

Prakash M. Dixit
Uday S. Dixit

Engineering Materials
and Processes

Modeling of Metal Forming and Machining Processes

by Finite Element and
Soft Computing Methods



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By Finite Element And Soft Computing Methods
Engineering Materials And Processes

Henry S. Valberg



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

Modeling of Metal Forming and Machining Processes Prakash Mahadeo Dixit, U.S. Dixit, 2008-05-14 The use of computational techniques is increasing day by day in the manufacturing sector. Process modeling and optimization with the help of computers can reduce expensive and time consuming experiments for manufacturing good quality products. Metal forming and machining are two prominent manufacturing processes. Both of these processes involve large deformation of elasto plastic materials due to applied loads. In metal forming the material is plastically deformed without causing fracture. On the other hand in machining the material is deformed till fracture in order to remove material in the form of chips. To understand the physics of metal forming and machining processes one needs to understand the kinematics of large deformation, dependence of deformation and its rate on displacement as well as the constitutive behavior of elasto plastic materials, dependence of internal forces on deformation and its rate. Once the physics is understood these phenomena have to be converted to mathematical relations in the form of differential equations. The interaction of the work piece with the tools, dies and other surroundings also needs to be expressed in a mathematical form known as the boundary and initial conditions. In this book the first four chapters essentially discuss the physics of metal forming and machining processes. The physical behavior of the work piece during the processes is modeled in the form of differential equations and boundary and initial conditions.

Soft Computing in Smart Manufacturing Tatjana Sibalija, J. Paulo Davim, 2021-12-06 This book aims at addressing the challenges of contemporary manufacturing in Industry 4.0 environment and future manufacturing aka Industry 5.0 by implementing soft computing as one of the major sub fields of artificial intelligence. It contributes to development and application of the soft computing systems including links to hardware, software and enterprise systems in resolving modern manufacturing issues in complex, highly dynamic and globalized industrial circumstances. It embraces heterogeneous complementary aspects such as control, monitoring and modeling of different manufacturing tasks including intelligent robotic systems and processes addressed by various machine learning and fuzzy techniques, modeling and parametric optimization of advanced conventional and non conventional eco friendly manufacturing processes by using machine learning and evolutionary computing techniques, cybersecurity framework for Internet of Things based systems, addressing trustworthiness and resilience in machine to machine and human machine collaboration, static and dynamic digital twins integration and synchronization in a smart factory environment, STEP NC technology for a smart machine vision system and integration of Open CNC with Service Oriented Architecture for STEP NC monitoring system in a smart manufacturing. Areas of interest include but are not limited to applications of soft computing to address the following: dynamic process system modeling and simulation, dynamic process system parametric optimization, dynamic planning and scheduling, smart predictive maintenance, intelligent and autonomous systems, improved machine cognition, effective digital

twins integration human machine collaboration robots and cobots Mechanics of Materials in Modern Manufacturing Methods and Processing Techniques Vadim Silberschmidt, 2020-04-03 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 **Microfabrication and Precision Engineering** J. Paulo Davim, J Paulo Davim, 2016-11-19 Microfabrication and precision engineering is an increasingly important area relating to metallic polymers ceramics composites biomaterials and complex materials Micro electro mechanical systems MEMS emphasize miniaturization in both electronic and mechanical components Microsystem products may be classified by application and have been applied to a variety of fields including medical automotive aerospace and alternative energy Microsystems technology refers to the products as well as the fabrication technologies used in production With detailed information on modelling of micro and nano scale cutting as well as innovative machining strategies involved in microelectrochemical applications microchannel fabrication as well as underwater pulsed Laser beam cutting among other techniques Microfabrication and Precision Engineering is a valuable reference for students researchers and professionals in the microfabrication and precision engineering fields Contains contributions by top industry experts Includes the latest techniques and strategies Special emphasis given to state of the art research and development in microfabrication and precision engineering Computational Methods for Optimizing Manufacturing Technology: Models and Techniques Davim, J. Paulo, 2012-02-29 This book contains the latest research developments in manufacturing technology and its optimization and demonstrates the fundamentals of new computational approaches and the range of their potential application Provided by publisher **Applied Metal Forming** Henry S. Valberg, 2010-03-31 A professional reference for advanced courses in two of the most common manufacturing processes metal forming and metal cutting **Dynamic Methods and Process Advancements in Mechanical, Manufacturing, and Materials Engineering** Davim, J. Paulo, 2012-07-31 Engineering and design are often a necessary steps for an industry to become effective Industry modeling can help to bridge the

