
Book Reviews

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1 Maraging Steels, Modelling of Microstructure, Properties and Applications

by: W. Sha and Z. Guo

Published 2009

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Great Abington, Cambridge CB21 6AH, UK**

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Maraging steels are high-strength steels combined with good toughness. They are used particularly in aerospace and tooling applications. Maraging refers to the ageing of martensite, a hard microstructure commonly found in steels.

This book is a research monograph, accumulating the experience of many years research by the authors. It includes more recent results, since 2000, but also covers relevant, recent work by other researchers around the world. The book includes both conventional maraging steels and precipitation hardened (PH) stainless steels.

Research papers are the backbone of this book, but the underlying structure of the book is based on the physical metallurgical phenomena of the maraging process. In addition, other researchers work is reviewed and the major results presented and discussed.

Maraging steels: modelling of microstructure, properties and applications covers the following topics: introduction to maraging steels; microstructure of maraging steels; mechanical properties of maraging steels; thermodynamic calculations for quantifying the phase fraction and element partition in maraging systems and precipitation hardening steels; quantification of phase transformation kinetics in maraging steels; quantification of age hardening in maraging steels; maraging steels and overageing; precipitation hardening stainless steel; applications of artificial neural network to modelling maraging steel properties.

With its distinguished authors, *Maraging steels: modelling of microstructure, properties and applications* will be a standard reference for industry and researchers concerned with maraging steels and modelling as well as users of maraging steels in the aerospace and tooling sectors. The book includes both conventional maraging steels and precipitation hardened (PH) stainless steels.

The book on this subject is very much needed and it is hoped that this book will be welcomed by academics and industrialists alike.

The book contains the following chapters:

- Introduction to maraging steels
- Microstructure of maraging steels
- Mechanical properties of maraging steels
- Thermodynamic calculations for quantifying the phase fraction and element partition in maraging systems and precipitation hardening steels
- Quantification of phase transformation kinetics in maraging steels
- Quantification of age hardening in maraging steels
- Maraging steels and overageing
- Precipitation hardening stainless steels
- Applications of artificial neural network to modelling steel properties.

The book is primarily intended for researchers who are interested in either maraging steels or modelling. The maraging steels expert will be able to learn modelling and apply this increasingly important technique in their maraging steels research and development. The modelling expert will be able to apply their modelling expertise to the remarkable material that is maraging steel. The idea behind this book is to combine modelling and maraging steel into one place.

2 Battery Management Systems for Large Lithium-Ion Battery Packs

by: F.D. Andrea

Published 2010

by Artech house, Boston, London, 685 Canton Street

Norwood, MA 02062, USA, 290pp

ISBN: 13: 978-1-60807-104-3

This book is about control systems and electronics, and not about chemist cells are seen as black boxes and only in terms of their equivalent electrical circuit. In general, it is written for the reader with a basic understanding of physics and technology.

This book is divided into six chapters, starting from general concepts and then progressively getting into deeper, more practical details.

Book chapters cover the following issues:

- Li-Ion cells, BMS concepts, and the need for a Li-Ion BMS
- BMS options: functionality, technology, and topology
- The functions that may be found in a BMS
- Commercially available BMS solutions

- BMS electronics and algorithms
- Deployment of a Li-Ion BMS.

Lithium-ion cells have been the workhorse of small batteries for consumer products and are now starting to supplant lead-acid batteries and NiMH cells in large packs for applications such as vehicle traction packs and land-based distributed energy storage.

Compared to other chemistries, Li-Ion cells perform wonderfully, but only if treated well; hence, they require an effective battery management system or large Li-Ion battery pack.

3 Time Series, Applications to Finance with R and S-Plus

by: N.H. Chan

Published 2010

by WILEY, John Wiley & Sons, Inc. Hoboken, New Jersey

111 River Street, Hoboken, NJ 07030-5774, USA, 296pp

ISBN: 978-0-470-58362-3

This textbook evolved in conjunction with teaching a course in time series analysis at Carnegie Mellon University and the Chinese University of Hong Kong. There are two unique features of this program that differ from those of a traditional statistics curriculum.

