. Gallavotti-Cohen symmetry is also discussed.

Modeling and Mechanics of Granular and Porous Materials

Springer Science & Business Media Soils are complex materials: they have a particulate structure and fluids can seep through pores, mechanically interacting with the solid skeleton. Moreover, at a microscopic level, the behaviour of the solid skeleton is highly unstable. External loadings are in fact taken by grain chains which are continuously destroyed and rebuilt. Many issues of modeling, even of the physical details of the phenomena, remain open, even obscure; de Gennes listed them not long ago in a critical review. However, despite physical complexities, soil mechanics has developed on the assumption that a soil can be seen as a continuum, or better yet as a medium obtained by the superposition of two and sometimes three con and the other fluids, which occupy the same portion of tinua, one solid space. Furthermore, relatively simple and robust constitutive laws were adopted to describe the stress-strain behaviour and the interaction between the solid and the fluid continua. The contrast between the intrinsic nature of soil and the simplistic engi neering approach is self-evident. When trying to describe more and more sophisticated phenomena (static liquefaction, strain localisation, cyclic mo bility, effects of diagenesis and weathering, ...), the nalve description of soil must be abandoned or, at least, improved. Higher order continua, incrementally non-linear laws, micromechanical considerations must be taken into account. A new world was opened, where basic mathematical questions (such as the choice of the best tools to model phenomena and the proof of the well-posedness of the consequent problems) could be addressed.

Granular and Complex Materials

World Scientific The science of complex materials continues to engage researchers from a vast range of disciplines, including physics, mathematics, computational science, and virtually all domains of engineering. This volume presents a unique multidisciplinary panorama of the current research in complex materials. The contributions explore an array of problems reflecting recent developments in four main areas: characterization and modeling of disordered packings, micromechanics and continuum theory; discrete element method; statistical mechanics. The common theme is the quest to unravel the connection between the microscopic and macroscopic properties of complex materials. Sample Chapter(s). Chapter 1: Foam as granular matter (2,433 KB). Contents: Foam as Granular Matter (D Weaire et al.); Delaunay Simplex Analysis of the Structure of Equal Sized Spheres (A V Anikeenko et al.); On Entropic Characterization of Granular Materials (R Blumenfeld); Mathematical Modeling of Granular Flow-Slides (I Vardoulakis & S Alevizos); The Mechanics of Brittle Granular Materials (I Einav); Stranger than Friction: Force Chain Buckling and Its Implications for Constitutive Modelling (A Tordesillas); Investigations of Size Effects in Granular Bodies During Plane Strain Compression (J Tejchman & J Grski); Granular Flows: Fundamentals and Applications (P W Cleary); Fine Tuning DEM Simulations to Perform Virtual Experiments with Three-Dimensional Granular Packings (G W Delaney et

al.); Fluctuations in Granular Materials (R P Behringer); Statistical Mechanics of Dense Granular Media (M Pica Ciamarra et al.); Compaction of Granular Systems (P Richard et al.). Readership: Physicists, material scientists, soil engineers and applied mathematicians.

IUTAM Symposium on Mechanics of Granular and Porous Materials

Proceedings of the IUTAM Symposium held in Cambridge, U.K., 15–17 July 1996

Springer This volume constitutes the Proceedings of the IUT AM Symposium on Mechanics of Granular and Porous Materials, held in Cambridge from 15th to 17th July 1996. The objectives were: 1. To review existing experimental results and practical phenomena on the flow and compaction of particulate media; 2. To review the current state of constitutive models, and their implementation for predicting the macroscopic response. 3. Identification of the shortcomings of existing models and procedures in understanding practical phenomena. The Symposium brought together the research communities of solid mechanics, materials science, geomechanics, chemical engineering and mathematics to review current knowledge of the flow and compaction of granular and porous media. The meeting emphasised the development and use of constitutive laws to model practical processes such as mixing, drainage and drying, compaction of metal and ceramic powders and soils, and instabilities associated with these processes. A common theme was to develop constitutive models from an understanding of the underlying physical mechanisms of deformation and fracture. It was particularly rewarding to find that the separate research communities came together during the meeting and came to a consensus as to the main mechanisms of deformation and failure of particulate and porous solids.

