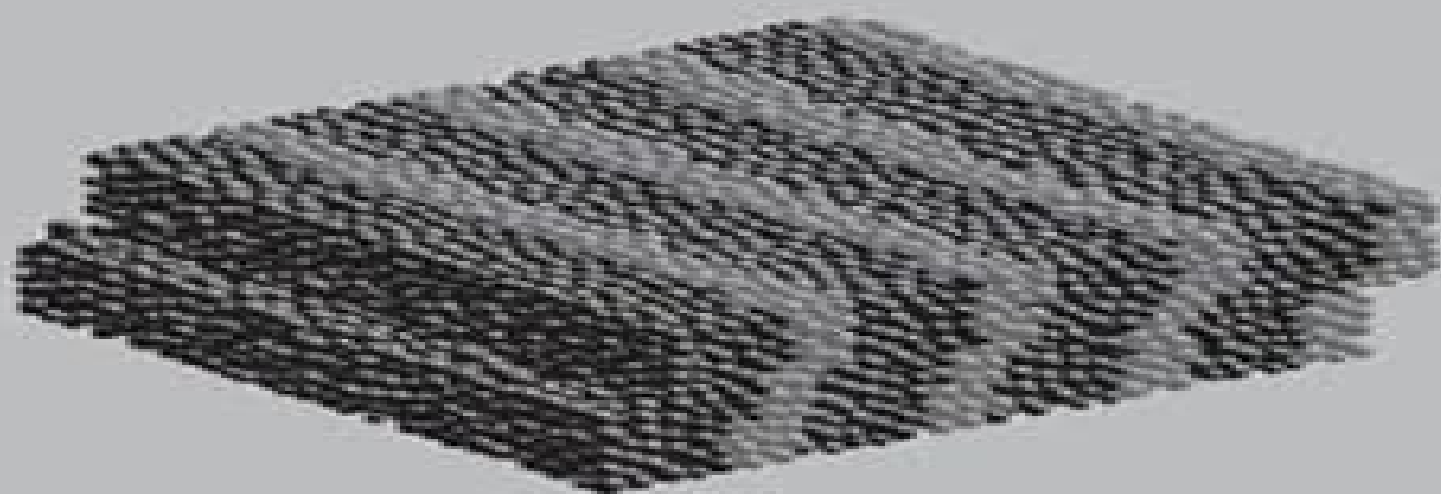


# PARTICULATE DISCRETE ELEMENT MODELLING

A Geomechanics Perspective

CATHERINE O'SULLIVAN



APPLIED GEOTECHNICS VOLUME 4



# Particulate Discrete Element Modelling A Geomechanics Perspective Applied Geotechnics

**Yu-Kweng Lin, T. C. Su**



## **Particulate Discrete Element Modelling A Geomechanics Perspective Applied Geotechnics:**

**Particulate Discrete Element Modelling** Catherine O'Sullivan, 2011-04-06 The first single work on DEM providing the information to get started with this powerful numerical modelling approach Provides the basic details of the numerical method and the approaches used to interpret the results of DEM simulations It will be of use to professionals researchers and higher level students with a theoretical overview of DEM as well as practical guidance Selected Contents 1 Introduction 2 Use of DEM in Geomechanics 3 Calculation of Contact Forces 4 Particle Motion 5 Particle Types 6 Boundary Conditions 7 Initial Geometry and Specimen Generation 8 Time Integration and Discrete Element Modelling 9 DEM Interpretation A Continuum Perspective 10 Postprocessing Graphical Interpretation of DEM Simulations 11 Basic Statistics **Particulate**

**Discrete Element Modelling** Catherine O'Sullivan, 2011-04-13 Particulate discrete element analysis is becoming increasingly popular for research in geomechanics as well as geology chemical engineering powder technology petroleum engineering and in studying the physics of granular materials With increased computing power practising engineers are also becoming more interested in using this technology for analysis in industrial applications This is the first single work on Discrete Element Modelling DEM providing the information to get started with this powerful numerical modelling approach Written by an independent author with experience both in developing DEM codes and using commercial codes this book provides the basic details of the numerical method and the approaches used to interpret the results of DEM simulations Providing a basic overview of the numerical method Particulate Discrete Element Modelling discusses issues related to time integration and numerical stability particle types contact modelling and boundary conditions It summarizes approaches to interpret DEM data so that users can maximize their insight into the material response using DEM The aim of this book is to provide both users and prospective users of DEM with a concise reference book that includes tips to optimize their usage Particulate Discrete Element Modelling is suitable both for first time DEM analysts as well as more experienced users It will be of use to professionals researchers and higher level students as it presents a theoretical overview of DEM as well as practical guidance on running DEM simulations and interpreting DEM simulation data *Particulate Discrete Element*

