Numerical Methods And Constitutive Modelling In Geomechanics Cism International Centre For Mechanical Sciences Courses And Lectures

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Mathematical Modelling in Solid Mechanics Elsevier
With its discussion of strategies for modeling complex materials using new numerical techniques, mainly those based on the finite element method, this monograph covers a range of topics including computational plasticity, multi-scale formulations, optimization and parameter identification, damage mechanics and nonlinear finite elements.

Numerical Methods in Geotechnical Engineering IX, Volume 2 CRC Press
The NUMGE98 Conference brought together senior and young researchers, scientists and practicing engineers from European and overseas countries, to share their knowledge and experience on the various aspects of the analysis of Geotechnical Problems through Numerical Methods. The papers address a broad spectrum of geotechnical problems, including tunnels and underground openings, shallow and deep foundations, slope stability, seepage and consolidation, partially saturated soils, geothermal effects, constitutive modelling, etc.
Numerical Simulation of Mechanical Behavior of Composite Materials Springer Nature
An unified approach to numerical modeling, integrating aspects of continuum mechanics, differential equations, and numerical analysis. Explains how to formulate a mathematical description of the phenomena under consideration, devise techniques for solving the governing equations, then refine the model and interpret the results. Emphasizes physical applications and relates the three major classes of partial differential equations -- elliptic, parabolic, and hyperbolic -- to steady-state systems, dissipative systems, and nondissipative systems, respectively. Also examines

some higher-order equations, nonlinear equations, and coupled systems of equations.

Numerical Methods in Geomechanics Volume 1 CRC Press

The Second International Symposium on Constitutive Modeling of Geomaterials: Advances and New Applications (IS-Model 2012), is to be held in Beijing, China, during October 15-16, 2012. The symposium is organized by Tsinghua University, the International Association for Computer Methods and Advances in Geomechanics (IACMAG), the Committee of Numerical and Physical Modeling of Rock Mass, Chinese Society for Rock Mechanics and Engineering, and the Committee of Constitutive Relations and Strength Theory, China Institution of Soil Mechanics and Geotechnical Engineering, China Civil Engineering Society. This Symposium follows the first successful International Workshop on Constitutive Modeling held in Hong Kong, which was organized by Prof. JH Yin in 2007. Constitutive modeling of geomaterials has been an active research area for a long period of time. Different approaches have been used in the development of various constitutive models. A number of models have been implemented in the numerical analyses of geotechnical structures. The objective of the symposium is to provide a forum for researchers and engineers working or interested in the area of constitutive modeling to meet together and share new ideas, achievements and experiences through presentations and discussions. Emphasis is placed on recent advances of constitutive modeling and its applications in both theoretic and experimental aspects. Six famous scholars have been invited for the plenary speeches of the symposiums. Some prominent scholars have been invited to organize four specialized workshops on hot topics, including “Time-dependent stress-strain behavior of geomaterials”, “Constitutive modeling within critical state soil mechanics”, “Multiscale and multiphysics in geomaterials”, and “Damage to failure in rock structures”. A total of 49 papers are included in the above topics. In addition, 51 papers are grouped under three topics covering “Behaviour of geomaterials”, “Constitutive model”, and “Applications”. The editors expect that the book can be helpful as a reference to all those in the field of constitutive modeling of geomaterials.

Process and Mechanical Modelling of Engineering Composites CRC Press

First Published in 2017. Routledge is an imprint of Taylor & Francis, an Informa company.