First, students in the program have diversified backgrounds. Many of them have worked in the finance world in the past, and some have had extensive trading experiences. On the other hand, a substantial number of these students have already completed their PhD degrees in theoretical disciplines such as pure mathematics or theoretical physics. The common denominator between these two groups of students is that they all want to analyse data the way a statistician does.

Second, the course is designed to be fast-paced and concise. Only six weeks of three-hour lectures are devoted to covering the first nine chapters of the text. After completing the course, students are expected to have acquired a working knowledge of modern time series techniques.

As result, a set of lecture notes that balances theory and applications, particularly within the financial domain, has been developed. The current text is the consequence of several iterations of these lecture notes. In developing the book a number of features have been emphasised.

The first seven chapters cover the standard topics in statistical time series, but at a much higher and more succinct level. Technical details are left to the references, but important ideas are explained in a conceptual manner. By introducing time series in this way, both students with a strong theoretical background and those with strong practical motivations get excited about the subject early on.

Many recent developments in non-standard time series techniques, such as univariate and multivariate GARCH, state space modelling, co-integrations, and common trends, are discussed and illustrated with real finance examples in the last six chapters. Although many of these recent developments have found applications in financial econometrics, they are less well understood among practitioners of finance.

To the extent possible, almost all of the examples are illustrated through SPLUS programs, with detailed analyses and explanations of the SPLUS commands. Readers will be able to reproduce the analyses by replicating some of the empirical works and testing alternative models so as to facilitate and understanding of the subject.

The author also supplies a new presentation of statistical arbitrage that includes discussion of pairs trading and co-integration. In addition to standard topics such as forecasting and spectral analysis, real-world financial examples are used to illustrate recent developments in non-standard techniques, including:

- non-stationarity
- heteroscedasticity
- multivariate time series
- state space modelling and stochastic volatility
- multivariate GARCH
- co-integration and common trends.

The book's succinct and focused organisation allows readers to grasp the important ideas of time series. All examples are systematically illustrated with S-Plus[®] and R software, highlighting the relevance of time series in financial applications. End-of-chapter exercises and selected solutions allow readers to test their comprehension of the presented material, and a related website features additional datasets.

4 Contact Problems in Elasticity: A Study of Variational Inequalities and Finite Element Methods

by: N. Kikuchi and J.T. Oden

Published 1998

by SIAM Society for Industrial and Applied Mathematics

3600 University City Science Center, Philadelphia

PA 19104-2688, USA, 509pp

ISBN: 0-89871-468-0

The contact of one deformable body with another lies at the heart of almost every mechanical structure. Here, in a comprehensive treatment, two of the field's leading researchers present a systematic approach to contact problems. Using variational formulations, Kikuchi and Oden derive a multitude of results, both for classical problems and for non-linear problems, involving large deflections and buckling of thin plates with unilateral supports, dry friction with non-classical laws, large elastic and elastoplastic deformations with frictional contact, dynamic contacts with dynamic frictional effects, and rolling contacts. This method exposes properties of solutions obscured by classical methods, and it provides a basis for the development of powerful numerical schemes.

Among the novel results presented here are algorithms for contact problems with non-linear and non-local friction, and very effective algorithms for solving problems involving the large elastic deformation of hyperelastic bodies with general contact conditions. Also included are detailed discussions of numerical methods for non-linear materials with unilateral contact and friction, with examples of metal forming

simulations. Algorithms for the finite deformation rolling contact problem, along with a discussion of numerical examples, are also presented.

The first nine chapters of the book discuss the mathematical formulation of classical contact problems on linearly elastic bodies in which no friction is present, along with finite element approximations and numerical algorithms for solving problems of this type. In Chapters 10–14, we discuss generalisations of the theory, the complications of friction contact, various models of dry friction, and applications to static, quasi-static, and dynamic contact problems, including problems of large deformation, rolling contact, and inelastic materials. Much of this latter section represents work still very much in development and hence not fully explored from mathematical or numerical points of view. Some concluding comments and opinions are collected at the end of the volume.

