Rezensionen

Harzheim, L.:
Strukturoptimierung
Grundlagen und Anwendungen
Verlag Harri Deutsch, 2008, 396 Seiten, zahlreiche Abb.
ISBN 978-3-8171-1809-0, 32,00 €

Untypical, for a textbook author, Dr. Harzheim is from industry and is within Opel responsible for the usage of optimization tools. This already emphasizes the focus of the book - it is a quite detailed textbook summarizing most aspects of modern optimization in an impressive width and not a scientific monograph publishing latest research in detail.

Chapter 1 contains an overview over the contents of the book and describes and separates different concepts in optimization. In Chapter 2 the optimization without constraints is introduced which is an important topic of deterministic optimization. For the one dimensional scalar case the line search is described and later used in the multidimensional case. Some simple algorithms like conjugate gradients and Quasi-Newton Methods are described. In Chapter 3 constraints are added. This is essential for practical usage of optimization. Although the description is very brief, the important aspects are mentioned and very good graphical representations improve the insight. The famous Karush-Kuhn-Tucker conditions are explained in detail. Chapter 4 continues with the Lagrange-function with the goal to introduce primal and dual concepts. In Chapter 5 optimality criteria methods are introduced. This is somehow strange since these methods are only useful for certain problem classes like fully stressed design but of course a lot of literature exists in this area. Chapter 6 introduces approximation methods. Especially interesting are so-called response surface methods which try to create a global approximation of the original performance function which is to be minimized. Another version of global approximation / interpolation are Kriging methods. In Chapter 7 the coupling to FEM is introduced. This certainly belongs to the most important aspects in the optimization of mechanical systems. Certain special criteria and design variables are introduced which are, e.g., required to have smooth surfaces and a globally optimal behaviour. Some methods of sensitivity analysis are introduced and examples of practical optimization are shown. Chapter 8 introduces shape optimization and the book contains more and more applications, mainly from the automotive area. Also, the simulation of growing processes based on optimization is described. In Chapter 9 topology optimization is introduced. Here the domain is modified, e.g. by introducing holes in the structure. So-called homogenization methods modify properties like the density, thickness or stiffness in certain regions. Techniques like SIMP or Checkerboard filtering are explained. Several examples solved with different optimization codes are shown. This is especially useful to emphasize that even topology optimization finds its way to engineering practice. Global optimization methods like stochastic optimization are introduced in Chapter 10. Even just recently developed methods like particle swarm optimization are explained briefly. In Chapter 11 multi-criteria optimization methods are shown. After introducing the Edgeworth-Pareto set some approaches to solve these problems are mentioned. It can be tried to identify important design variables by stochastic methods and a brief introduction to robust optimization is given. This is a rapidly developing field in research and this is another reason why the book is changing its focus in the second part more and more from detailed descriptions to brief basic explanations of many new concepts.

The book is very useful for students of all levels and researchers new in the field. The particular strength of the author (related to the book) is his ability to clearly describe complicated ideas and procedures in a simple but not too simple way. This can be seen clearly, e.g., in the introductory chapters where within a few pages the most important basic concepts of optimization are nicely described. The later chapters are from their content more directed towards applications and special aspects but also there the author manages to give the readers within a few pages a sound impression. Of course this requires that no aspect can be described in the depth of current research. This is one of the most important differences compared to some other books about optimization often used in classes.

The many figures are of high quality and serve well the purpose of gaining more insight. The application examples are well chosen and show in an impressive way the broad usability of modern optimization tools and also the industrial background and experience of the author. They are also a good motivation for the student or other reader that it is worth doing optimization (but also that it must be applied with care and a sound technical and mathematical background).

The book by Lothar Harzheim about 'Strukturoptimierung - Grundlagen und Anwendungen is a very welcome addition to the growing optimization bookshelf. Due to its clear textbook style it is especially well suited for

students and beginners and the impressive industrial applications make it also very useful for experienced experts. I congratulate the author for the great book and wish its readers a lot of pleasure and insight during its study.

P. Eberhard

Jenkins, C.; Khanna, S.:
Mechanics of Materials. A Modern Integration of Mechanics and Materials in Structural Design
Elsevier, 2005, 408 Seiten
ISBN-10: 0123838525, ISBN-13: 978-0123838520, 68,99 €

This book is a typical textbook to accompany courses on elementary structural mechanics. In contains all the fundamental theories like tension, bending, torsion, fracture, buckling, etc., but does not go as far as to include plates and shells. Many examples and little problems with solutions help the reader to study it on his own, and the motivation for each topic is largely given. The presentation is simple and elementary. In contrast to many other books on structural mechanics, the material part is more profound, not only for metals. Higher mathematics are not needed to understand this book, but instead much information about the physics of materials is given. Many appendices, in particular on material properties, units, etc. are added. All in all, a textbook which can be recommended to students in pregraduate courses.