communication gap among engineers and system designers Dynamic Methods and Process Advancements in Mechanical Manufacturing and Materials Engineering examines the principles of physics and materials science for analysis design manufacturing and maintenance of mechanical equipments and systems Targeting researchers practitioners and academicians this volume promotes innovative findings in mechanical manufacturing and materials engineering **Welding Technology** J. Paulo Davim, 2021-02-12 This book presents some developments in the field of welding technology It starts with classical welding concepts covering then new approaches Topics such as ultrasonic welding robots welding defects and welding quality control are presented in a clear didactic way Lower temperature metal joining techniques such as brazing and soldering are highlighted as well *Plasticity* P.M. Dixit, U.S. Dixit, 2014-10-23 All materials undergo some deformation under the application of a load When the load is removed a solid material may return to its original state or retain some deformation Plasticity Fundamentals and Applications places emphasis on the fundamentals of elastic plastic deformation This book includes topics such as stress strain constitutive relations fracture anisotropy and contact problems In addition the text also provides a discussion of updated Lagrangian and Eulerian formulations **Materials Forming and Machining** J. Paulo Davim, J Paulo Davim, 2015-10-20 Materials Forming and Machining Research and Development publishes refereed high quality articles with a special emphasis on research and development in forming materials machining and its applications A large family of manufacturing processes are now involved in material formation with plastic deformation and other techniques commonly used to change the shape of a workpiece Materials forming techniques discussed in the book include extrusion forging rolling drawing sheet metal forming microforming hydroforming thermoforming and incremental forming among others In addition traditional machining non traditional machining abrasive machining hard part machining high speed machining high efficiency machining and micromachining are also explored proving that forming technologies and machining can be applied to a wide variety of materials Presents the family of manufacturing processes involved in material formation Includes traditional and non traditional machining methods Consists of high quality refereed articles by researchers from leading institutions Places special emphasis on research and development in forming materials and machining and its applications Finite Element Method in Machining Processes Angelos P. Markopoulos, 2012-08-04 Finite Element Method in Machining Processes provides a concise study on the way the Finite Element Method FEM is used in the case of manufacturing processes primarily in machining The basics of this kind of modeling are detailed to create a reference that will provide guidelines for those who start to study this method now but also for scientists already involved in FEM and want to expand their research A discussion on FEM formulations and techniques currently in use is followed up by machining case studies Orthogonal cutting oblique cutting 3D simulations for turning and milling grinding and state of the art topics such as high speed machining and micromachining are explained with relevant examples This is all supported by a literature review and a reference list for further study As FEM is a key method for

