Overall, the book is good value for its price. It could have done with better editing. Typographic errors abound. Syntax could be better at places. Despite all the drawbacks, I enjoyed reading the book.

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Variational Methods in Shape Optimization Problems – Progress in Nonlinear Differential Equations and their Applications, vol. 65. Dorin Bucur and Giuseppe Buttazzo (eds). Birkhauser, Boston, C/o Springer Science, Business Media Inc, 233, Spring Street, New York, NY 10013, USA. 210 pp. Price: 62.06 Euro.

This book is a collection of lecture notes from the two courses given in the academic year 2000–2001 by the authors at the Dipartimento di Matematica Universit di Pisa and at Scula Normale Superiore di Pisa. These courses were mainly addressed to Ph D students and required background topics in functional analysis and functional spaces. It presents both classical and modern aspects of the fascinating field of shape optimization very well. The intriguing feature is 'shape', i.e. domains of R^N space, instead of functions as is the case in calculus of variations. A sound mathematical background; specifically variational calculus, functional analysis and spaces, differential equations will be required to understand some of the terminology and concepts. It gives good overview of various mathematical theorems and also discusses classical problems like Newton's problem of a least resistance to body moving in fluid, problems in convex domains, etc.

Initially the book introduces the subject with good examples and arouses the interest of the reader. Chapter 1 introduces shape optimization problem in a general way and presents some classical problems like isoperimetric problem and its variants. It gives relevant examples of shape optimization problems like isoperimetric problem, Newton problem of optimal aerodynamical profiles, etc. A shape optimization problem is a minimization problem where the unknown variable runs over a class of domains. Chapter 2 considers an important case where the additional constraint of convexity is assumed on the competing domains. This geometrical constraint is rather strong and sufficient in many cases and provides the extra compactness necessary to guarantee the existence of an optimal solution. An admissible shape plays the role of admissible control in many shape optimization problems. This point along with the relaxation theory is explained in chapter 3 under optimal control problems. Many problems in applied sciences can be modelled by means of optimal control problems. In chapter 4 variational problems with Dirichlet region as one of the unknowns are studied. Continuity under geometrical constraints and under topological constraints is also discussed. Chapter 5 presents existence of classically admissible domains and solutions. Some relevant examples of problems that fulfil the required assumption are also shown. Chapter 6 deals with special case problems where cost functional is dependent on eigenvalues. It discusses stability of eigenvalues under geometric domain perturbation, setting up optimization problem, unbounded design regions, etc. Finally, chapter 7 is devoted to shape optimization problems governed by elliptic equations with Neumann conditions on free boundary. Only homogeneous boundary conditions are considered as this situation is encountered in different physical models (cracks, free parts of structure, image segmentation, etc.).

Different schemes of problems are presented with definitions, illustrations, good examples and proofs wherever required. Several problems that are still open are also discussed. Problems to which optimization can be applied like boundary value problems, problems governed by partial differential equations (PDE), etc. are also analysed. Certain advanced topics that are generally not present in the books for graduate students are discussed; like optimal control problems, optimization problems for functions of eigenvalues, problems governed by PDE, problems of free boundary Neumann conditions, etc. Various shape optimization problems, associated theories, relaxation solutions, particular contrary cases, etc. are also explained, along with additional difficulties that may arise. General nature problems, existence of solution, stability of solution have also been discussed. Many shape optimization books consider the topic from the engineering perspective with emphasis on numerical algorithms and solution techniques, but this book gives good mathematical background substantiated by examples; which includes problems of optimum shaped cantilever, quasistatic growth of brittle fracture, variable boundary problems, etc. Theoretical aspects of these are dealt in quite a nice manner. Although it covers many advanced problems of engineering interest and gives introduction to practical problems, the practical problems are dealt and discussed in short.

This book also gives a good bibliography covering about 200 references of this rapidly developing subject. It can serve as an all-time reference for those who are keen on mathematical framework for practical problems and their solutions. It will be useful to the students for advanced optimization topics. For people with mathematics background, it gives good collection of theorems and lemmas associated with the subject of shape optimization. For engineering people, it provides an in-depth basis for development of mathematical structure that forms foundations of numerical solution techniques.

It is commendable that the author has been able to include so much material in a book of 210 pages, and yet the book is well written, and the material is presented in a readable format. It covers all the important topics required to teach basic concepts and methods of optimization, with special emphasis on mathematical formulation. These topics are presented in a concise yet rigorous manner. This study can serve as an excellent text for a graduate course in variational methods for shape optimization to both students and instructors.

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