# Thermo Mechanical Industrial Processes

An abridgement of a 17-volume set of instructional materials, this guide offers brief descriptions of some 130 manufacturing processes, tools, and materials in such areas a mechanical, thermal, and chemical reducing; consolidation; deformation; and thermal joining. Includes numerous tables and illustrations. Annotation copyright by Book News, Inc., Portland, OR

III European Conference on Computational Mechanics: Solids, Structures and Coupled Problem in Engineering Computational Mechanics in Solid, Structures and Coupled Problems in Engineering is today a mature science with applications to major industrial projects. This book contains the edited version of the Abstracts of Plenary and Keynote Lectures and Papers, and a companion CD-ROM with the full-length papers, presented at the III European Conference on Computational Mechanics: Solids, Structures and Coupled Problems in Engineering (ECCM-2006), held in the National Laboratory of Civil Engineering, Lisbon, Portugal 5th - 8th June 2006. The book reflects the state-of-art of Computation Mechanics in Solids, Structures and Coupled Problems in Engineering and it includes contributions by the world most active researchers in this field.

The numerical simulation of manufacturing processes and of their mechanical consequences is of growing interest in industry. However, such simulations need the modeling of couplings between several physical phenomena such as heat transfer, material transformations and solid or fluid mechanics, as well as to be adapted to numerical methodologies. This book gathers a state of the art on how to simulate industrial processes, what data are needed and what numerical simulation can bring. Assembling processes such as welding and friction stir welding, material removal processes, elaboration processes of composite structures, sintering processes, surface-finishing techniques, and thermo-chemical treatments are investigated. This book is the work of a group of researchers who have been working together in this field for more than 12 years. It should prove useful for both those working in industry and those studying the numerical methods applied to multiphysics problems encountered in manufacturing processes.

Conventional manufacturing processes often require a large amount of machining and cannot satisfy the continuously increasing requirements of a sustainable, low cost, and environmentally friendly modern industry. Thus, Additive Manufacturing (AM) has become an important industrial process for the manufacture of custom-made metal workpieces. Among the different AM processes, Wire and Arc Additive Manufacture (WAAM) has the ability to manufacture large, low volume metal work-pieces due to its high deposition rate. In this process, 3D metallic components are built by depositing beads of weld metal in a layer by layer fashion. However, the non-uniform expansion and contraction of the material during the thermal cycle results in residual stresses and distortion. To obtain a better understanding of the thermo-mechanical performance of the WAAM process, a study based on FE simulation was untaken in this thesis. The mechanism of the stress generation during the deposition process was analysed via a 3D transient thermo-mechanical FE model which is verified with experimental results. To be capable of analysing the thermo-mechanical behaviour of large-scale WAAM components, an efficient FE approach was developed which can significantly reduce the computational time. The accuracy of this model was validated against the transient model as well as experimental measurements. With the help of the FE models studies on different

deposition parameters, deposition sequences and deposition strategies were carried out. It has been proved that the residual stresses and the distortions are possible to be reduced by using optimised deposition parameters and sequences. In addition, a robot path generation prototype has been developed to help efficiently integrate these optimised process settings in the real-wold WAAM process.

Discrete Element Method to Model 3D Continuous Materials

Storage, Visualization and In Memory Strategies

Exergy Analysis and Optimization

Computational Materials Engineering

Jean Mandel Memorial Symposium, Paris France, 1-5 September, 1986

Modeling of Thermo-Electro-Mechanical Manufacturing Processes

***Among the most important and exciting current steps forward in geo-engineering is the development of coupled numerical models. They represent the basic physics of geo-engineering processes which can include the effects of heat, water, mechanics and chemistry. Such models provide an integrating focus for the wide range of geo-engineering disciplines. The articles within this volume were originally presented at the inaugural GeoProc conference held in Stockholm and contain a collection of unusually high quality information not available elsewhere in an edited and coherent form. This collection not only benefits from the latest theoretical developments but also applies them to a number of practical and wide ranging applications. Examples include the environmental issues around radioactive waste disposal deep in rock, and the search for new reserves of oil and gas.***

