Modeling Of Metal Forming And Machining Processes By Finite Element And Soft Computing Methods Engineering Materials And Processes

Applied Metal Forming: Including FEM Analysis describes metal forming theory and how experimental techniques can be used to study any metal forming operation with great accuracy. For each primary class of processes, such as forging, rolling, extrusion, wiredrawing, and sheet-metal forming, it explains how FEA (Finite Element Analysis) can be applied with great precision to characterize the

forming condition and in this way optimize the processes. FEA has made it possible to build very realistic FEM-models of any metal forming process, including complex three-dimensional forming operations, in which complex products are shaped by complex dies. Thus, using FEA it is now possible to visualize any metal forming process and to study strain, stresses, and other forming conditions inside the parts being manufactured as they develop throughout the process.

The principal aim of this text is to encourage the development and application of numerical modelling techniques as an aid to achieving greater efficiency and optimization of metal-forming processes. The contents of this book have therefore been carefully planned to provide both an introduction to the fundamental theory of material

deformation simulation, and also a comprehensive survey of the "state-of-the-art" of deformation modelling techniques and their application to specific and industrially relevant processes. To this end, leading international figures in the field of material deformation research have been invited to contribute chapters on subjects on which they are acknowledged experts. The information in this book has been arranged in four parts: Part I deals with plasticity theory, Part II with various numerical modelling techniques, Part III with specific process applications and material phenomena and Part IV with integrated computer systems. The objective of Part I is to establish the underlying theory of material deformation on which the following chapters can build. It begins with a chapter which reviews the basic theories of classical plasticity and describes their

analytical representations. The second chapter moves on to look at the theory of deforming materials and shows how these expressions may be used in numerical techniques. The last two chapters of Part I provide a review of isotropic plasticity and anisotropic plasticity.

The book gives a synthetic presentation of the research performed during more than twenty years by the members of the Research Centre on Sheet Metal Forming a'' CERTETA (Technical University of Cluj-Napoca, Romania). The first chapter reminds some fundamental topics of the theory of plasticity. A more extended chapter is devoted to the presentation of the phenomenological yield criteria, emphasizing the formulations proposed by the CERTETA team (BBC models). The sheet metal formability is discussed in a separate chapter. After presenting the methods used for the formability

assessment, the discussion focuses on the forming limit curves. In this context, the authors emphasize their contributions to the mathematical modeling of forming limit curves. The aspects related to the implementation of the constitutive models in finite-element codes are discussed in the last chapter of the book. The performances of the models are proved by the numerical simulation of various sheet metal forming processes: hydroforming, deep-drawing and bending. The book is useful for the students, doctoral fellows, researchers and engineers who are mainly interested in the mechanical modeling and numerical simulation of sheet metal forming processes.

Modeling of Metal Forming and Machining Processes

By Finite Element and Soft Computing Methods

Modeling and Applications to Forming

Plasticity of Metallic Materials

Friction Modeling in Computer Simulation of Sheet Metal Forming Processes

Modeling of Material Behavior in Metal Forming

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.

The application of computer-aided design and manufacturing techniques is becoming essential in modern metal-forming technology. Thus process modeling for the determination of deformation mechanics has been a major concern in research . In light of these developments, the finite element method--a technique by which an object is decomposed into pieces and treated as isolated, interacting sections--has steadily assumed increased importance. This volume addresses advances in modern metal-forming technology, computer-aided design and engineering, and the finite element method.

This book gives a unified presentation of the research performed in the field of multiscale modelling in sheet metal forming over the course of more than thirty years by the members of six teams from internationally acclaimed universities. The first chapter is devoted to the presentation of some recent phenomenological yield criteria (BBC 2005 and BBC 2008) developed at the CERTETA center from the Technical University of Cluj-Napoca. An overview on the crystallographic texture and plastic anisotropy is presented in Chapter 2. Chapter 3 is dedicated to multiscale modelling of plastic

anisotropy. The authors describe a new hierarchical multi-scale framework that allows taking into account the evolution of plastic anisotropy during sheet forming processes. Chapter 4 is focused on modelling the evolution of voids in porous metals with applications to forming limit curves and ductile fracture. The chapter details the steps needed for the development of dissipation functions and Gurson-type models for non-quadratic anisotropic plasticity criteria like BBC 2005 and those based on linear transformations. Chapter 5 describes advanced models for the prediction of

forming limit curves developed by the authors. Chapter 6 is devoted to anisotropic damage in elasto-plastic materials with structural defects. Finally, Chapter 7 deals with modelling of the Portevin-Le Chatelier (PLC) effect. This volume contains contributions from leading researchers from the Technical University of Cluj-Napoca, Romania, the Catholic University of Leuven, Belgium, Clausthal University of Technology, Germany, Amirkabir University of Technology, Iran, the University of Bucharest, Romania, and the Institute of Mathematics of the Romanian Academy, Romania. It will

prove useful to postgraduate students, researchers and engineers who are interested in the mechanical modeling and numerical simulation of sheet metal forming processes.