Modeling and Mechanics of Granular and Porous Materials

Birkhauser "Modeling and Mechanics of Granular and Porous Materials is fairly unique in the literature. It may serve as both an excellent reference text or in seminars, appealing to graduate students, researchers and scientists in applied mathematics, continuum mechanics, finite element methods, solid mechanics, and hydraulics engineering. A good foundation in continuum mechanics is a prerequisite."--BOOK JACKET.Title Summary field provided by Blackwell North America, Inc. All Rights Reserved

Constitutive Modelling of Granular Materials

Springer Science & Business Media Constitutive models are the key-stone not only for understanding the mechanical behaviour of granular materials (mainly soils but also other granulates such as sugar, wheat, coal, pellets) but also for carrying out numerical predictions by means of the finite elements method. However the extreme complexity of the behaviour of granular materials gave rise to confusing multiplicity of hardy tractable constitutive models proposed so far. the present book comprises a selection of the state-of the-art contributions of world-wide leading specialists with the aim to evaluate, specify and re-assess the present achievements as well as to point on needs for future research.

Characteristic State Plasticity for Granular Materials

Basic theory

Dynamic Response of Granular and Porous Materials under Large and Catastrophic Deformations

Springer Science & Business Media A "Sonderforschungsbereich" (SFB) is a programme of the "Deutsche For schungsgemeinschaft" to financially support a concentrated research effort of a number of scientists located principally at one University, Research La boratory or a number of these situated in close proximity to one another so that active interaction among individual scientists is easily possible. Such SFB are devoted to a topic, in our case "Deformation and Failure in Metallic and Granular M aterialK' , and financing is based on a peer reviewed proposal for three (now four) years with the intention of several prolongations after evaluation of intermediate progress and continuation reports. An SFB is terminated in general by a formal workshop, in which the state of the art of the achieved results is presented in oral or I and poster communications to which also guests are invited with whom the individual project investigators may have collaborated. Moreover, a research report in book form is produced in which a number of articles from these lectures are selected and collected, which present those research results that withstood a rigorous reviewing pro cess (with generally two or three referees). The theme deformation and failure of materials is presented here in two volumes of the Lecture Notes in Applied and Computational Mechanics by Springer Verlag, and the present volume is devoted to granular and porous continua. The complementary volume (Lecture Notes in Applied and Com putational Mechanics, vol. 10, Eds. K. HUTTER & H.

Granular and Complex Materials

Mechanics of Granular Media

Springer Science & Business Media This monograph covers phenomena of deformation and machining of granular media: macroscopic particles of different size, shape, and surface properties which typically exhibit behavior similar to fluids, as well as the behavior of solids under deformation. The book analyses the behavior of granular media in soils, rocks and stones, metals and various synthetic materials, presenting a theoretical description, applications and understanding of basic phenomena in granular matter.

Calibration and Validation of Granular Continuum Models from Particle Data

Bridging the Micro-Macro Gap

Iste Press - Elsevier Calibration and Validation of Granular Continuum Models from Particle Data: Bridging the Micro-Macro Gap reviews recent advances in the field and describes how to obtain continuum fields from particle level data. After a review of several methods, it focuses on one method, coarse-graining, and demonstrates the power of this method via various examples of granular continuum models, e.g., for shallow and segregating flows. Presents the coarse-graining method to overcome accurate result challenges by applying a local smoothing kernel with a well-defined smoothing length that automatically generates fields satisfying the continuum equations Presents a very flexible solution that can be extended to complex situations, such as two-phase flows and situations with complex external boundaries Shows readers how to apply such methods to calibrate and validate some of the most common granular flow models