***In this book, the Commission of the European Communities presents the proceedings of the Workshop on Solar Central Receiver Projects, held in Varese, I taly , in June 1984. This Workshop was supported by all operators of solar tower power plants around the world and, as a result, these proceedings provide a comprehensive overview of the technology in its current state of development. The Workshop was organized by the Commission of the European Communities in the frame of the second solar energy R&D programme under the responsibility of its Di rectorate-General (X 11) for Science, Research and Development in Brussels. The meeting place, Varese, in Italy, was selected because of its neighbourhood to the Ispra Establishment of the Commission's Joint Research Centre who cooperated in the organization of the Workshop. Solar power plants of the central receiving type have two conflicting characteristics: they employ very simple and classical components but as a system they are of tremendous complexity. It was the hope for rapid progress by using available components that guided the decisions taken in the late seventies to build six large experimental plants: four in Europe, one in Japan and one in the United States. At that time, this technology enjoyed high priority in solar energy R&D around the world. Once the plants were completed, however, it became clear that the technical complexity combined with difficult meteorological conditions at most construction sites made the yields less favourable than anticipated.***

***This book gathers a collection of papers summarizing some of the***

*latest developments in the thermomechanical processing of steels. The replacement of conventional rolling plus post-rolling heat treatments by integrated controlled forming and cooling strategies implies important reductions in energy consumption, increases in productivity and more compact facilities in the steel industry. The metallurgical challenges that this integration implies, though, are relevant and impressive developments that have been achieved over the last 40 years. The frequency of the development of new steel grades and processing technologies devoted to thermomechanically processed products is increasing, and their implementation is being expended to higher value added products and applications. In addition to the metallurgical peculiarities and relationships between chemical composition, process and final properties, the relevance impact of advanced characterization techniques and innovative modelling strategies provides new tools to achieve the further deployment of the TMCP technologies. The contents of the book cover low carbon microalloyed grades, ferritic stainless steels and Fe-Al-Cr alloys, medium-Mn steels, and medium carbon grades. Authors of the chapters of this "Thermomechanical Processing of Steels" book represent some of the most relevant research groups from both the steel industry and academia.*

*Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems provides unique and comprehensive guidelines on all non-battery energy storage technologies, including their technical and design details, applications, and how to make decisions and purchase them for commercial use. The book covers all short and long-term electric grid storage technologies that utilize heat or mechanical potential energy to store electricity, including their cycles, application, advantages and disadvantages, such as round-trip-efficiency, duration, cost and siting. Also discussed are hybrid technologies that utilize hydrogen as a storage medium aside from battery technology. Readers will gain substantial knowledge on all major mechanical, thermal and hybrid energy storage technologies, their market, operational challenges, benefits, design and application criteria. Provide a state-of-the-art, ongoing R&D review Covers comprehensive energy storage hybridization tactics Features standalone chapters containing technology advances, design and applications*

*Thermo-Mechanical Solar Power Plants*

*Energy Materials Coordinating Committe (EMaCC): Fiscal Year 2002 Annual Technical Report*

*Thermo-Mechanical Aspects Of Manufacturing And Materials Processing Milling Simulation*

*III European Conference on Computational Mechanics*

*3D Discrete Element Workbench for Highly Dynamic Thermo-mechanical Analysis*

Thermomechanical Industrial ProcessesModeling and Numerical SimulationJohn Wiley & Sons

Covering thermomechanical aspects of manufacturing and materials processing, this volume provides basic fundamentals for understanding and analyzing various

manufacturing processes and materials processing. It covers metal casting, metal forming, metal cutting, and the experimental tools available for solving problems of practical significance. It explores areas of future research and identifies problem areas with a view to minimizing energy losses and maximizing cost effective manufacture of industrial goods.

Numerical simulation is a technique of major importance in various technical and scientific fields. Used to understand diverse physical phenomena or to design everyday objects, it plays a major role in innovation in the industrial sector. Whilst engineering curricula now include training courses dedicated to it, numerical simulation is still not well-known in some economic sectors, and even less so among the general public. Simulation involves the mathematical modeling of the real world, coupled with the computing power offered by modern technology. Designed to perform virtual experiments, digital simulation can be considered as an "art of prediction". Embellished with a rich iconography and based on the testimony of researchers and engineers, this book shines a light on this little-known art. It is the first of two volumes and focuses on the principles, methods and industrial practice of numerical modeling.

Three-dimensional surface meshes are the most common discrete representation of the exterior of a virtual shape. Extracting relevant geometric or topological features from them can simplify the way objects are looked at, help with their recognition, and facilitate description and categorization according to specific criteria. This book adopts the point of view of discrete mathematics, the aim of which is to propose discrete counterparts to concepts mathematically defined in continuous terms. It explains how standard geometric and topological notions of surfaces can be calculated and computed on a 3D surface mesh, as well as their use for shape analysis. Several applications are also detailed, demonstrating that each of them requires specific adjustments to fit with generic approaches. The book is intended not only for students, researchers and engineers in computer science and shape analysis, but also numerical geologists, anthropologists, biologists and other scientists looking for practical solutions to their shape analysis, understanding or recognition problems.