5 Electromagnetic Material Interrogation Using Conductive Interfaces and Acoustic Wavefronts

by: H.T. Banks, M.W. Buksas and T. Lin

Published 2000

by SIAM Society for Industrial and Applied Mathematics

3600 University City Science Center, Philadelphia

PA 19104-2688, USA, 146pp

ISBN: 0-89871-459-1

Electromagnetic theory offers fascination and challenge from both a physical and a mathematical perspective. This monograph contains the newest results on the use of electromagnetic probes to interrogate dielectric material structures for material properties and geometry. This volume systematically exploits interface phenomena, the electrodynamics of material responses, and time-dependent interrogating signals in an integrated manner. The authors begin with basic electromagnetics, such as Maxwell's equations, and present modelling, theory, and computational results.

The book's strengths include a clear discussion of materials properties from the electromagnetic point of view, a careful formulation of the imaging problems addressed, rigorous treatment of mathematical issues, and useful illustration of computational methods and results. While confined to internal vision in one-dimensional settings, this volume will stimulate further developments in an internal vision to include two- and three-dimensional interior assessments. It is an excellent and robust source of applied mathematics and engineering research challenges for the future.

Imaging technology stands to benefit much from this research on low energy electromagnetic radiation. The use of electromagnetic pulses interacting with specially placed reflective surfaces, whether solid or acoustic, is a new dimension that will substantively impact medical imaging, subsoil investigation, and structure evaluation.

The text is accessible to the advanced undergraduate or early graduate engineering, bioengineering, geology, and mathematics or physics student. Its strengths include a clear discussion of materials properties from the electromagnetic point of view, a careful formulation of the imaging problems addressed, solid treatment of mathematical issues, and useful illustration of computational methods and results. While confined to internal vision in one-dimensional settings, this volume will stimulate further developments in

internal vision to include two- and three-dimensional interior assessments. It is an excellent and robust source of applied mathematics and engineering research challenges for the future.

6 Introduction to Derivative-free Optimization

by: A.R. Conn, K. Scheinberg and L.N. Vicente

Published 2009

by SIAM Society for Industrial and Applied Mathematics

3600 University City Science Center, Philadelphia

PA 19104-2688, USA, 277pp

ISBN: 978-0-898716-68-9

This book is the first contemporary comprehensive treatment of optimisation without derivatives, and it covers most of the relevant classes of algorithms from direct-search to model-based approaches. Readily accessible to readers with a modest background in computational mathematics, *Introduction to Derivative-Free Optimization* contains:

- a comprehensive description of the sampling and modelling tools needed for derivative-free optimisation that allow the reader to better understand the convergent properties of the algorithms and identify their differences and similarities
- analysis of convergence for modified Nelder–Mead and implicit-filtering methods as well as for model-based methods such as wedge methods and methods based on minimum-norm Frobenius models.

The book is intended for anyone interested in using optimisation on problems where derivatives are difficult or impossible to obtain. Such audiences include chemical, mechanical, aeronautical, and electrical engineers, as well as economists, statisticians, operations researchers, management scientists, biological and medical researchers, and computer scientists. It is also appropriate for use in an advanced undergraduate or early graduate-level course on optimisation for students having a background in calculus, linear algebra, and numerical analysis.

The book is meant to be reasonably self-contained and is addressed to readers at the level of graduate student or a senior undergraduate with a background in calculus, linear algebra, and numerical analysis. Some elementary notions of optimisation would be helpful but are not necessary. Author's intent is that practitioners would find the material covered to be both accessible and reasonably complete for their needs, whether their emphasis is on the algorithms or the applications. They have also made an effort to include figures and exercises when appropriate. The major aims include giving any interested reader a good idea of the state of the art of derivative-free optimisation, with a detailed description of the basic theory to the extent that the reader can well understand what is needed to ensure convergence, how this affects algorithm design, and what kind of success one can expect and where. Thus, it is certainly our goal that the material is of interest to those who want to do research in the area.