Computer-Aided Modeling of Selected Sheet Metal Forming Processes

Mechanics of Sheet Metal Forming

Modeling and Analysis of Laser Metal Forming Processes

Multiscale Modelling in Sheet Metal Forming

Mechanics Modeling of Sheet Metal Forming

Material properties -- Sheet deformation processes -- Deformation

of sheet in plane stress -- Simplified stamping analysis -- Load instability and tearing -- Bending of sheet -- Simplified analysis of circular shells -- Cylindrical deep drawing -- Stretching circular shells -- Combined bending and tension of sheet -- Hydroforming.

Modeling of Metal Forming and Machining Processesby Finite Element and Soft Computing MethodsSpringer Science & Business Media

Metal Forming: Formability, Simulation, and Tool Design focuses on metal formability, finite element modeling, and tool design, providing readers with an integrated overview of the theory, experimentation and practice of metal forming. The book includes formability and finite element topics, including insights on plastic instability, necking, nucleation and coalescence of voids. Chapters discuss

the finite element method, including its accuracy, reliability and validity and finite element flow formulation, helping readers understand finite element formulations, iterative solution methods, friction and contact between objects, and other factors. The book's final sections discuss tool design for cold, warm and hot forming processes. Examples of tools, design guidelines, and information related to tool materials, lubricants, finishes, and tool failure are included as well. Provides fundamental, integrated knowledge on metal formability, finite element topics and tool design Outlines user perspectives on accuracy, reliability and validity of finite element modeling Discusses examples of tools, their design guidelines, tool lubricants, and tool failure Considers the role played by stress triaxiality and shear and

introduces uncoupled ductile damage criteria Includes applications, worked examples and detailed techniques Analysis and Modeling

Applications in Metal Forming and Resistance Welding

Theories and Applications

Ductile Fracture in Metal Forming

Modeling of Thermo-Electro-Mechanical Manufacturing Processes

Modeling and Experimental Verification of Sheet Metal Forming Processes

The aim of this book is to summarize the current most effective methods for modeling, simulating, and optimizing metal forming processes, and to present the main features of new,

innovative methods currently being developed which will no doubt be the industrial tools of tomorrow. It discusses damage (or defect) prediction in virtual metal forming, using advanced multiphysical and multiscale fully coupled constitutive equations. Theoretical formulation, numerical aspects as well as application to various sheet and bulk metal forming are presented in detail. Virtual metal forming is nowadays inescapable when looking to optimize numerically various metal forming processes in

order to design advanced mechanical components. To do this, highly predictive constitutive equations accounting for the full coupling between various physical phenomena at various scales under large deformation including the ductile damage occurrence are required. In addition, fully 3D adaptive numerical methods related to time and space discretization are required in order to solve accurately the associated initial and boundary value problems. This book focuses on these two main and

complementary aspects with application to a wide range of metal forming and machining processes.
Contents 1. Elements of Continuum Mechanics and Thermodynamics. 2. Thermo mechanically-Consistent Modeling of the Metals Behavior with Ductile Damage. 3. Numerical Methods for Solving Metal Forming Problems. 4. Application to Virtual Metal Forming.
Thorough reference to numerical techniques used for simulating metal forming operations.

Discover the state-of-the-art in multiscale modeling and optimization in manufacturing from two leading voices in the field Modeling and Optimization in Manufacturing delivers a comprehensive approach to various manufacturing processes and shows readers how multiscale modeling and optimization processes help improve upon them. The book elaborates on the foundations and applications of computational modeling and optimization processes, as well as recent developments in the field. It

offers discussions of manufacturing processes, including forming, machining, casting, joining, coating, and additive manufacturing, and how computer simulations have influenced their development. Examples for each category of manufacturing are provided in the text, and industrial applications are described for the reader. The distinguished authors also provide an insightful perspective on likely future trends and developments in manufacturing modeling and

optimization, including the use of large materials databases and machine learning. Readers will also benefit from the inclusion of: A thorough introduction to the origins of manufacturing, the history of traditional and advanced manufacturing, and recent progress in manufacturing An exploration of advanced manufacturing and the environmental impact and significance of manufacturing Practical discussions of the economic importance of advanced manufacturing An

examination of the sustainability of advanced manufacturing, and developing and future trends in manufacturing Perfect for materials scientists, mechanical engineers, and process engineers, Modeling and Optimization in Manufacturing will also earn a place in the libraries of engineering scientists in industries seeking a one-stop reference on multiscale modeling and optimization in manufacturing.
Process Modeling of Sheet Metal Forming of General Shapes by the Finite Method