Emerging Trends, Concepts and Technologies

Metal Milling Mechanics, Dynamics and Clamping Principles

Topology Optimization Design of Heterogeneous Materials and Structures

GranOO

Nanotechnology in the Automotive Industry

Mesh Adaptation for Computational Fluid Dynamics, Volume 1

**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.**

**Presents the most up-to-date information on the state of Materials Fabrication, Properties, Characterization, and Modeling. It's a great mix of practical applied technology and hard science, which is of invaluable benefit to the global industry.**

**The need to reduce the ecological footprint of water/land/air vehicles in this era of climate change requires pushing the limits regarding the development of lightweight structures and materials. This requires a thorough understanding of their thermomechanical behavior at several stages of the production chain. Moreover, during service, the response of lightweight alloys under the simultaneous influence of mechanical loads and temperature can determine the lifetime and performance of a multitude of structural components. The present Special Issue, comprising eight original research articles, is dedicated to disseminating current efforts around the globe aimed at advancing understanding of the thermomechanical behavior of structural lightweight alloys under processing or service conditions.**

**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.**

**Thermomechanical Couplings in Solids**

**Non-conforming Coupling and Shape Optimization of Complex Multipatch Structures**

**Variational Methods for Engineers with Matlab**

**Manufacturing Processes Reference Guide**

**Mesh Adaptation for Computational Fluid Dynamics, Volume 2**

***Isogeometric analysis (IGA) consists of using the same higher-order and smooth spline functions for the representation of geometry in Computer Aided Design as for the approximation of solution fields in Finite Element Analysis. Now, about fifteen years after its creation, substantial works are being reported in IGA, which make it very competitive in scientific computing. This book provides a contemporary vision of IGA by first discussing the current challenges in achieving a true bridge between design and analysis, then proposing original solutions that answer the issues from an analytical point of view, and, eventually, studying the shape optimization of structures, which is one of the greatest applications of IGA. To handle complex structures, a full analysis-to-optimization framework is developed, based on non-invasive coupling, parallel domain decomposition and immersed geometrical modeling. This seems to be***

*very robust, taking on all of the attractive features of IGA (the design–analysis link, numerical efficiency and natural regularization), giving us the opportunity to explore new types of design. Triangulations, and more precisely meshes, are at the heart of many problems relating to a wide variety of scientific disciplines, and in particular numerical simulations of all kinds of physical phenomena. In numerical simulations, the functional spaces of approximation used to search for solutions are defined from meshes, and in this sense these meshes play a fundamental role. This strong link between the meshes and functional spaces leads us to consider advanced simulation methods in which the meshes are adapted to the behaviors of the underlying physical phenomena. This book presents the basic elements of this meshing vision.*

*This book is issued from a 30 years' experience on the presentation of variational methods to successive generations of students and researchers in Engineering. It gives a comprehensive, pedagogical and engineer-oriented presentation of the foundations of variational methods and of their use in numerical problems of Engineering. Particular applications to linear and nonlinear systems of equations, differential equations, optimization and control are presented. MATLAB programs illustrate the implementation and make the book suitable as a textbook and for self-study. The evolution of knowledge, of the engineering studies and of the society in general has led to a change of focus from students and researchers. New generations of students and researchers do not have the same relations to mathematics as the previous ones. In the particular case of variational methods, the presentations used in the past are not adapted to the previous knowledge, the language and the centers of interest of the new generations. Since these methods remain a core knowledge – thus essential - in many fields (Physics, Engineering, Applied Mathematics, Economics, Image analysis …), a new presentation is necessary in order to address variational methods to the actual context.*

*Complex behavior models (plasticity, cracks, visco elascticity) face some theoretical difficulties for the determination of the behavior law at the continuous scale. When homogenization fails to give the right behavior law, a solution is to simulate the material at a meso scale in order to simulate directly a set of discrete properties that are responsible of the macroscopic behavior. The discrete element model has been developed for granular material. The proposed set shows how this method is capable to solve the problem of complex behavior that are linked to discrete meso scale effects. This first book solves the local problem, the second one presents a coupling approach to*

*link the structural effects to the local ones, the third book presents the software workbench that includes all the theoretical developments.*

*Proceedings of the Second International Workshop on the Design, Construction and Operation of Solar Central Receiver Projects, Varese, Italy, 4–8 June, 1984*