Modern Trends in Geomechanics

Numerical Methods and Constitutive Modelling in GeomechanicsThe Mechanics of Constitutive Modeling

Proceedings of the NATO Advanced Study Institute, Braga, Portugal, August 24-September 4, 1981

Elements of Constitutive Modelling and Numerical Analysis of Frictional Soils

Elsevier

This book presents new research results in multidisciplinary fields of mathematical and numerical modelling in mechanics. The chapters treat the topics: mathematical modelling in solid, fluid and contact mechanics nonconvex variational analysis with emphasis to nonlinear solid and structural mechanics numerical modelling of problems with non-smooth constitutive laws, approximation of variational and hemivariational inequalities, numerical analysis of discrete schemes, numerical methods and the corresponding algorithms, applications to mechanical engineering numerical aspects of non-smooth mechanics, with emphasis on developing accurate and reliable computational tools mechanics of fibre-reinforced materials behaviour of elasto-plastic materials accounting for the microstructural defects definition of structural defects based on the differential geometry concepts or on the atomistic basis interaction between phase transformation and dislocations at nano-scale energetic arguments bifurcation and post-buckling analysis of elasto-plastic structures engineering optimization and design, global optimization and related algorithms The book presents selected papers presented at ETAMM 2016. It includes new and original results written by internationally recognized specialists.

Numerical Methods in Geomechanics Volume 1 Cambridge University Press

The solution of stress analysis problems through numerical, computer oriented techniques is becoming more and more popular in soil and rock engineering. This is due to the ability of these methods to handle geometrically complex problems even in the presence of highly nonlinear material behaviour, characterizing the majority of soils and rocks, and of media consisting of two or more phases, like saturated and partially saturated soils. Aim of this book is to present to researchers and engineers working in the various branches of geomechanics an updated state of the research on the development and application of numerical methods in geotechnical and foundation engineering. Particular attention is devoted to the formulation of nonlinear material models and to their use for the analysis of complex engineering problems. In addition to the constitutive modelling, other topics discussed concern the use of the finite element and boundary element methods in geomechanics; the dynamic analysis of inelastic and saturated soils; the solution of seepage, consolidation and coupled problems; the analysis of soil-structure interaction problems; the numerical procedures for the interpretation of field measurements; the analysis of tunnels and underground openings.

Numerical Methods and Constitutive Modelling in Geomechanics Routledge

This textbook demonstrates the application of the finite element philosophy to the solution of real-world problems and is aimed at graduate level students, but is also suitable for advanced undergraduate students. An essential part of an engineer’s training is the development of the skills necessary to analyse and predict the behaviour of engineering systems under a wide range of potentially complex loading conditions. Only a small proportion of real-life problems can be solved analytically, and consequently, there arises the need to be able to use numerical methods capable of simulating real phenomena accurately. The finite element (FE) method is one such widely used numerical method. Finite Element Applications begins with demystifying the ‘black box’ of finite element solvers and progresses to addressing the different pillars that make up a robust finite element solution framework. These pillars include: domain creation, mesh generation and element formulations, boundary conditions, and material response considerations. Readers of this book will be equipped with the ability to develop models of real-world problems using industry-standard finite element packages.

Numerical Methods in Geomechanics Thomas Telford

This book explains the hypoplastic modelling framework. It is divided into two parts, the first of which is devoted to principles of hypoplasticity. First, the basic features of soil’s mechanical behaviour are introduced, namely non-linearity and asymptotic properties. These features are then incorporated into simple one-dimensional hypoplastic equations for compression and shear. Subsequently, a hypoplastic equivalent of the Modified Cam-Clay model is developed in 2D space using stress and strain invariants to demonstrate key similarities and differences between elasto-plastic and hypoplastic formulations. Lastly, the mathematical structure of hypoplastic models is explained by tracing their

