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GIOVANNA BLANKENSHIP

Sheet Metal Forming Processes
Academic Press
Flat rolling is considered to be one of the most important and most widely used metal forming processes. This book emphasizes the importance of mathematical simulation of this process in the light of the ever in-creasing need for quality improvements through automation. Mathematical models of the hot, warm and cold rolling processes are discussed, compared and critically evaluated.

Engineers in the steel industry will find this book particularly useful in their everyday work.

Process Modeling of Sheet Metal Forming of General Shapes by the Finite Method Based on Large Strain Formulation

ASM International

This book contains the most relevant papers presented in the International Conference on Materials Forming, ESAFORM 2005. It gathers selected plenary and keynote papers presented in the conference, offering an up-to-date synthesis of the academic and industrial research in the fields of physical and numerical modeling of materials forming processes.

Applied Metal Forming

Cambridge University Press

It is the objective of the series IIMaterials Research and Engineeringll to publish information on technical facts and pro cesses together with specific scientific models and theories. Fundamental considerations assist in the recognition of the origin of properties and the roots of processes. By providing a higher level of understanding , such considerations form the basis for further improving the quality of both traditional and future engineering materials, as well as the

efficiency of industrial operations. In a more general sense, theory helps to integrate facts into a framework which ties relations between physical equilibria and mechanisms on the one hand, product development and econo mical competition on the other. Aspects of environmental compati bili ty, conservation of resources and of socio-cul tural inter action form the final horizon - a subject treated in the first ll volume of this series, llMaterials in World Perspective . The four authors of the present book endeavor to present a comprehensiv e picture of process modelling in the important field of metal forming and thermomecha nical treatment. The reader will be introduced to the rapidly-growing new field of application of computer-aided numerical methods to the quanti tative simulation of complex technical processes. Extensive use is made of the state of scientific knowledge related to materials behavior under mechanical stress and thermal treat ment.

Numerical Modelling and Simulation of Metal Processing

Springer Science & Business Media

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.

Process Modeling Applied to Metal Forming and Thermomechanical Processing

Springer Science & Business Media

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.

Sheet Metal Forming Processes

Academic Press

This book systematically introduces the principles of flexible forming technologies to manufacture thin-walled complex-shaped components, the mechanism of controlling the material flow, the design and the configuration of flexible forming technologies' equipment and tools. It covers new technologies and new processes for forming hollow components, and relevant research on forming mechanisms, deformation laws, and defect control with examples from practical applications. It will be a useful reference for researchers, engineers, graduate and undergraduate students in aerospace, nuclear, railway, vehicle and petrochemical engineering, etc.

Modelling of

Metal Forming Processes World Scientific Publishing Company 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 **Computer Modeling of Metal Forming** SAE International Micro Metal Forming, i. e. forming of parts and features with dimensions below 1 mm, is a young area of research in the wide field of metal forming technologies, expanding the limits for applying metal forming towards micro technology. The essential challenges arise from the reduced geometrical size and the increased lot size. In order to enable potential users to apply micro metal forming in production, information about the following topics are given: tribological behavior: friction between tool and work piece as well as tool wear mechanical behavior: strength and formability of the work piece material, durability of the work pieces size effects: basic description of effects occurring due to the fact, that the quantitative relation between different features changes with

decreasing size process windows and limits for forming processes tool making methods numerical modeling of processes and process chains quality assurance and metrology All topics are discussed with respect to the questions relevant to micro metal forming. The description comprises information from actual research and the young history of this technology branch to be used by students, scientists and engineers in industry who already have a background in metal forming and like to expand their knowledge towards miniaturizatio n. tribological behavior: friction between tool and work piece as well as tool wear mechanical behavior: strength and formability of the work piece material, durability of the work pieces size effects: basic description of effects occurring due to the fact, that the quantitative relation between different features changes with decreasing size process windows and limits for forming processes tool making methods numerical modeling of processes and process chains quality assurance and metrology All topics are discussed with respect to the questions relevant to micro metal forming. The description

comprises information from actual research and the young history of this technology branch to be used by students, scientists and engineers in industry who already have a background in metal forming and like to expand their knowledge towards miniaturizatio n.

Advanced Methods in Material Forming

Springer Science & Business Media

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.

Flexible Metal Forming Technologies

Elsevier

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.

Process Modelling of Metal Forming and Thermomechanical Treatment John Wiley & Sons

Modeling of Metal Forming and Machining ProcessesSpringer Science & Business Media

Metal Forming Springer 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

Modeling Ductile Damage Evolution in Metal Forming Processes
John Wiley & Sons
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.
Damage Mechanics in Metal Forming
Springer
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.

Numerical Modelling of Material Deformation Processes

Modeling of Metal Forming and Machining Processes

This book deals with metal processing and its numerical modelling and simulation. In total, 21 papers from different distinguished authors have been compiled in this area. Various processes are addressed, including solidification, TIG welding, additive manufacturing, hot and cold rolling, deep drawing, pipe deformation, and galvanizing. Material models are developed at different length scales from atomistic simulation to finite element analysis in order to describe the evolution and behavior of materials during thermal and thermomechanical treatment. Materials under consideration are carbon, Q&T, DP, and stainless steels; ductile iron; and aluminum, nickel-based, and titanium alloys. The developed models and simulations shall help to predict structure evolution, damage, and

service behavior of advanced materials.

Thermal-Mechanical Modelling of the Flat Rolling Process

Springer Science & Business Media

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 transformation s. 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. Mechanics Modeling of Sheet Metal Forming MDPI 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. Thermomechanically-Consistent Modeling of the Metals Behavior with Ductile Damage. 3. Numerical Methods for Solving Metal Forming Problems. 4. Application to Virtual Metal Forming.

Finite Element Modeling of Metal-forming Processes

Oxford University Press

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—CER TETA (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.

Metal Forming - Challenges in Constitutive and Fracture Modeling

Springer Science & Business Media

Manufacturing industries strive to improve the quality and reliability of their products,

while simultaneously reducing production costs. To do this, modernized work tools must be produced; this will enable a reduction in the duration of the product development cycle, optimization of product development procedures, and ultimately improvement in the productivity of design and manufacturing phases. Numerical simulations of forming processes are used to this end, and in this book various methods and models for forming processes (including stamping, hydroforming and additive manufacturing) are presented. The theoretical and numerical advances of these processes involving large deformation mechanics on the basis of large transformations are explored, in addition to the various techniques for optimization and calculation of reliability. The advances and techniques within this book will be of interest to professional engineers in the automotive, aerospace, defence and other industries, as well as graduates and undergraduates in these fields.

Multiscale Modelling in Sheet Metal Forming

Springer Science & Business Media

The physical modelling of metal forming

processes has been widely used both in University and in Industry for many years. Relatively simple numerical models, such as the Slab Method and the Upper Bound Method, were first used and many such models are implemented in the industry for practical design or regulation of forming processes. These are also under investigation in the University, mainly for treat models ments which require low cost calculations or very fast answers for on-line integration. More recently, sophisticated numerical methods have been used for the simulation of metal flow during forming operations. Since the early works in 1973 and 1974, mainly in U. K. and U. S. A. , the applications of the finite element method to metal processing have been developed in many laboratories all over the world. Now the numerical approach seems to be widely re cognized as a powerful tool for comprehensio n oriented studies, for predic ting the main technological parameters, and for the design and the optlmi zation of new forming sequences. There is also a very recent trend for the introduction of physical laws in the thermo-mechanical models, in order to

predict the local evolution of internal variable representing the micro structure of the metal. To day more and more practicians of the Industry are asking for compu ter models for design of their forming processes.

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