

## Preface

*'I am always obliged to a person who has taught me a single word'*

The finite element method has become a mature powerful approach for numerical simulation of various engineering and industrial applications. With rapid development of the computing facilities, the analysis of large scale real discontinuum problems has now become a reality.

A month after I returned back to Iran, I was asked to arrange for a new state of the art course for the Ph.D. students studying structural mechanics. My answer was 'Computational Contact Mechanics'. After three years, a comprehensive book has now become available, covering the discrete element methodology and principles of discontinuum mechanics. It is mainly prepared as a postgraduate textbook for Ph.D. students and research institutions undergoing research on general contact mechanics and discontinuum problems. Here, I should mention my students in University of Tehran, whose frequent questions helped me to prepare this book with the least possible errors, I hope.

The book can be classified into three parts. The first part is dedicated to the basic concepts of constraint definitions and various methods for constraint enforcement as well as a short discussion on the finite element discretization and necessary finite deformation theory as the bases of the combined finite/discrete element method.

The second part is devoted to the contact interaction and detection procedures. Physical and experimental observations, normal and tangential contact formulations, theoretical considerations and computational algorithms will be discussed for both granular flow and deformable finite/discrete element modelings.

The final part describes the progressive fracturing phenomena. Stability and convergence discussions, an anisotropic material model, localization difficulties, remeshing techniques and their associated computational algorithms will be discussed.

A limited version of the UTdem discrete element code has been included in the accompanying CD. It is primarily aimed at giving the reader an overall insight of how a complex discrete element software performs and how various control parameters may affect the progressive cracking and granular flow simulations. A sample manual for preparing the input data file has been included as an appendix. I would like to gratefully appreciate my colleague

Mr. A. Najafi Amin for his outstanding work on pre and postprocessing modulus of the UTdem.

The present textbook is a result of ‘infinite’ research works for many years all over the world. It has been tried to appropriately acknowledge the achievements of corresponding researchers within the text, relevant figures, tables and formulae. I am much indebted to their outstanding research works, and any shortcoming in sufficiently acknowledging them is sincerely apologized.

First of all, I would like to express my sincere gratitude to Prof. D.R.J. Owen who was the first to open my eyes beyond the continuum barriers, introducing me to new challenging frontiers of the computational science. Also to Dr. A.J.L. Crook, my first discrete element teacher and to Prof. D. Peric and the late Prof. E. Hinton for valuable discussions. To this end, I have used and built on the experience and work of Dr. N. Petrinic, Dr. A. Munjiza, Dr. J. Yu, Dr. G.Q. Liu and Dr. J. Macedo since the first days I got involved with this new subject; I gratefully acknowledge and appreciate them.

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Finally, my special thanks to my family for their never ending support. I have spent many hours preparing this text; hours that had to be spent for my wife and little ‘sogol’. Without their understanding and love this book may not ever have been written.

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