historical development, from the early trial-and-error models to more recent approaches. In turn, Part II introduces specific hypoplastic models for soils. First, two reference models for sand and clay are defined. After summarising their mathematical formulations, calibration procedures are described and discussed. Subsequently, more advanced modelling approaches are covered: the intergranular strain concept incorporating the effects of small strain stiffness and cyclic loading, viscohypoplasticity for predicting rate effects, soil structure to represent structured and bonded materials and soil anisotropy. The book concludes with a description of partial saturation and thermal effects: topics that are increasingly important to the disciplines of energy and environmental geotechnics. Selecting a constitutive model and its parameters is often the most important and yet challenging part of any numerical analysis in geotechnical engineering. Hypoplasticity involves a specific class of soil constitutive models, which are described in detail here. The book offers an essential resource, both for model users who need a more advanced model for their geotechnical calculations and are mainly interested in parameter calibration procedures, and for model developers who are seeking a comprehensive understanding of the mathematical structure of hypoplasticity.
Advanced Computational Materials Modeling CRC Press
Constitutive modelling is the mathematical description of how materials respond to various loadings. This is the most intensely researched field within solid mechanics because of its complexity and the importance of accurate constitutive models for practical engineering problems. Topics covered include: Elasticity - Plasticity theory - Creep theory - The nonlinear finite element method - Solution of nonlinear equilibrium equations - Integration of elastoplastic constitutive equations - The thermodynamic framework for constitutive modelling – Thermoplasticity - Uniqueness and discontinuous bifurcations • More comprehensive in scope than competitive titles, with detailed discussion of thermodynamics and numerical methods. • Offers appropriate strategies for numerical solution, illustrated by discussion of specific models. • Demonstrates each topic in a complete and self-contained framework, with extensive referencing.
Numerical Methods in Geomechanics CRC Press
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.
Computational Modeling of Multiphase Geomaterials Springer Science & Business Media
Due to their unique properties, rubber materials are found in multiple engineering applications such as tires, engine mounts, shock absorbers, flexible joints, seals, etc. Nevertheless, the complex nature of the behavior of such material makes it difficult to accurately model and predict the performance of these units. The challenge to correctly reproduce the observed characteristics of rubber elements necessitates detailed experimental investigations, development of accurate constitutive models, validation of techniques to identify material parameters and efficient numerical methods. Aspects regarding fatigue and damage in elastomers are not to be left aside, as they influence the durability of the products. State-of-the-art technology in terms of constitutive modeling, numerical implementation, damage and fatigue resistance are strongly represented in these Proceedings, along with insights into advanced elastomers to be used in novel applications. Topics included in this volume are: Ageing, Friction and abrasion, Adhesion, Swelling, Continuum mechanical models and numerical implementation, Hyperelasticity, Micro-mechanical approaches, Fracture and fatigue, Mullins effect, Strain induced crystallization, Thermal effects, Reinforcement and vulcanization, Design and applications, Smart elastomers. Constitutive Models for Rubber VIII is of interest not only for undergraduates, postgraduates, academics and researchers in the discipline, but also for all those design and development engineers in the industry.
Sheet Metal Forming Processes Springer
Numerical Methods in Geotechnical Engineering IX contains 204 technical and scientific papers presented at the 9th European Conference on Numerical Methods in Geotechnical Engineering (NUMGE2018, Porto, Portugal, 25—27 June 2018). The papers cover a wide range of topics in the field of computational geotechnics, providing an overview of recent developments on scientific achievements, innovations and engineering applications related to or employing numerical methods. They deal with subjects from emerging research to engineering practice, and are grouped under the following themes: Constitutive modelling and numerical implementation Finite element, discrete element and other numerical methods. Coupling of diverse methods Reliability and probability analysis Large deformation – large strain analysis Artificial intelligence and neural networks Ground flow, thermal and coupled analysis Earthquake engineering, soil dynamics and soil-structure interactions Rock mechanics Application of numerical methods in the context of the Eurocodes Shallow and deep foundations Slopes and cuts Supported excavations and retaining walls Embankments and dams Tunnels and caverns (and pipelines) Ground improvement and reinforcement Offshore geotechnical engineering Propagation of vibrations Following the objectives of previous eight thematic conferences, (1986 Stuttgart, Germany; 1990 Santander, Spain; 1994 Manchester, United Kingdom; 1998 Udine, Italy; 2002 Paris, France; 2006 Graz, Austria; 2010 Trondheim, Norway; 2014 Delft, The Netherlands), Numerical Methods in Geotechnical Engineering IX updates the state-of-the-art regarding the application of numerical methods in geotechnics, both in a scientific perspective and in what concerns its application for solving practical boundary value problems. The book will be much of interest to engineers, academics and professionals involved or interested in Geotechnical Engineering. This is volume 2 of the NUMGE 2018 set.
Experimental Modeling and Numerical Simulation of Lateral Spreading for Validation of Constitutive Models Springer
This book adopts numerical method to model soil constitutive relationship while it