*Modelling* Catherine O'Sullivan, 2011-04-06 The first single work on DEM providing the information to get started with this powerful numerical modelling approach Provides the basic details of the numerical method and the approaches used to interpret the results of DEM simulations It will be of use to professionals researchers and higher level students with a theoretical overview of DEM as well as practical guidance Selected Contents 1 Introduction 2 Use of DEM in Geomechanics 3 Calculation of Contact Forces 4 Particle Motion 5 Particle Types 6 Boundary Conditions 7 Initial Geometry and Specimen Generation 8 Time Integration and Discrete Element Modelling 9 DEM Interpretation A Continuum Perspective 10 Postprocessing Graphical Interpretation of DEM Simulations 11 Basic Statistics *Numerical Methods in Geotechnical Engineering IX, Volume 1* José Marques, 2018-06-22 NUMGE 2018 is the ninth in a series of conferences on Numerical

Methods in Geotechnical Engineering organized by the ERTC7 under the auspices of the International Society for Soil Mechanics and Geotechnical Engineering ISSMGE The first conference was held in 1986 in Stuttgart Germany and the series continued every four years 1990 Santander Spain 1994 Manchester United Kingdom 1998 Udine Italy 2002 Paris France 2006 Graz Austria 2010 Trondheim Norway 2014 Delft The Netherlands The conference provides a forum for exchange of ideas and discussion on topics related to numerical modelling in geotechnical engineering Both senior and young researchers as well as scientists and engineers from Europe and overseas are invited to attend this conference to share and exchange their knowledge and experiences This work is the first volume of NUMGE 2018

**Numerical Methods in Geotechnical Engineering IX** António Cardoso, José Borges, Pedro Costa, António Gomes, José Marques, Castorina Vieira, 2018-06-19

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

Indian Geotechnical Journal, 1996

*Distinct Element Modelling in Geomechanics* K.R. Saxena, 2018-12-20

Linear mathematical assumptions for procedures in other branches of engineering have little relevance for geoengineering which must accommodate non linear behaviors Contributors to eight papers apply the breakthrough numerical modeling Distinct Element Method Cundall late 1960s The design philosophy for structures or excavations in geotechnical engineering is different from that followed for fabricated materials like steel and concrete The designer has little data both with regard to geological weaknesses and strength and deformation characteristics of materials before finalizing the designs Also these

characteristics vary from place to place In situ stresses due to gravity and tectonics and transient forces imposed due to rainfall and earthquakes make the matter more complicated The pore waters carry the load initially before passing it on to the solids For the analytical procedure to be realistic it should account for large displacements and non linear behaviour including strain softening Because of these considerations the designers have followed procedures based on simplifying assumptions such as linear small strain elastoplastic behaviour Numerical procedures based on such assumptions though very popular in other branches of engineering have made little impact in geo engineering An attempt has been made in this book to compile the recent use of distinct element codes for solutions of some of the problems in geomechanics particularly those involving excavations It is hoped that it will provide an opportunity for the fraternity of geotechnical engineers to appreciate the opening of new frontiers in the use of computers for solving more challenging geotechnical problems *The Application of Discrete Element Modelling to Finite Deformation Problems in Geomechanics* Catherine O'Sullivan (Professor of civil and environmental engineering),2002 Computer Methods and Advances in Geomechanics ,1991 **Matrix Discrete Element Analysis of Geological and Geotechnical Engineering** Chun Liu,2021-01-23 This book introduces the basic structure modeling methods numerical calculation processes post processing and system functions of MatDEM which applies the basic principles and algorithm of the discrete element method The discrete element method can effectively simulate the discontinuity inhomogeneity and large deformation damage of rock and soil It is widely used in both research and industry Based on the innovative matrix discrete element computing method the author developed the high performance discrete element software MatDEM from scratch which can handle millions of elements in discrete element numerical simulations This book also presents several examples of applications in geological and geotechnical engineering including basic geotechnical engineering problems discrete element tests three dimensional landslides and dynamic and multi field coupling functions Teaching videos and the relevant software can be accessed on the MATDEM website <http://matdem.com> The book serves as a useful reference for research and engineering staff undergraduates and postgraduates who work in the fields of geology geotechnical water conservancy civil engineering mining and physics *Innovative Numerical Modelling in Geomechanics* Luis Ribeiro e Sousa,Eurípedes Vargas Jr.,M.M. Fernandes,Roberto Azevedo,2012-05-03 Since the 1990s five books on Applications of Computational Mechanics in Geotechnical Engineering have been published Innovative Numerical Modelling in Geomechanics is the 6th and final book in this series and contains papers written by leading experts on computational mechanics The book treats highly relevant topics in the field of geotechnic Géotechnique ,2009 Geomechanics and Geotechnics of Particulate Media Masayuki Hyodo,Hidekazu Murata,Yukio Nakata,2017-12-14 Microscopic re examination of geomaterials consisting of aggregates can shed light on macroscopic behaviour including compressibility anisotropy yielding creep cyclic liquefaction and shear rupture As a result of this process of examination new methods of material characterization emerge leading to a greater degree of accuracy in the specification of new constitutive