*Severe Plastic Deformation and Thermomechanical Processing: Nanostructuring and Properties*

*Thermomechanical Fatigue Behavior of Materials*

*Thermo-Mechanical Behaviour of Structural Lightweight Alloys*

*Meshing, Geometric Modeling and Numerical Simulation 3*

*The Efficiency of Industrial Processes*

*Reliable scheduling in cutting conditions is very important in machining processes, and this requires thorough understanding of the physical behaviors of the machining process, which cannot be achieved without understanding the underlying mechanism of the processes. The book describes the mechanics and dynamics together with the clamping principles in milling processes, and can be used as a guideline for graduate students and research engineers who wish to be effective manufacture engineers and researchers. Many books have focused on common principles, which are suitable for general machining processes, e.g., milling, turning and drilling, etc. This book specifically aims at exploring the mechanics and dynamics of milling processes. Original theoretical derivations and new observations on static cutting force models, dynamic stability models and clamping principles associated with milling processes are classified and detailed. The book is indented as a text for graduate students and machining engineers who wish to intensively learn milling mechanism and machine tool vibration.*

*Simulation technology, and computational fluid dynamics (CFD) in particular, is essential in the search for solutions to the modern challenges faced by humanity. Revolutions in CFD over the last decade include the use of unstructured meshes, permitting the modeling of any 3D geometry. New frontiers point to mesh adaptation, allowing not only seamless meshing (for the engineer) but also simulation certification for safer products and risk prediction. Mesh Adaptation for Computational Dynamics 1 is the first of two volumes and introduces basic methods such as feature-based and multiscale adaptation for steady*

*models. Also covered is the continuous Riemannian metrics formulation which models the optimally adapted mesh problem into a pure partial differential statement. A number of mesh adaptative methods are defined based on a particular feature of the simulation solution. This book will be useful to anybody interested in mesh adaptation pertaining to CFD, especially researchers, teachers and students.*
*Thermo-Mechanical Processing of Metallic Materials describes the science and technology behind modern thermo-mechanical processing (TMP), including detailed descriptions of successful examples of its application in the industry. This graduate-level introductory resource aims to fill the gap between two scientific approaches and illustrate their successful linkage by the use of suitable modern case studies. The book is divided into three key sections focusing on the basics of metallic materials processing. The first section covers the microstructural science base of the subject, including the microstructure determined mechanical properties of metals. The second section deals with the current mechanical technology of plastic forming of metals. The concluding section demonstrates the interaction of the first two disciplines in a series of case studies of successful current TMP processing and looks ahead to possible new developments in the field. This text is designed for use by graduate students coming into the field, for a graduate course textbook, and for Materials and Mechanical Engineers working in this area in the industry. * Covers both physical metallurgy and metals processing * Links basic science to real everyday applications * Written by four internationally-known experts in the field*
*Numerical simulation is a technique of major importance in various technical and scientific fields. Whilst engineering curricula now include training courses dedicated to it, numerical simulation is still not well-known in some economic sectors, and even less so among the general public. Simulation involves the mathematical modeling of the real world, coupled with the computing power offered by modern technology. Designed to perform virtual experiments, digital simulation can be considered as an "art of prediction". Embellished with a rich iconography and based on the testimony of researchers and engineers, this book shines a light on this little-known art. It is the second*

***of two volumes and gives examples of the uses of numerical simulation in various scientific and technical fields: agriculture, industry, Earth and universe sciences, meteorology and climate studies, energy, biomechanics and human and social sciences.***