abandons the traditional idea of looking for plastic potential as the only way to model. Firstly, the triaxial compression tests of expansive soil, sand and clay under different stress paths are introduced; then the elastoplastic constitutive equations of expansive soil, sand and clay under various stress paths are established by numerical modeling method; finally, the constitutive equations are embedded in the finite element program and verified by comparing the finite element calculation results of the triaxial test soil samples with the corresponding test results. The modeling obtains high accuracy.

Practice of Constitutive Modelling for Saturated Soils Springer

Effective measurement of the composition and properties of petroleum is essential for its exploration, production, and refining; however, new technologies and methodologies are not adequately documented in much of the current literature. Analytical Methods in Petroleum Upstream Applications explores advances in the analytical methods and instrumentation that allow more accurate determination of the components, classes of compounds, properties, and features of petroleum and its fractions. Recognized experts explore a host of topics, including: A petroleum molecular composition continuity model as a context for other analytical measurements A modern modular sampling system for use in the lab or the process area to collect and control samples for subsequent analysis The importance of oil-in-water measurements and monitoring The chemical and physical properties of heavy oils, their fractions, and products from their upgrading Analytical measurements using gas chromatography and nuclear magnetic resonance (NMR) applications Asphaltene and heavy ends analysis Chemometrics and modeling approaches for understanding petroleum composition and properties to improve upstream, midstream, and downstream operations Due to the renaissance of gas and oil production in North America, interest has grown in analytical methods for a wide range of applications. The understanding provided in this text is designed to help chemists, geologists, and chemical and petroleum engineers make more accurate estimates of the crude value to specific refinery configurations, providing insight into optimum development and extraction schemes.

Numerical Modeling in Science and Engineering Springer

In this volume a number of developments on a variety of topics have been reported. These topics include: partially saturated soil; instabilities in soil behaviour; environmental geomechanics; parallel computing; and applications to tunnels, embankments, slopes, foundations and anchors.

Fluid Mechanics of Viscoelasticity Springer Nature

The concept of virtual manufacturing has been developed in order to increase the industrial performances, being one of the most ef cient ways of reducing the m- ufacturing times and improving the quality of the products. Numerical simulation of metal forming processes, as a component of the virtual manufacturing process, has a very important contribution to the reduction of the lead time. The nite element method is currently the most widely used numerical procedure for s- ulating sheet metal forming processes. The accuracy of the simulation programs used in industry is in uenced by the constitutive models and the forming limit curves models incorporated in their structure. From the above discussion, we can distinguish a very strong connection between virtual manufacturing as a general concept, ?nite element method as a numerical analysis instrument and constitutive laws,aswellas forming limit curves as a speci city of the sheet metal forming processes. Consequently, the material modeling is strategic when models of reality have to be built. The book gives a synthetic presentation of the research performed in the eld of sheet metal forming simulation during more than 20 years by the members of three international teams: the Research Centre on Sheet Metal Forming—CERTETA (Technical University of Cluj-Napoca, Romania); AutoForm Company from Zürich, Switzerland and VOLVO automotive company from Sweden. The rst chapter presents an overview of different Finite Element (FE) formu- tions used for sheet metal forming simulation, now and in the past.

Numerical Methods in Geotechnical Engineering CRC Press

This is a modern textbook for courses in continuum mechanics. It provides both the theoretical framework and the numerical methods required to model the behaviour of continuous materials. This self-contained textbook is tailored for advanced undergraduate or first-year graduate students with numerous step-by-step derivations and worked-out examples. The author presents both the general continuum theory and the mathematics needed to apply it in practice. The derivation of constitutive models for ideal gases, fluids, solids and biological materials, and the numerical methods required to solve the resulting differential equations, are also detailed. Specifically, the text presents the theory and numerical implementation for the finite difference and the finite element methods in the Matlab® programming language. It includes thirteen detailed Matlab® programs illustrating how constitutive models are used in practice.