IUTAM Symposium on Mechanics of Granular and Porous Materials

Proceedings of the IUTAM Symposium Held in Cambridge, U.K., 15-17 July 1996

Kluwer Academic Pub This volume contains 39 contributions presented at the IUTAM Symposium on Mechanics of Granular and Porous Materials. The Symposium reviewed the current understanding of the constitutive behaviour of porous and granular solids, based on experimental data, numerical simulations and micromechanical models. An interdisciplinary approach is adopted, involving the fields of solid mechanics, materials science, geomechanics, chemical engineering and mathematics. This book emphasises the development and use of constitutive laws to model practical processes such as mixing, drainage and drying, compaction of metal and ceramic powders and soils, and instabilities associated with these processes. A common theme is the development of constitutive models from an understanding of the underlying physical mechanisms of deformation and fracture. The volume will be of interest to researchers and to engineers concerned with measuring and predicting the response of granular and porous solids for structural applications.

Continuum Description of Granular Materials

Springer A thematic introduction to the modern theory of continuum mechanics and thermodynamics is presented from the viewpoint of granular and porous materials. In the approach taken here, granular and porous media are treated as continuous macroscopic systems of which the overall response is significantly influenced and determined by microstructural effects. In the continuum mechanical modeling, those microscale effects are captured by the introduction of so-called internal variables which account for geometric and material inhomogeneities or the multiphase nature of granular mixtures. Describing the evolution of such internal variables by additional balance laws, the resulting continuum-thermodynamical system requires careful analysis, including, e.g. the application of the entropy principle of Müller with the corresponding approach of exploitation as suggested by Liu. The book is self-contained and addresses an interdisciplinary audience including civil and geotechnical engineers, physicists, applied mathematicians, soil mechanicians and continuum mechanicians.

Micro to MACRO Mathematical Modelling in Soil Mechanics

Springer This special issue collects selected contributions (excluding general lectures) of a Symposium on "Micro to MACRO Mathematical Modelling in Soil Mechanics", which took place at the University of Reggio Calabria, Italy, from May 29th to June 1st, 2018. The Symposium provided an opportunity to enhance the scientific debate on the construction of mathematical models for the description of the physical behaviour of soils, as well as on the suggestions provided by the micro-mechanical observation of the matter. The focus was on the comparison between the appropriateness of models and the need of mathematics to obtain rigorous results, which involves know-how from applied mathematical physics, geotechnical engineering and mechanics of solids. The contributions were selected by the Editors and the other Members of the Scientific Committee of the Symposium: Gianfranco Capriz (Pisa, Roma), Claudio di Prisco (Milan), Wolfgang Ehlers (Stuttgart), James T. Jenkins (Cornell), Stefan Luding (Twente), David Muir Wood (Dundee), Kenichi Soga (Berkeley).

Topics On The Nonlinear Dynamics And Acoustics Of Ordered Granular Media

World Scientific This research monograph provides a brief overview of the authors' research in the area of ordered granular media over the last decade. The exposition covers one-dimensional homogeneous and dimer chains in great detail incorporating novel analytical tools and experimental results supporting the analytical and numerical studies. The proposed analytical tools have since been successfully implemented in studying two-dimensional dimers, granular dimers on on-site perturbations, solitary waves in Toda lattices to name a few. The second part of the monograph dwells on weakly coupled homogeneous granular chains from analytical, numerical and experimental perspective exploring the interesting phenomenon of Landau–Zener tunneling in granular media. The final part of the monograph provides a brief introduction to locally resonant acoustic metamaterials incorporating internal rotators and the resulting energy channeling mechanism in unit-cells and in one- and two-dimensional lattices. The monograph provides a comprehensive overview of the research in this interesting domain. However, this exposition is not all exhaustive with regard to equally exciting research by other researchers across the globe, but we provide an exhaustive list of references for the interested readers to further explore in this direction.

Characteristic State Plasticity for Granular Materials

Part 2: Model Calibration and Results

Developments and Novel Approaches in Nonlinear Solid Body Mechanics

Springer Nature This book features selected manuscripts presented at ICoNSoM 2019, exploring cutting-edge methods for developing novel models in nonlinear solid mechanics. Innovative methods like additive manufacturing—for example, 3D printing— and miniaturization mean that engineers need more accurate techniques for modeling solid body mechanics. The book focuses on the formulation of continuum and discrete models for complex materials and systems, particularly the design of metamaterials.