***Achieving High Accuracy and Efficiency in Metals Processing Simulations***

***Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems***

***Form Functions, Triangulations and Geometric Modeling***

***TMS 2011 140th Annual Meeting and Exhibition, Materials Fabrication, Properties, Characterization, and Modeling***

***Meshing, Geometric Modeling and Numerical Simulation 1***

***Theory***

*Computational Materials Engineering: Achieving High Accuracy and Efficiency in Metals Processing Simulations describes the most common computer modeling and simulation techniques used in metals processing, from so-called "fast" models to more advanced multiscale models, also evaluating possible methods for improving computational accuracy and efficiency. Beginning with a discussion of conventional fast models like internal variable models for flow stress and microstructure evolution, the book moves on to advanced multiscale models, such as the CAFÉ method, which give insights into the phenomena occurring in materials in lower dimensional scales. The book then delves into the various methods that have been developed to deal with problems, including long computing times, lack of proof of the uniqueness of the solution, difficulties with convergence of numerical procedures, local minima in the objective function, and ill-posed problems. It then concludes with suggestions on how to improve accuracy and efficiency in computational materials modeling, and a best practices guide for selecting the best model for a particular application. Presents the numerical approaches for high-accuracy calculations Provides researchers with essential information on the methods capable of exact representation of microstructure morphology Helpful to those working on model classification, computing costs, heterogeneous hardware, modeling efficiency, numerical algorithms, metamodeling, sensitivity analysis, inverse method, clusters, heterogeneous architectures, grid environments, finite element, flow stress, internal variable method, microstructure evolution, and more Discusses several techniques to overcome modeling and simulation limitations, including distributed computing methods, (hyper) reduced-order-modeling techniques, regularization, statistical representation of material microstructure, and the*

*Gaussian process Covers both software and hardware capabilities in the area of improved computer efficiency and reduction of computing time*

*Triangulations, and more precisely meshes, are at the heart of many problems relating to a wide variety of scientific disciplines, and in particular numerical simulations of all kinds of physical phenomena. In Volume 1, the theoretical foundations relating to triangulations, finite element shape functions and their interpretations as geometric patches were explored. This has made it possible to build tools that make the geometric modeling of any object possible. These elements are used in Volume 2 to treat meshing problems in their different implementations. Meshing, Geometric Modeling and Numerical Simulation 3 offers technical additions to the methods seen in the first two volumes and a significant portion of this book is dedicated to mesh visualization problems and solutions, especially those with a high degree of complexity.*

*Thermo-mechanical Modeling of Additive Manufacturing provides the background, methodology and description of modeling techniques to enable the reader to perform their own accurate and reliable simulations of any additive process. Part I provides an in depth introduction to the fundamentals of additive manufacturing modeling, a description of adaptive mesh strategies, a thorough description of thermal losses and a discussion of residual stress and distortion. Part II applies the engineering fundamentals to direct energy deposition processes including laser cladding, LENS builds, large electron beam parts and an exploration of residual stress and deformation mitigation strategies. Part III concerns the thermo-mechanical modeling of powder bed processes with a description of the heat input model, classical thermo-mechanical modeling, and part scale modeling. The book serves as an essential reference for engineers and technicians in both industry and academia, performing both research and full-scale production. Additive manufacturing processes are revolutionizing production throughout industry. These technologies enable the cost-effective manufacture of small lot parts, rapid repair of damaged components and construction of previously impossible-to-produce geometries. However, the large thermal gradients inherent in these processes incur large residual stresses and mechanical distortion, which can push the finished component out of engineering tolerance. Costly trial-and-error methods are commonly used for failure mitigation. Finite element modeling provides a compelling alternative, allowing for the prediction of residual stresses and distortion, and thus a tool to investigate methods of failure mitigation prior to building.*

*Provides understanding of important components in the finite element modeling of additive manufacturing processes necessary to obtain accurate results Offers a deeper understanding of how the thermal gradients inherent in additive manufacturing induce distortion and residual stresses, and how to mitigate these undesirable phenomena Includes a set of strategies for the modeler to improve computational efficiency when simulating various additive manufacturing processes Serves as an essential reference for engineers and technicians in both industry and academia*

*Nanotechnology in the Automotive Industry explores how nanotechnology and nanomaterials are used to enhance the performance of materials and devices for automotive application by fabricating nano-alloys, nanocomposites, nano coatings, nanodevices, nanocatalysts and nanosensors. Consisting of 36 chapters in 6 parts, this new volume in the Micro and Nano Technologies series is for materials scientists, nanotechnologists and automotive engineers working with nanotechnology and nanomaterials for automotive applications. Nanotechnology is seen as one of the core technologies for the future automotive industry to sustain competitiveness. The benefits that nanotechnology brings to the automotive sector include stronger and lighter materials for increased safety and reduced fuel consumption, improved engine performance and fuel consumption for gasoline powered vehicles due to nanocatalysts, fuel additives and lubricants, and more. Discusses various approaches and techniques such as nanoalloys, nanocomposites, nanocoatings, nanodevices, nanocatalysts and nanosensors used in modern vehicles Presents the challenges and future of automotive materials Explores how nanotechnology and nanomaterials are used to enhance the performance of materials and devices for automotive applications*

*Thermomechanical Industrial Processes*

*Innovative Process Optimization Methods in Logistics*

*Solids, Structures and Coupled Problems in Engineering: Book of Abstracts*

*Thermal-Mechanical Modelling of the Flat Rolling Process*

*Energy Materials Coordinating Committe (EMaCC): Fiscal Year 2004 Annual Technical Report*

*Examples*

The broaching process remains an essential machining process when manufacturing fir tree slots in turbine disks for aircraft engines. The cost- and time-intensive experiment-based approach restricts the application of alternative cutting tool materials when broaching nickel-based alloys. Given the accuracy and computation time, the developed model-based multiscale approach presents great advantages in prediction of the broaching process and thus can accelerate the development process.