Transient/Dynamic Analysis and Constitutive Laws for Engineering Materials CRC Press

Numerical modeling is often relied on as the most advanced approach for predicting the effects of liquefaction for complex geosystems. While numerical methods are often used to model seismic performance, little is known about how accurately constitutive models capture the physics behind liquefaction. The Liquefaction Experiments and Analysis Projects (LEAP) is an international effort among numerical and physical modelers to validate numerical models used to predict the effects of liquefaction. LEAP is conducted over a series of phases, or projects, each addressing a specific component of the overall goal of validation. The research in this dissertation presents components of LEAP, considering both experimental and numerical modeling of liquefaction. The overall goals are to: 1) provide high quality experimental data for validation of numerical constitutive models and 2) demonstrate the behavior and sensitivity of commonly used numerical liquefaction models. The goal of the first major US phase of LEAP, LEAP-GWU-2015, was to repeat the same centrifuge experiment at different research facilities, to serve as a single point for validation. The experiment consisted of a submerged slope of uniform sand. The centrifuge experiment performed at UC Davis as a part of the LEAP-GWU-2015 phase is discussed, including the experiment results, novel testing procedures, modifications to the model container, and nonconformities with experiment specifications. Prior to the second major LEAP phase, new centrifuge testing equipment was developed to characterize the initial conditions of the experiment and model response during liquefaction. A low-cost cone penetrometer device was designed and distributed to the LEAP testing facilities for improved quality control. A linear regression is presented that uses measured cone tip stresses to correct reported initial densities from mass and volume measurements. A novel hardware configuration to measure liquefaction induced deformations of a submerged slope was developed. The new configuration records displacements using five GoPro cameras attached to a submerged clear acrylic window located above the slope, which acts as a glass-bottom boat to avoid distortion due to water surface waves. The highspeed videos recorded during shaking are converted to images and using GEO-PIV displacements time histories are calculated. Time series displacements measured with the new hardware configuration were shown to produce comparable results as hand measurements and sensor data. The second major LEAP phase, LEAP-UCD-2017, consisted of twenty-four centrifuge experiments performed at nine research facilitates using the same testing geometry as the LEAP-GWU-2015 exercise. The new strategy of the LEAP-UCD-2017 phase was to intentionally vary the key input variables of motion intensity and soil density to determine the sensitivity of residual displacements to these variables. The three centrifuge experiments performed at UC Davis for LEAP-UCD-2017 are presented, including the experiment results, new procedures to estimate model specimen density, and minor nonconformities with experimental specifications. Following the LEAP-UCD-2017 and LEAP-ASIA-2019 phases an experimental displacement response surface that relates soil density, input motion intensity, and slope displacement was developed using nonlinear regression analysis of the centrifuge test data. A numerical response surface was developed using the PDMY02 constitutive model using the OpenSees finite element framework. The PDMY02 model was calibrated for three relative densities using available cyclic element test laboratory data; after considerable effort the triggering curves (cyclic stress ratio vs number of cycles to liquefaction) for the PDMY02 model cross the triggering curves developed from laboratory data, but the shapes of the numerical curves do not match the laboratory curves. A finite element mesh of the LEAP-UCD-2017 centrifuge test geometry was developed and the displacement response surface for the PDMY02 model was developed by varying the intensity of the input motion for the three calibration densities. The resulting numerical response surface is shown to match the experimental surface well, despite the fact that the numerical liquefaction triggering curves are not a good fit with the laboratory liquefaction triggering curves. Together, the results presented in this dissertation contribute to our understanding of numerical model validation and help to reconcile the different inferences produced through numerical modeling and centrifuge experiments.