Theoretical Analyses, Computations, and Experiments of Multiscale Materials

A Tribute to Francesco Dell'Isola

Springer Nature This book is devoted to the 60th birthday of the Prof. Francesco dellIsola, who is known for his long-term contribution in the field of multiscale materials. It contains several contributions from researchers in the field, covering theoretical analyses, computational aspects and experiments.

Computational Granular Mechanics and Its Engineering Applications

Springer Nature This book systematically introduces readers to computational granular mechanics and its relative engineering applications. Part I describes the fundamentals, such as the generation of irregular particle shapes, contact models, macro-micro theory, DEM-FEM coupling, and solid-fluid coupling of granular materials. It also discusses the theory behind various numerical methods developed in recent years. Further, it provides the GPU-based parallel algorithm to guide the programming of DEM and examines commercial and open-source codes and software for the analysis of granular materials. Part II focuses on engineering applications, including the latest advances in sea-ice engineering, railway ballast dynamics, and lunar landers. It also presents a rational method of parameter calibration and thorough analyses of DEM simulations, which illustrate the capabilities of DEM. The computational mechanics method for granular materials can be applied widely in various engineering fields, such as rock and soil mechanics, ocean engineering and chemical process engineering.

Micromechanics of Granular Materials

John Wiley & Sons Nearly all solids are compised of grains. However most studies treat materials as a continious solid. The book applies analysis used on loose granular materials to dense grainular materials. This title’s main focus is devoted to static or dynamic loadings applied to dense materials, although rapid flows and widely dispersed media are also mentioned briefly. Three essential areas are covered: Local variable analysis: Contact forces, displacements and rotations, orientation of contacting particles and fabric tensors are all examples of local variables. Their statistical distributions, such as spatial distribution and possible localization, are analyzed, taking into account experimental results or numerical simulations. Change of scales procedures: Also known as “homogenization techniques”, these procedures make it possible to construct continuum laws to be used in a continuum mechanics approach or performing smaller scale analyses. Numerical modeling: Several methods designed to calculate approximate solutions of dynamical equations together with unilateral contact and frictional laws are presented, including molecular dynamics, the distinct element method and non-smooth contact dynamics. Numerical examples are given and the quality of numerical approximations is discussed.

Practice of Constitutive Modelling for Saturated Soils

Springer Nature This book describes the development of a constitutive modeling platform for soil testing, which is one of the key components in geomechanics and geotechnics. It discusses the fundamentals of the constitutive modeling of soils and illustrates the use of these models to simulate various laboratory tests. To help readers understand the fundamentals and modeling of soil behaviors, it first introduces the general stress–strain relationship of soils and the principles and modeling approaches of various laboratory tests, before examining the ideas and formulations of constitutive models of soils. Moving on to the application of constitutive models, it presents a modeling platform with a practical, simple interface, which includes various kinds of tests and constitutive models ranging from clay to sand, that is used for simulating most kinds of laboratory tests. The book is intended for undergraduate and graduate-level teaching in soil mechanics and geotechnical engineering and other related engineering specialties. Thanks to the inclusion of real-world applications, it is also of use to industry practitioners, opening the door to advanced courses on modeling within the industrial engineering and operations research fields.

The Princeton Companion to Applied Mathematics

Princeton University Press This is the most authoritative and accessible single-volume reference book on applied mathematics. Featuring numerous entries by leading experts and organized thematically, it introduces readers to applied mathematics and its uses; explains key concepts; describes important equations, laws, and functions; looks at exciting areas of research; covers modeling and simulation; explores areas of application; and more. Modeled on the popular Princeton Companion to Mathematics, this volume is an indispensable resource for undergraduate and graduate students, researchers, and practitioners in other disciplines seeking a user-friendly reference book on applied mathematics. Features nearly 200 entries organized thematically and written by an international team of distinguished contributors Presents the major ideas and branches of applied mathematics in a clear and accessible way Explains important mathematical concepts, methods, equations, and applications Introduces the language of applied mathematics and the goals of applied mathematical research Gives a wide range of examples of mathematical modeling Covers continuum mechanics, dynamical systems, numerical analysis, discrete and combinatorial mathematics, mathematical physics, and much more Explores the connections between applied mathematics and other disciplines Includes suggestions for further reading, cross-references, and a comprehensive index