researchers in the manufacturing and especially in the machining sector Finite Element Method in Machining Processes is a key reference for students studying manufacturing processes but also for industry professionals *Modern Mechanical Engineering* J. Paulo Davim, 2014-01-07 This book covers modern subjects of mechanical engineering such as nanomechanics and nanotechnology mechatronics and robotics computational mechanics biomechanics alternative energies sustainability as well as all aspects related with mechanical engineering education The chapters help enhance the understanding of both the fundamentals of mechanical engineering and its application to the solution of problems in modern industry This book is suitable for students both in final undergraduate mechanical engineering courses or at the graduate level It also serves as a useful reference for academics mechanical engineering researchers mechanical materials and manufacturing engineers professionals in related with mechanical engineering *Simulations for Design and Manufacturing* Uday S. Dixit, Ravi Kant, 2018-04-19 This book focuses on numerical simulations of manufacturing processes discussing the use of numerical simulation techniques for design and analysis of the components and the manufacturing systems Experimental studies on manufacturing processes are costly time consuming and limited to the facilities available Numerical simulations can help study the process at a faster rate and for a wide range of process conditions They also provide good prediction accuracy and deeper insights into the process The simulation models do not require any pre simulation experimental or analytical results making them highly suitable and widely used for the reliable prediction of process outcomes The book is based on selected proceedings of AIMTDR 2016 The chapters discuss topics relating to various simulation techniques such as computational fluid dynamics heat flow thermo mechanical analysis molecular dynamics multibody dynamic analysis and operational modal analysis These simulation techniques are used to 1 design the components 2 to investigate the effect of critical process parameters on the process outcome 3 to explore the physics of the process 4 to analyse the feasibility of the process or design and 5 to optimize the process A wide range of advanced manufacturing processes are covered including friction stir welding electro discharge machining electro chemical machining magnetic pulse welding milling with MQL minimum quantity lubrication electromagnetic cladding abrasive flow machining incremental sheet forming ultrasonic assisted turning TIG welding and laser sintering This book will be useful to researchers and professional engineers alike *Inelasticity Of Materials: An Engineering Approach And A Practical Guide* Arun R Srinivasa, Sivakumar M Srinivasa, 2009-07-09 With the advent of a host of new materials ranging from shape memory alloys to biomaterials to multiphase alloys acquiring the capacity to model inelastic behavior and to choose the right model in a commercial analysis software has become a pressing need for practicing engineers Even with the traditional materials there is a continued emphasis on optimizing and extending their full range of capability in the applications This textbook builds upon the existing knowledge of elasticity and thermodynamics and allows the reader to gain confidence in extending one's skills in understanding and analyzing problems in inelasticity By reading this textbook and working through the assigned exercises the reader will gain a level of comfort and

competence in developing and using inelasticity models Thus the book serves as a valuable book for practicing engineers and senior level undergraduate graduate level students in the mechanical civil aeronautical metallurgical and other disciplines The book is written in three parts Part 1 is primarily focused on lumped parameter models and simple structural elements such as trusses and beams This is suitable for an advanced undergraduate class with just a strength of materials background Part II is focused on small deformation multi dimensional inelasticity and is suitable for a beginning graduate class Sufficient material is included on how to numerically implement an inelastic model and solve either using a simple stress function type of approach or using commercial software Case studies are included as examples There is also an extensive discussion of thermodynamics in the context of small deformations Part III focuses on more advanced situations such as finite deformation inelasticity thermodynamical ideas and crystal plasticity More advanced case studies are included in this part This textbook takes a new task or scenario based approach to teaching and learning inelasticity The book is written in an active learning style that appeals to engineers and students who wish to design or analyze structures and components that are subject to inelasticity The book incorporates thermodynamical considerations into the modeling right from an early stage Extensive discussions are provided throughout the book on the thermodynamical underpinnings of the models This textbook is the first to make extensive use of MATLAB to implement many inelasticity models It includes the use of concepts such as Airy stress functions to solve plane problems for inelastic materials The MATLAB codes are listed in the appendix for one to modify with their own models and requirements Step by step procedures for formulations and calculations are provided for the reader to readily adapt to the inelastic problems that he or she attempts to solve A large number of problems exercises and projects for one to teach or learn from are included These can be assigned as homework in class exercises or projects The book is written in a modular fashion which provides adequate flexibility for adaptation in classes that cater to different audiences such as senior level students graduate students research scholars and practicing engineers