A. Bertram

Papula, L.:
Mathematik für Ingenieure und Naturwissenschaftler, Band 2
Vieweg Verlag, Wiesbaden, 2007
11., überarbeitete Auflage
801 Seiten, 377 Abb., 31,00 €
ISBN 978-3-8348-0304-7

Wie schon Band 1 wendet sich auch Band 2 dieser sechsbändigen Reihe an Studenten im Grundstudium ingenieurwissenschaftlicher Fachrichtungen. Anliegen ist es, einen möglichst komplikationslosen Übergang von der Schule zur Universität zu ermöglichen.
Band 2 behandelt unter anderem Matrizen, Determinanten, lineare Gleichungssysteme, Eigenwertprobleme, die Differential- und Integralrechnung, gewöhnliche Differenzialgleichungen. Diese Gebiete gewinnen im Grundstudium schnell Bedeutung. Das didaktische Konzept des ersten Bandes wird konsequent weitergeführt. Der Leser findet schnell die hervorgehobenen wichtigen Definitionen, Merksätze und Zusammenfassungen. Zu jedem Thema findet man im Text sofort anschauliche Beispiele. Zum gebotenen Stoff gibt es zahlreiche Übungsaufgaben, zu denen im Anhang auch die Lösungen angegeben sind. Einige Anwendungen aus der Technik runden das Bild ab. Die für viele technische Probleme wichtigen Mehrfachintegrale werden sehr ausführlich und anschaulich behandelt. Sie sind für die Mehrzahl der Studienanfänger Neuland. Die gewöhnlichen Differentialgleichungen nehmen ebenfalls einen breiten Raum ein. Die Lösungsmethoden und Anwendungen werden anhand von Aufgaben zu Schwingungen, Biegelinie, Knickung demonstriert. Studienanfänger finden außerdem einige für sie völlig neue Gebiete wie zum Beispiel die Laplace-Transformation. Für Studenten, die die Bücher von Papula zum Selbststudium oder als Nachschlagewerke benutzen, sind diese Kapitel jedoch nützlich.
Die Aufgaben sind so gestellt, dass sie im Wesentlichen ohne technische Hilfsmittel gelöst werden können. Das Buch eignet sich als sehr gutes Lehr- und Nachschlagewerk für das Studium.

W. Lenz

Skrzypek, J.J.; Ganczarski, A.W.; Rustichelli, F.; Egner, H.:
Advanced Materials and Structures for Extreme Operation Conditions
Springer Verlag, 2008, 238 pages, 157 illus., 106,95 €
ISBN 978-3-540-74299-9

Increasing demands from practical applications require new materials with improved properties like high temperature, high temperature gradients, high heat cycle, high wear, impact, etc. resistance. In addition new structural elements should combine safety and light weight. Considering all these facts the new design rules should be based on modern developments in engineering, especially materials science and continuum structural mechanics. That means that one has to take into account the microstructural development, but finally the phenomenological models are the bases of the modern design.

The new book summarizes new research results of a common Polish-Italian group, which was supported by a European Grant within the Network of Excellence "Knowledge Based Multicomponent Materials for Durable and Safe Performance". This group focuses the research activities on metal/matrix and ceramic/matrix composite materials among others which have replaced traditional materials like steels, nickel- and aluminium-

based alloys, etc. These new materials are very expansive, but the application area up to 800 C (titanium matrix composites) or even up to 2000 C (ceramic matrix composites) is possible.

From the point of view of the continuum mechanics the design rules should be improved. At first, the field equations of continuum mechanics should be coupled (coupled equations of thermo-mechanics). At second, the constitutive equations should depend on the thermal variables like temperature, temperature gradient, etc. At third, one needs for the sufficient description of the complex behaviour the material properties like the Young's modulus or thermal properties as functions of the temperature.

The content of the book demonstrates that any advanced theory for the case of high temperature loading needs a deep understanding of thermodynamics and damage mechanics. The corresponding computational algorithms are briefly discussed. In this way the elastic-damage, the elasto-plastic-damage and the thermo-elasto-plastic-damage models are discussed and applied to some real structures. In addition, some methods of the microstructural investigations are presented.

The book consists of 5 chapters:

1. Material properties for high temperature applications,
2. Thermodynamics of constitutive modelling of damaged materials,
3. Developing and implementing selected constitutive models for elasto-plastic-damage materials
4. Developing and implementing constitutive models for specific FGM applications,
5. Microstructural analysis and residual stress determination based on scattering of neutrons and X-ray synchrotron radiation.

Finally, there is an appendix – European sources of neutrons and X-ray synchrotron radiation and their main instrumentation.

The book is useful for students of advanced courses and PhD-students, who are interested in new developments in constitutive modelling. It can be recommended not only for scientists and researchers in mechanical engineering, but also in materials science and physics. It is helpful in the case if one needs materials data because a lot of data is collected by the authors and presented in the book.

H. Altenbach