Based on Large Strain Formulation
Metal Forming and the Finite-Element Method
Modeling of Sheet Metal Forming
Modeling and Optimization in Manufacturing Process and Materials
Modeling in Metal Forming
Damage Mechanics in Metal Forming

The numerical simulation of sheet metal forming processes has become an indispensable tool for the design of components and their forming processes. This role was attained due to the huge impact in reducing time to market and the cost of developing new components in industries ranging from

automotive to packing, as well as enabling an improved understanding of the deformation mechanisms and their interaction with process parameters. Despite being a consolidated tool, its potential for application continues to be discovered with the continuous need to simulate more complex processes, including the integration of the various processes involved in the production of a sheet metal component and the analysis of in-service behavior. The quest for more robust and sustainable processes has also changed its deterministic character into stochastic to be able to consider the scatter in mechanical properties induced by previous manufacturing processes. Faced with these challenges, this Special Issue presents scientific advances in the development of

numerical tools that improve the prediction results for conventional forming process, enable the development of new forming processes, or contribute to the integration of several manufacturing processes, highlighting the growing multidisciplinary characteristic of this field.

Mechanics of Materials in Modern Manufacturing Methods and Processing Techniques provides a detailed overview of the latest developments in the mechanics of modern metal forming manufacturing. Focused on mechanics as opposed to process, it looks at the mechanical behavior of materials exposed to loading and environmental conditions related to modern manufacturing processes, covering deformation as well as damage and fracture

processes. The book progresses from forming to machining and surface-treatment processes, and concludes with a series of chapters looking at recent and emerging technologies. Other topics covered include simulations in autofrettage processes, modeling strategies related to cutting simulations, residual stress caused by high thermomechanical gradients and pultrusion, as well as the mechanics of the curing process, forging, and cold spraying, among others. Some non-metallic materials, such as ceramics and composites, are covered as well. Synthesizes the latest research in the mechanics of modern metal forming processes Suggests theoretical models and numerical codes to predict mechanical responses Covers mechanics of shot peening, pultrusion, hydroforming, magnetic pulse forming

Considers applicability of different materials and processes for optimum performance

Modeling of Thermo-Electro-Mechanical Manufacturing Processes with Applications in Metal Forming and Resistance Welding provides readers with a basic understanding of the fundamental ingredients in plasticity, heat transfer and electricity that are necessary to develop and proper utilize computer programs based on the finite element flow formulation. Computer implementation of a wide range of theoretical and numerical subjects related to mesh generation, contact algorithms, elasticity, anisotropic constitutive equations, solution procedures and parallelization of equation solvers is comprehensively described. Illustrated and enriched with selected examples obtained from

industrial applications, Modeling of Thermo-Electro-Mechanical Manufacturing Processes with Applications in Metal Forming and Resistance Welding works to diminish the gap between the developers of finite element computer programs and the professional engineers with expertise in industrial joining technologies by metal forming and resistance welding.

Process Modeling Applied to Metal Forming and Thermomechanical Processing

A State-of-the-Art Volume in Honour of Professor J.A. Schey's 80th Birthday

Finite Element Modeling of Metal-forming Processes

by Finite Element and Soft Computing Methods

Modelling and Simulation of Sheet Metal Forming Processes

Computer Modeling of Sheet Metal Forming Process

Written by authorities in the subject, this book provides a complete treatment of metal forming and machining by using the computational techniques FEM, fuzzy set theory and neural networks as modelling tools. The algorithms and solved examples included make this book of value to postgraduates, senior undergraduates, and lecturers and researchers in these fields. Research and development engineers and consultants for the

manufacturing industry will also find it of use. Functioning as an introduction to modern mechanics principles and various applications that deal with the science, mathematics and technical aspects of sheet metal forming, Mechanics Modeling of Sheet Metal Forming details theoretically sound formulations based on principles of continuum mechanics for finite or large deformation, which can then be implemented into simulation codes. The forming processes of complex panels by computer codes, in

addition to extensive practical examples, are recreated throughout the many chapters of this book in order to benefit practicing engineers by helping them better understand the output of simulation software.
Sheet metal forming processes, such as brake bending, rubber forming, and punch stretch forming, have significant use in manufacturing aircraft, automotive, and appliance parts. Computer-aided modeling and simulation of these processes provides information for production

planning, for equipment and tooling selection, and for predicting potential failure during forming. Mathematical models and computer programs are developed to analyze and simulate these widely used sheet forming processes. The validity of these process models and the accuracy of the predicted results were evaluated by laboratory and production site tests.