Advances in Micromechanics of Granular Materials

Proceedings of the Second US/Japan Seminar on Micromechanics of Granular Materials, Potsdam, NY, USA, August 5-9, 1991

Elsevier The 45 papers presented in this volume all share the common goal of constructing continuum models based on the micro behaviours of granular materials. Computer simulations continue to provide observations to aid modelling, while new experimental works begin to show promise for increased understanding in this area. Theoretical studies have extended into transitions between the rapid and quasi-static regimes and the fluid and solid mixture flows. Exciting new topics discussed in this volume include: concepts of a measure for randomness in quasi-static granular materials, which is analogous to the granular temperature in a rapid flow; scaling effects in granular media and their implications in both physical and computer simulations; instability; and boundary effects on heterogeneous behavior in simple flow configurations, which are posing new challenges for mathematical modelling. The volume will prove indispensable reading for researchers interested in the current developments in the fundamental aspects of mechanics of granular materials.

Mechanics and Thermodynamics of a Mixture of a Granular Material with a Fluid

Nonlinear PDE's, Dynamics and Continuum Physics

1998 AMS-IMS-SIAM Joint Summer Research Conference on Nonlinear PDE's, Dynamics, and Continuum Physics, July 19-23, 1998, Mount Holyoke College

American Mathematical Soc.

Computational Granular Dynamics

Models and Algorithms

Springer Science & Business Media Computer simulations not only belong to the most important methods for the theoretical investigation of granular materials, but provide the tools that have enabled much of the expanding research by physicists and engineers. The present book is intended to serve as an introduction to the application of numerical methods to systems of granular particles. Accordingly emphasis is on a general understanding of the subject rather than on the presentation of latest advances in numerical algorithms. Although a basic knowledge of C++ is needed for the understanding of the numerical methods and algorithms in the book, it avoids usage of elegant but complicated algorithms to remain accessible for those who prefer to use a different programming language. While the book focuses more on models than on the physics of granular material, many applications to real systems are presented.

New Achievements in Continuum Mechanics and Thermodynamics

A Tribute to Wolfgang H. Müller

Springer This book presents a liber amicorum dedicated to Wolfgang H. Müller, and highlights recent advances in Prof. Müller's major fields of research: continuum mechanics, generalized mechanics, thermodynamics, mechanochemistry, and geomechanics. Over 50 of Prof. Müller's friends and colleagues contributed to this book, which commemorates his 60th birthday and was published in recognition of his outstanding contributions.

Mathematics and Materials

American Mathematical Soc. A co-publication of the AMS, IAS/Park City Mathematics Institute, and Society for Industrial and Applied Mathematics Articles in this volume are based on lectures presented at the Park City summer school on "Mathematics and Materials" in July 2014. The central theme is a description of material behavior that is rooted in statistical mechanics. While many presentations of mathematical problems in materials science begin with continuum mechanics, this volume takes an alternate approach. All the lectures present unique pedagogical introductions to the rich variety of material behavior that emerges from the interplay of geometry and statistical mechanics. The topics include the order-disorder transition in many geometric models of materials including nonlinear elasticity, sphere packings, granular materials, liquid crystals, and the emerging field of synthetic self-assembly. Several lectures touch on discrete geometry (especially packing) and statistical mechanics. The problems discussed in this book have an immediate mathematical appeal and are of increasing importance in applications, but are not as widely known as they should be to mathematicians interested in materials science. The volume will be of interest to graduate students and researchers in analysis and partial differential equations, continuum mechanics, condensed matter physics, discrete geometry, and mathematical physics. Titles in this series are co-published with the Institute for Advanced Study/Park City Mathematics Institute. Members of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) receive a 20% discount from list price. NOTE: This discount does not apply to volumes in this series co-published with the Society for Industrial and Applied Mathematics (SIAM).