This book pursues optimal design from the perspective of mechanical properties and resistance to failure caused by cracks and fatigue. The book abandons the scale separation hypothesis and takes up phase-field modeling, which is at the cutting edge of research and is of high industrial and practical relevance. Part 1 starts by testing the limits of the homogenization-based approach when the size of the representative volume element is non-negligible compared to the structure. The book then introduces a non-local homogenization scheme to take into account the strain gradient effects. Using a phase field method, Part 2 offers three significant contributions concerning optimal placement of the inclusion phases. Respectively, these contributions take into account fractures in quasi-brittle materials, interface cracks and periodic composites. The topology optimization proposed has significantly increased the fracture resistance of the composites studied.

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, 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 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.

Hardbound. The subject of this book is the exergy analysis of the efficiency of processes involving energy and matter transformations. Efficiency is one of the most important criteria used in evaluating the performance of all types of processing plants; in particular those of the energy and chemical industries. The beauty of the exergetic approach to thermodynamic analysis is that it permits a universally applicable definition of efficiency and is free of contradictions in its treatment of numerous and diverse systems. The book provides the reader with the quantitative methods and calculations of efficiency considered to be applicable to different systems and their components. Methods, procedures and instructions for using the efficiency analysis in optimizing the performance of thermal, chemical and other industrial plants are also given. Numerous examples are used in the book to aid the reader in understanding the concepts of efficiency, exergy and thei

IGA

Geometric and Topological Mesh Feature Extraction for 3D Shape Analysis

Thermo-mechanical Analysis of Wire and Arc Additive Manufacturing Process Modeling and Numerical Simulation

Unsteady and Goal-oriented Adaptation

Energy Materials Coordinating Committe (EMaCC): Fiscal Year 2001 Annual Technical Report

Complex behavior models (plasticity, cracks, visco elascticity) face some theoretical difficulties for the determination of the behavior law at the continuous scale. When homogenization fails to give the right behavior law, a solution is to simulate the material at a meso scale in order to simulate directly a set of discrete properties that are responsible of the macroscopic behavior. The discrete element model has been developed for granular material. The proposed set shows how this method is capable to solve the problem of complex behavior that are linked to discrete meso scale effects. The first book solves the local problem, the second one presents a coupling approach to link the structural effects to the local ones, this third book presents the software workbench that includes all the theoretical developments.

Severe plastic deformation (SPD) is a very attractive research field for metallic materials because it provides new possibilities for manufacturing nanostructured materials in large quantities and allows microstructural design on different hierarchical levels. The papers included in this issue address the following topics: novel SPD processes as well as recent advancements in established processing methods, microstructure evolution and grain refinement in single- and multi-phase alloys as well as composites, strategies to enhance the microstructure stability at elevated temperatures, mechanically driven phase transformations, surface nanostructuring, gradient and multilayered materials, and mechanical and physical properties of SPD-processed materials.

Simulation technology, and computational fluid dynamics (CFD) in particular, is essential in the search for solutions to the modern challenges faced by humanity. Revolutions in CFD over the last decade include the use of unstructured meshes, permitting the modeling of any 3D geometry. New frontiers point to mesh adaptation, allowing not only seamless meshing (for the engineer) but also simulation certification for safer products and risk prediction. Mesh Adaptation for Computational Dynamics 2 is the second of two volumes and introduces topics including optimal control formulation, minimizing a goal function, and extending the steady algorithm to unsteady physics. Also covered are multi-rate strategies, steady inviscid flows in aeronautics and an extension to viscous flows. This book will be useful to anybody interested in mesh adaptation pertaining to CFD, especially researchers, teachers and students.

Thermomechanical Processing of Steels

Coupled Thermo-Hydro-Mechanical-Chemical Processes in Geo-systems

Continuous Riemannian Metrics and Feature-based Adaptation

Thermo-Mechanical Modeling of Additive Manufacturing

Thermo-Mechanical Processing of Metallic Materials

Multiscale Modeling of Thermomechanical Loads in the Broaching of Direct Aged Inconel 718