Using Computational Intelligence for Sustainable Manufacturing of Advanced Materials Muduli, Kamalakanta, Moharana, Bikash Ranjan, Ales, Steve Korakan, Biswal, Dillip Kumar, 2025-04-23 The shift toward sustainable manufacturing is vital for addressing the pressing environmental challenges of the 21st century By integrating sustainability principles manufacturing processes can minimize resource consumption reduce greenhouse gas emissions and extend product lifecycles This approach emphasizes designing for regeneration using eco friendly materials and adopting advanced digital technologies like artificial intelligence AI Internet of Things IoT and blockchain to optimize production and promote environmental stewardship Sustainable manufacturing not only mitigates ecological harm but also fosters innovation enhances competitiveness and supports long term economic and societal resilience Adopting such practices is essential for transitioning to a more responsible and sustainable global economy *Using Computational Intelligence for Sustainable Manufacturing of Advanced Materials* highlights how the application of computational intelligence techniques can promote resource and environmental

sustainability in manufacturing systems and operational practices It further examines how sustainable practices and advanced technologies in materials manufacturing can revolutionize production processes while minimizing environmental impact and promoting resource efficiency Covering topics such as energy storage nanoparticles and biomaterials this book is an excellent resource for computer scientists business professionals manufacturers environmentalists researchers professionals scholars academicians and more

4th Mechanical and Manufacturing Engineering Al Emran Ismail,Nik Hisyamudin Muhd Nor,Mas Fauzi Mohd Ali,Rosli Ahmad,Ibrahim Masood,Abdul Latif Mohd Tobi,Mohammad Fahmi Abdul Ghafir,Musli Mohammad,Md. Saidin Wahab,Badrul Aisham Md Zain,Waluyo Adi Siswanto,2013-12-19 Selected peer reviewed papers from the 4th International Conference on Mechanical and Manufacturing Engineering ICME 2013 December 17 18 2013 Bangi Putrajaya Malaysia

Autofrettage Processes Uday S Dixit,Seikh Mustafa Kamal,Rajkumar Shufen,2019-09-23 Autofrettage Processes Technology and Modeling deals with the technology and modeling of autofrettage processes explaining the subject in a lucid manner It highlights how the theory of plasticity and finite element modeling are applied in the modeling of autofrettage processes Aimed at senior students of mechanical production automobile and chemical engineering it has the potential to directly benefit practicing engineers and industrials owing to the inclusion of topics like thermal autofrettage Key Features Provides a general introduction to autofrettage Covers the application of theory of plasticity and finite element modeling of autofrettage processes Offers exposure to newer autofrettage processes that to date have not been implemented in industries along with useful practical data

IAENG Transactions on Engineering Sciences Sio-Iong Ao,Alan Hoi-Shou Chan,Hideki Katagiri,Li Xu,2014-04-07 Two large international conferences on Advances in Engineering Sciences were held in Hong Kong March 13 15 2013 under the International MultiConference of Engineers and Computer Scientists IMECS 2013 and in London U K 3 5 July 2013 under the World Congress on Engineering 2013 WCE 2013 respectively IMECS 2013 and WCE 2013 were organize

Damage Mechanics in Metal Forming Khemais Saanouni,2013-02-04 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 Hybrid Micromachining and Microfabrication Technologies Sandip Kumar, Golam Kibria, Prasenjit Chatterjee, Asma Perveen, 2023-05-04 HYBRID MICROMACHINING and MICROFABRICATION TECHNOLOGIES The book aims to provide a thorough understanding of numerous advanced hybrid micromachining and microfabrication techniques as well as future directions providing researchers and engineers who work in hybrid micromachining with a much appreciated orientation The book is dedicated to advanced hybrid micromachining and microfabrication technologies by detailing principals techniques processes conditions research advances research challenges and opportunities for various types of advanced hybrid micromachining and microfabrication It discusses the mechanisms of material removal supported by experimental validation Constructional features of hybrid micromachining setup suitable for industrial micromachining applications are explained Separate chapters are devoted to different advanced hybrid micromachining and microfabrication to design and development of micro tools which is one of the most vital components in advanced hybrid micromachining and which can also be used for various micro and nano applications Power supply and other major factors which influence advanced hybrid micromachining processes are covered and research findings concerning the improvement of machining accuracy and efficiency are reported

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