Non-Classical Continuum Mechanics

A Dictionary

Springer This dictionary offers clear and reliable explanations of over 100 keywords covering the entire field of non-classical continuum mechanics and generalized mechanics, including the theory of elasticity, heat conduction, thermodynamic and electromagnetic continua, as well as applied mathematics. Every entry includes the historical background and the underlying theory, basic equations and typical applications. The reference list for each entry provides a link to the original articles and the most important in-depth theoretical works. Last but not least, ever y entry is followed by a cross-reference to other related subject entries in the dictionary.

Fluid and Thermodynamics

Volume 3: Structured and Multiphase Fluids

Springer This third volume describes continuous bodies treated as classical (Boltzmann) and spin (Cosserat) continua or fluid mixtures of such bodies. It discusses systems such as Boltzmann continua (with trivial angular momentum) and Cosserat continua (with nontrivial spin balance) and formulates the balance law and deformation measures for these including multiphase complexities. Thermodynamics is treated in the spirit of Müller–Liu: it is applied to Boltzmann-type fluids in three dimensions that interact with neighboring fluids on two-dimensional contact surfaces and/or one-dimensional contact lines. For all these situations it formulates the balance laws for mass, momenta, energy, and entropy. Further, it introduces constitutive modeling for 3-, 2-, 3-d body parts for general processes and materially objective variable sets and their reduction to equilibrium and non-equilibrium forms. Typical (reduced) fluid spin continua are liquid crystals. Prominent nematic examples of these include the Ericksen–Leslie–Parodi (ELP) formulation, in which material particles are equipped with material unit vectors (directors). Nematic liquid crystals with tensorial order parameters of rank 1 to n model substructure behavior better, and for both classes of these, the book analyzes the thermodynamic conditions of consistency. Granular solid–fluid mixtures are generally modeled by complementing the Boltzmann laws with a balance of fluctuation (kinetic) energy of the particles. The book closes by presenting a full Reynolds averaging procedure that accounts for higher correlation terms e.g. a k-epsilon formulation in classical turbulence. However, because the volume fraction is an additional variable, the theory also incorporates 'k-epsilon equations' for the volume fraction.

Continuum Mechanics in Environmental Sciences and Geophysics

Springer Modern continuum mechanics is the topic of this book. After its introduction it will be applied to a few typical systems arising in the environmental sciences and in geophysics. In large lake/ocean dynamics peculiar effects of the rotation of the Earth will be analyzed in linear/nonlinear processes of a homogenous and inhomogenous water body. Strong thermomechanical coupling paired with nonlinear rheology affects the flow of large ice sheets (such as Antarctica and Greenland) and ice shelves. Its response to the climatic forcing in an environmental of greenhouse warming may significantly affect the life of future generations. The mechanical behavior of granular materials under quasistatic loadings requires non-classical mixture concepts and encounters generally complicated elastic-plastic-type constitutive behavior. Creeping flow of soils, consolidation processes and ground water flow are described by such theories. Rapid shearing flow of granular materials lead to constitutive relations for the stresses which incorporate rate independent behavior of Mohr-Coulomb type together with dispersive stress contributions due to particle collisions. Rockfalls, sturzstroms, snow and ice avalanches, but also debris flow and sea ice drifting can be described with such formulations.