As they state in the introduction, due to the growing sophistication and efficiency of computer simulations as well as of other applications, there is an increasing number of instances where one wishes to perform optimisation of a complex system and the derivative information of the resulting objective functions is not available. The

book is intended to help the reader to study and select, if necessary, suitable approaches to do exactly that. It is also intended to extract and emphasise the common theoretical features used by modern derivative-free algorithms, as well as highlight the differences.

7 Thermal Analysis of Polymers, Fundamentals and Applications

by: J.D. Menczel and R.B. Prime

Published 2010

by WILEY, John Wiley & Sons, Inc. Hoboken, New Jersey

111 River Street, Hoboken, NJ 07030-5774, USA, 688pp

ISBN: 978-0-471-76917-0

This book is about thermal analysis as applied to polymers. It is organised by thermal analysis techniques and thus contains chapters on the core techniques of differential scanning calorimetry, thermogravimetric analysis, thermomechanical analysis, and dynamic mechanical analysis. Although it can be argued that dielectric analysis is more frequency than temperature oriented, we decided to include micro/nano-TA because we believe that with the ever increasing ability to probe the macromolecular size scale, this field will become increasingly more important in the characterisation and development of new materials. Each chapter describes the basic principles of the respective techniques, calibration, how to perform an experiment, applications to polymeric materials, instrumentation, and its own list of symbols and acronyms and abbreviations. Several examples are given where thermal analysis was instrumental in solving industrial problems.

In undertaking this project they wanted to write a book that described the underlying principles of the various thermal analysis techniques in a way that could be easily understood by those new to the field but sufficiently comprehensive to be of value to the experienced thermal analyst looking to refresh his or her skills. They also wanted to describe the practical aspects of thermal analysis, for example, how to make proper measurements and how best to analyse and interpret the data. They wrote this book with a broad audience in mind, including all levels of thermal analysts, their supervisors, and those that teach thermal analysis. Their purpose was to create a learning tool for the practitioner of thermal analysis.

8 Wavelets and Their Applications, Case Studies

by: M. Kobayashi

Published 1998

by SIAM Society for Industrial and Applied Mathematics

3600 University City Science Center, Philadelphia

PA 19104-2688, USA, 142pp

ISBN: 0-89871-416-8 (pbk.)

This book is written as a collection of essays in a case studies format. Each essay begins with a description of the problem under study and points to specific properties of wavelets and techniques which were used to determine a solution. In each case study, the goal is to quickly determine a simple solution to a specific problem at hand.

Scientists do not necessarily need to develop a new theory or conduct extensive (and probably expensive) comparison studies neither of which is an encouraged practice in industrial laboratories.

The first case study describes work conducted at the Earthquake Research Institute (ERI) of the University of Tokyo to develop a system to accurately display two-dimensional geographical data at user-specified resolutions on a personal computer (PC). Wavelet-based methods for curve and three-dimensional map display have been investigated by other scientists in different contexts.

In the second case study, a very simple and inexpensive wavelet-based technique to reduce noise in data is successfully applied to correct experimental measurements of dry friction and data from a drop mass test. The attractiveness of the method lies in its relative simplicity and ability to run on a small, unremarkable PC; its application to mechanical engineering laboratory data yields results which are so clean that more involved and sophisticated methods.

This collection of independent case studies demonstrates how wavelet techniques have been used to solve open problems and develop insight into the nature of the systems under study. Each case begins with a description of the problem and points to the specific properties of wavelets and techniques used for determining a solution.

Although calculus and some junior and senior mathematics courses for scientists and engineers will suffice, a solid background in undergraduate mathematics, particularly analysis and numerical analysis, and some familiarity with the basics of wavelets are helpful for reading this book.