Metal Forming - Challenges in Constitutive and Fracture Modeling

Mechanics of Materials in Modern Manufacturing

Methods and Processing Techniques

Theory, Verification, and Application : Proceedings of a Symposium Sponsored by the Metallurgical Society and the TMS Detroit Section, Held at the 12th Automotive Materials Symposium, Ann Arbor, Michigan, April 29-30, 1985

Automated Modeling and Remeshing in Metal Forming Simulation

Including FEM Analysis

Processes and Applications

This book provides a comprehensive introduction to the unique theory developed over years of

research on materials and process modelling and its application in metal forming technologies. It starts with the introduction of fundamental theories on the mechanics of materials, computational mechanics and the formulation of unified constitutive equations. Particular attention is paid to elastic–plastic formulations for cold metal forming and unified elastic–viscoplastic constitutive equations for warm/hot metals processing. Damage in metal forming and numerical techniques to

solve and determine the unified constitutive equations are also detailed. Examples are given for the application of the unified theories to solve practical problems encountered in metal forming processes. This is particularly useful to predict microstructure evolution in warm/hot metal forming processes. Crystal plasticity theories and modelling techniques with their applications in micro-forming are also introduced in the book. The book is self-contained and unified in presentation. The

explanations are highlighted to capture the interest of curious readers and complete enough to provide the necessary background material to further explore/develop new theories and applications. This publication has been written to honour the contribution to science and education made by the Distinguished Professor Emeritus Professor Schey on his eightieth birthday. The contributors to his book are among the countless researchers who have read, studied and learned from

Professor Schey's work, which includes books, research monographs, invited papers, keynote papers, scientific journals and conferences. The topics include manufacturing, sheet and bulk metal forming and tribology, amongst others. The topics included in this book include: John Schey and value-added manufacturing; Surface finish and friction in cold-metal rolling; Direct observation of interface for tribology in metal forming; An examination of the coefficient of friction;

Studies on micro plasto hydrodynamic lubrication in metal forming; Numerical simulation of sheet metal forming; Geometric and mechanics model of sheet forming; Modelling and optimisation of metal forming processes; The mathematical modelling of hot rolling steel; Identification of rheological and tribological parameters; Oxide behaviour in hot rolling; Friction, lubrication and surface response in wire drawing; and Modelling and control of temper rolling and skin pass rolling.

Ductile Fracture in Metal Forming: Modeling and Simulation examines the current understanding of the mechanics and physics of ductile fracture in metal forming processes while also providing an approach to micromechanical ductile fracture prediction that can be applied to all metal forming processes. Starting with an overview of different ductile fracture scenarios, the book then goes on to explain modeling techniques that predict a range of mechanical phenomena that can lead to ductile fracture.

The challenges in creating micromechanical models are addressed alongside methods of applying these models to several common metal forming processes. This book is suitable for researchers working in mechanics of materials, metal forming, mechanical metallurgy, and plasticity. Engineers in R&D industries involved in metal forming such as manufacturing, aerospace, and automation will also find the book very useful. Explains innovative micromechanical modeling techniques for a variety of

material behaviors Examines how these models can be applied to metal forming processes in practice, including blanking, arrowed cracks in drawing, and surface cracks in upset forging Provides a thorough examination of both macroscopic and microscopic ductile fracture theory

Fundamentals of Materials Modelling for Metals Processing Technologies

Numerical Modelling of Material Deformation Processes

Metal Forming Science and

Practice
Sheet Metal Forming
Modeling and Simulation
Metal Forming

Plasticity of Metallic Materials presents a rigorous framework for description of plasticity phenomena, classic and recent models for isotropic and anisotropic materials, new original analytical solutions to various elastic/plastic boundary value problems and new interpretations of mechanical data based on these recent models. The book covers models for metals with both cubic and hexagonal crystal structures, presents the mechanical tests required to determine the model parameters, various identification procedures, verification, and validation tests, and numerous applications to metal forming. Outlines

latest research on plastic anisotropy and its role in metal forming Presents characterization and validation tests for metals with various crystal structures Compares the predictive capabilities of various models for a variety of loadings

Advanced Modeling and Numerical Simulation

Applied Metal Forming

Research, Development and Applications

Formability, Simulation, and Tool Design

Process Modeling Applied to Metal Forming and Thermo Mechanical Processing

Computer Modeling of Metal Forming