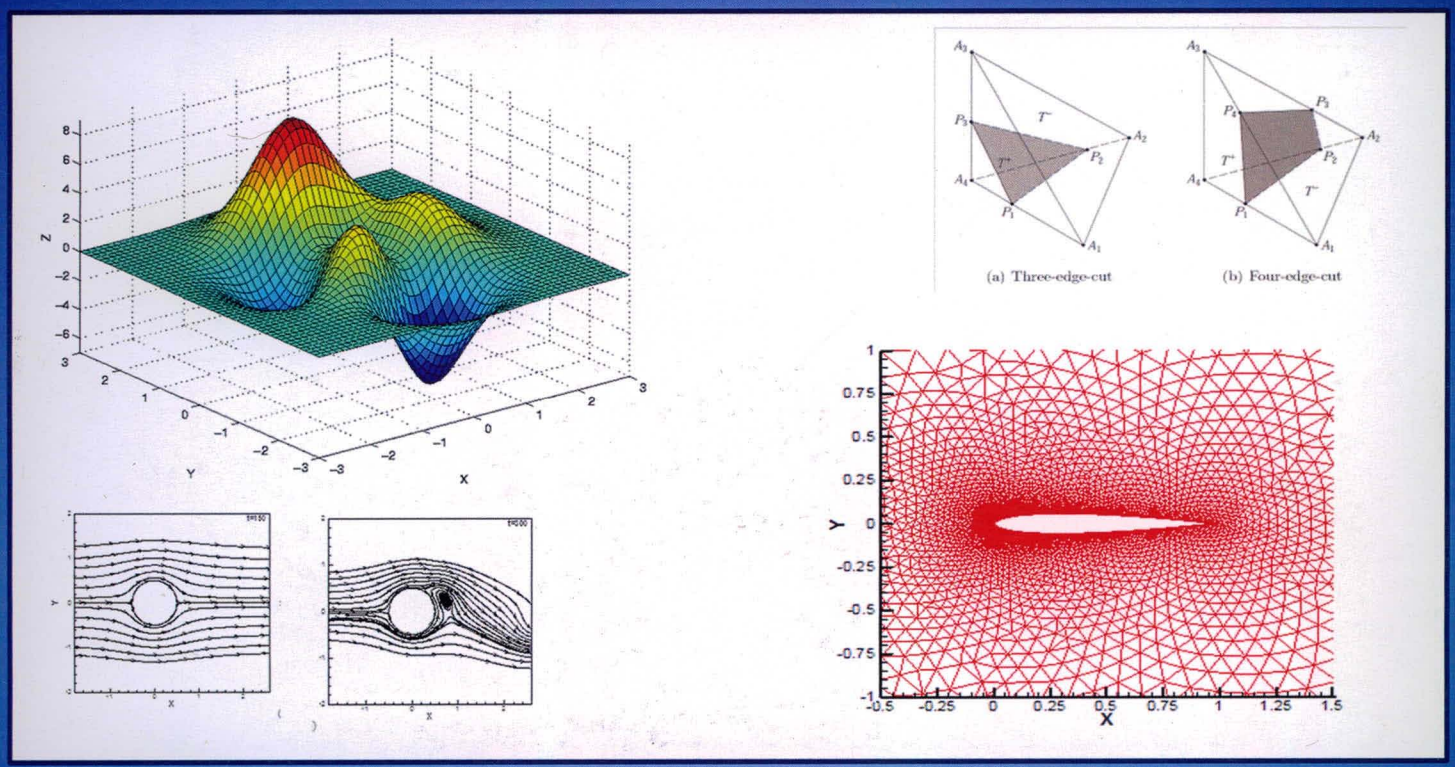
# ADVANCED NUMERICAL TECHNIQUES IN ENGINEERING and SCIENCE




Editors
AHMAD TARIQ JAMEEL
WAQAR ASRAR

IIUM Press
International Islamic University Malaysia
2011

# ADVANCED NUMERICAL TECHNIQUES IN ENGINEERING AND SCIENCE

**Editors**

**AHMAD TARIQ JAMEEL**
*Department of Biotechnology Engineering*

**WAQAR ASRAR**
*Department of Mechanical Engineering*

**IIUM Press**
**International Islamic University Malaysia**
**2011**

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011


Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Ahmad Tariq Jameel & Waqar Asrar: Advanced Numerical Techniques in Engineering & Science

ISBN: 978-967-418-020-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
**IIUM PRINTING SDN. BHD.**
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

# Contents

# CHAPTER 7

# Finite Element Modeling of the Powder Compaction Process

MEFTAH HRAIRI[1], HEDI CHTOUROU[2]

[1]Department of Mechanical Engineering, International Islamic University Malaysia,
[2]Department of Technology, IPEIS, Sfax University, Tunisia

## ABSTRACT

Finite element simulation of the rigid die compaction of metal powders can significantly help the designers to avoid some of the typical problems of this forming process such as the high density gradients within the compacted parts and the related cracking. A material constitutive model of the Cap type has been developed, experimentally calibrated for the 316L stainless steel powder and implemented into the finite element code ABAQUS. Simulations are run by an integrated module that uses the Ideas-Master Series software for the geometrical definition of the problem, ABAQUS as the non linear finite element solver, an in-house developed software (Idequs) for the prescription of all the boundary conditions and material properties and finally, the ABAQUS-Post software for the results post processing. This chapter addresses the formulation of the rigid die compaction process as a finite element problem. It also presents some theoretical aspects of the material model as well as its experimental characterization for the 316L stainless steel powder. In addition, the finite element simulation module that has been developed to facilitate the application of the global approach is presented. Finally, the predictive capabilities of the model are illustrated through the simulation of the rigid die compaction of two industrial parts.

***Keywords***: powder metallurgy, compaction process, finite element, density, Cap model, ABAQUS, material parameters, stainless steel powder