Mechanics of Sheet Metal Forming 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. The book covers topics on forming processes as well as deformation 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.

Mechanics of Sheet Metal Forming 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.

Micro Metal Forming Monitoring and control of microstructure evolution in metal processing is essential in developing the right properties in a metal. Microstructure evolution in sheet metal forming processes summarises the wealth of recent research on the mechanisms, modelling and control of microstructure evolution during forming processes. Part one reviews the general principles involved in understanding and controlling microstructure evolution in metal forming. Techniques for modelling microstructure and optimising processes are explored, along with recrystallisation, grain growth, and severe plastic deformation. Microstructure evolution in the processing of steel is the focus of part two, which reviews the modelling of phase transformations in steel, unified constitutive equations and work hardening in microalloyed steels. Part three examines microstructure evolution in the processing of other metals, including ageing behaviour in the processing of aluminium and microstructure control in processing nickel, titanium and other special alloys. With its distinguished editors and international team of expert contributors, Microstructure evolution in metal forming processes is an invaluable reference tool for metal processors and those using steels and other metals, as well as an essential guide for academics and students involved in fundamental metal research. Summarises the wealth of recent research on the mechanisms, modelling and control of microstructure evolution during metal forming processes; Provides a fully up-to-date overview of microstructure evolution and processing of steel and other metals; Examine the modelling of phase transformations in steel, unified constitutive equations and work hardening in microalloyed steels; Examines microstructure evolution in the processing of other materials, including ageing behaviour in the processing of aluminium.

Modeling of Thermo-Electro-Mechanical Manufacturing Processes

Modeling of Metal Forming and Machining Processes

Modeling and Simulation in Engineering Sciences 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 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 comprehension oriented studies, for predicting the main technological parameters, and for the design and the optimisation 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 practitioners of the Industry are asking for computer models for design of their forming processes.

Friction Modeling in Computer Simulation of Sheet Metal Forming Processes

Metal Forming The concept of virtual manufacturing has been developed in order to increase the industrial performances, being one of the most of 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 finite element method is currently the most widely used numerical procedure for simulating sheet metal forming processes. The accuracy of the simulation programs used in industry is in unced 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, finite element method as a numerical analysis instrument and constitutive laws, as well as forming limit curves as a specific 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) forms--tions used for sheet metal forming simulation, now and in the past.

Mechanics of Materials in Modern Manufacturing Methods and Processing Techniques

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 classical data on metal forming. 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.

Computer-Aided Modeling of Selected Sheet Metal Forming Processes

Process Modeling Applied to Metal Forming and Thermomechanical Processing 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.

Fundamentals of Materials Modelling for Metals Processing Technologies It is the objective of the series IIMaterials Research and Engineering to publish information on technical facts and processes 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 economic competition on the other. Aspects of environmental compatibility, conservation of resources and of socio-cultural interaction form the final horizon - a subject treated in the first II volume of this series, IIMaterials in World Perspective. The four authors of the present book endeavor to present a comprehensive picture of process modelling in the important field of metal forming and thermomechanical treatment. The reader will be introduced to the rapidly-growing new field of application of computer-aided numerical methods to the quantative simulation of complex technical processes. Extensive use is made of the state of scientific knowledge related to materials behavior under mechanical stress and thermal treatment.

Modelling of Metal Forming Processes

Computer Modeling of Sheet Metal Forming Processes 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 that introduce the reader to computer simulations that are applied to manufacturing processes 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 data sets 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 state of the art in manufacturing and the potential 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.

Modeling Ductile Damage Evolution in Metal Forming Processes 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.

Sheet Metal Forming

Computer Modeling of Metal Forming

Process and Materials Modeling in Metal Forming

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

Inclusions applies, worked examples and detailed techniques

Sheet Metal Forming Processes 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 recent 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.

Microstructure Evolution in Metal Forming Processes This book presents 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. Chapter 5 describes advanced models for the prediction of forming limit curves developed by the authors. Chapter 6 is devoted to anisotropic damage in elastoplastic 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. Results are useful to postgraduate students, researchers and engineers who are interested in the mechanical modelling and numerical simulation of sheet metal forming processes.

Modelling and Simulation of Sheet Metal Forming Processes

Modeling and Optimization in Manufacturing 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 laws. 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.

Metal Forming

Modeling of Behavior in Metal Forming This book provides a comprehensive introduction to the unique theory developed over years of research on materials and process modeling 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.

Modeling and Experimental Verification of Sheet Metal Forming Processes 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 works on the development of numerical codes and prediction tools that improve the tools in the development of virtual 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.

Metal Forming and the Finite-Element Method This Lecture Series considers process modeling which provides a new perspective to advance metal forming and thermo-mechanical processing. Working and forming processes are viewed as systems which integrate component behaviour such as workpiece flow, heat flow and friction at the workpiece-tooling interface, and microstructural evolution. These are combined to form a system process model using deformation mechanics. The Lecture Series covers extrusion, forging, rolling, and sheet forming processes. It will provide specific results for light metals, steels and superalloys and introduce finite element methods and related aspects of computer-aided process design. The Lecture Series was sponsored by the Structures and Materials Panel and organized by the Consultant and Exchange Program of AGARD.

Computer Modeling of Sheet Metal Forming Process

Process Modeling Applied to Metal Forming and Thermo Mechanical Processing

Modeling of Sheet Metal Forming


Process Modelling of Metal Forming and Thermomechanical Treatment

Finite Element Method

Polymer Injection Sheet Metal Forming - Experiments and Modeling 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 an overview of the 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 miniaturization.
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 miniaturization.

Multiscale Modelling in Sheet Metal Forming The book entitled Finite Element Method: Simulation, Numerical Analysis, and Solution Techniques aims to present results of the applicative research performed using FEM in various engineering fields by researchers affiliated to well-known universities. The book has a profound interdisciplinary character and is mainly addressed to researchers, PhD students, graduate and undergraduate students, teachers, engineers, as well as all other readers interested in the engineering applications of FEM. I am confident that readers will find information and challenging topics of high academic and scientific level, which will encourage them to enhance their knowledge in this engineering domain having a continuous expansion. The applications presented in this book cover a broad spectrum of finite element applications starting from mechanical, electrical, or energy production and finishing with the successful simulation of severe meteorological phenomena.

Ductile Fracture in Metal Forming This book features state-of-the-art contributions in mathematical, experimental and numerical simulations in engineering sciences. The contributions in this book, which comprise twelve chapters, are organized in six sections spanning mechanical, aerospace, electrical, electronic, computer, materials, geotechnical and chemical engineering. Topics include metal micro-forming, compressible reactive flows, radio frequency circuits, barrier infrared detectors, fiber Bragg and long-period fiber gratings, semiconductor modelling, many-core architecture computers, laser processing of materials, alloy phase decomposition, nanofluids, geo-materials and rheokinetics. Contributors are from Europe, China, Mexico, Malaysia and Iran. The chapters feature many sophisticated approaches including Monte Carlo simulation, FLUENT and ABAQUS computational modelling, discrete element modelling and partitioned frequency-time methods. The book will be of interest to researchers and also consultants engaged in many areas of engineering simulation.

Plasticity of Metallic Materials 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.

Damage Mechanics in Metal Forming 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

Copyright code: e490992a7586804cc9ee253b217c08d1