Shear Localization in Granular Bodies with Micro-Polar Hypoplasticity

Springer Science & Business Media This book includes a numerical investigation of shear localization in granular materials within micro-polar hypoplasticity, which was carried out during my long research stay at the Institute of Soil and Rock Mechanics at Karlsruhe University from 1985 to 1996. I dedicate my book to Prof. Gerd Gudehus from Germany, the former head of the Institute of Rock and Soil Mechanics at Karlsruhe University and the supervisor of my scientific research during my stay in Karlsruhe, who encouraged me to deal with shear localization in granular bodies within micro-polar hypoplasticity. I greatly - preciate his profound knowledge, kind help constructive discussions, and collegial attitude to his co-workers. I am thankful to the both series editors: Prof. Wei Wu from Universität für Bodenkultur in Austria and Prof. Ronaldo Borja from Stanford University in USA for their helpful suggestions with respect to the contents and structure of the book. I am also grateful to Dr. Thomas Ditzinger and Mrs. Heather King from the Springer Publishing Company and SPS data processing team for their help in editing this book. Gdansk, Jacek Tejchman June 2008 Contents 1 Introduction..... 1 2 Literature Overview on Experiments..... 11 3 Theoretical Model..... 47 3.1 Hypoplastic Constitutive Model..... 47 3.2 Calibration of Hypoplastic Material Parameters..... 60 3.3 Micro-polar Continuum..... 67 3.4 Micro-polar Hypoplastic Constitutive Model..... 72 3.5 Finite Element Implementation..... 75 4 Finite Element Calculations: Preliminary Results.....

The Physics Of The Deformation Of Densely Packed Granular Materials

World Scientific This book is of interest for those that are concerned professionally with granular materials: civil engineers, geologists and geophysicists, chemical engineers, pharmacists, food technologists, agriculturalists, biologists and astronomers.Granular materials play a role in nearly all human activities. For example, users of sand, from children in sandpits to sophisticated geotechnical engineers, know that it is a fascinating — and to some extent, unpredictable — material. In addition to sand, which itself may be of many compositions, there are various types of materials including gravel, fine-particle aggregates as employed in cosmetics, pharmaceuticals, dust, crushed rock and granules that occur in a domestic environment, such as breakfast cereals, sugar, salt and (instant or ground) coffee granules.The aim of the book is to present a theory that explains the physics behind the phenomena during the deformation of densely packed granular media. The physics that describes such features is rather subtle and is developed from the micro to macro level (the latter is the continuum mechanics level that is used in practical applications). It requires the analysis of anisotropy and the heterogeneity of the packing evaluated against the background of a frictional inter-particle interaction.

Recent Advances in Mechanics of Non-Newtonian Fluids

MDPI Non-Newtonian (non-linear) fluids are common in nature, for example, in mud and honey, but also in many chemical, biological, food, pharmaceutical, and personal care processing industries. This Special Issue of Fluids is dedicated to the recent advances in the mathematical and physical modeling of non-linear fluids with industrial applications, especially those concerned with CFD studies. These fluids include traditional non-Newtonian fluid models, electro- or magneto-rheological fluids, granular materials, slurries, drilling fluids, polymers, blood and other biofluids, mixtures of fluids and particles, etc.

Granular Dynamics, Contact Mechanics and Particle System Simulations

A DEM study

Springer This book is devoted to the Discrete Element Method (DEM) technique, a discontinuum modelling approach that takes into account the fact that granular materials are composed of discrete particles which interact with each other at the microscale level. This numerical simulation technique can be used both for dispersed systems in which the particle-particle interactions are collisional and compact systems of particles with multiple enduring contacts. The book provides an extensive and detailed explanation of the theoretical background of DEM. Contact mechanics theories for elastic, elastic-plastic, adhesive elastic and adhesive elastic-plastic particle-particle interactions are presented. Other contact force models are also discussed, including corrections to some of these models as described in the literature, and important areas of further research are identified. A key issue in DEM simulations is whether or not a code can reliably simulate the simplest of systems, namely the single particle oblique impact with a wall. This is discussed using the output obtained from the contact force models described earlier, which are compared for elastic and inelastic collisions. In addition, further insight is provided for the impact of adhesive particles. The author then moves on to provide the results of selected DEM applications to agglomerate impacts, fluidised beds and quasi-static deformation, demonstrating that the DEM technique can be used (i) to mimic experiments, (ii) explore parameter sweeps, including limiting values, or (iii) identify new, previously unknown, phenomena at the microscale. In the DEM applications the emphasis is on discovering new information that enhances our rational understanding of particle systems, which may be more significant than developing a new continuum model that encompasses all microstructural aspects, which would most likely prove too complicated for practical implementation. The book will be of interest to academic and industrial researchers working in particle technology/process engineering and geomechanics, both experimentalists and theoreticians.

Thesaurus of Engineering and Scientific Terms