models with physically meaningful parameters The impetus behind this development is an increasing awareness on sustainability leading to the more efficient use of recycled materials for geotechnical applications The characteristics of recycled materials such as compressibility and self hardening may differ significantly from those of natural materials and it is crucial that evaluation is made from a specifically particulate perspective Discrete Element Methods Benjamin K. Cook, Richard P. Jensen, 2002 Proceedings of the Third International Conference on Discrete Element Methods held in Santa Fe New Mexico on September 23-25 2002 This Geotechnical Special Publication contains 72 technical papers on discrete element methods DEM a suite of numerical techniques developed to model granular materials rock and other discontinua at the grain scale Topics include DEM formulation and implementation approaches coupled methods experimental validation and techniques including three dimensional particle representations efficient contact detection algorithms particle packing schemes and code design Coupled methods include approaches to linking solid continuum and fluid models with DEM to simulate multiscale and multiphase phenomena Applications include fundamental investigations of granular mechanics micromechanical studies of powder soil and rock behavior and large scale modeling of geotechnical material processing mining and petroleum engineering problems **Engineering Mechanics** Yu-Kweng Lin, T. C. Su, 1996 Slope Stability 2007 Yves Potvin, 2007 **Discrete Element Modelling of Particulate Media** Chuan-Yu Wu, 2012-08-01 Discrete Element Methods DEM is a numerical technique for analysing the mechanics and physics of particulate systems Originated in the late seventies for analysing geotechnical problems it has seen significant development and is now employed extensively across disciplines Produced in celebration of the 70th Birthday of Colin Thornton this book contains a selection of papers concerning advances in discrete element modelling which were presented at the International Symposium on Discrete Element Modelling of Particulate Media held at Birmingham UK on 28-30th March 2012 The book showcases the wide application of discrete element modelling in gas solid fluidisation particulate flows liquid solid systems and quasi static behaviour It also reports the recent advancement in coupled DEM with computational fluid dynamics Lattice Boltzmann Methods for multiphase systems and the novel application of DEM in contact electrification and fracture of granular systems Aimed at research communities dealing with this technique in the powder handling and formulation industries this will be a welcomed addition to the literature in this area **Numerical Modelling of Discrete Materials in Geotechnical Engineering, Civil Engineering and Earth Sciences** Heinz Konietzky, 2004-11-23 In this fully up to date volume important new developments and applications of discrete element modelling are highlighted and brought together for presentation at the First International UDEC 3DEC Symposium Papers covered the following key areas behaviour of masonry structures walls bridges towers columns stability and deformation of tunnels and caverns in fractured rock masses geomechanical modelling for mining and waste repositories rock reinforcement design anchors shotcrete bolts mechanical and hydro mechanical behaviour of dams and foundations rock slope stability deformation and failure mechanisms modelling of fundamental rock

mechanical problems modelling of geological processes constitutive laws for fractured rock masses and masonry structures dynamic behaviour of discrete structures Numerical Modelling of Discrete Materials in Geotechnical Engineering Civil Engineering and Earth Sciences provides an ultra modern in depth analysis of discrete element modelling in a range of different fields thus proving valuable reading for civil mining and geotechnical engineers as well as other interested professionals

**Deterministic Numerical Modeling of Soil Structure Interaction** Stephane Grange, Diana Salciarini, 2021-12-22 In order to describe soil structure interaction in various situations nonlinear static dynamic hydro mechanical couplings this book gives an overview of the main modeling methods developed in geotechnical engineering The chapters are centered around the finite element method FEM the finite difference method FDM and the discrete element method DEM Deterministic Numerical Modeling of Soil Structure Interaction allows the reader to explore the classical and well known FEM and FDM using interface and contact elements available for coupled hydro mechanical problems Furthermore this book provides insight on the DEM adapted for interaction laws at the grain level Within a classical finite element framework the concept of macro element is introduced which generalizes constitutive laws of SSI and is particularly straightforward in dynamic situations Finally this book presents the SSI in the case of a group of structures such as buildings in a town using the notion of metamaterials and a geophysics approach Distinct Element Modelling in Geomechanics V. M. Sharma, 1999

## The Enigmatic Realm of **Particulate Discrete Element Modelling A Geomechanics Perspective Aplied Geotechnics**: Unleashing the Language is Inner Magic

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