Olivier Pironneau

Optimal Shape Design for Elliptic Systems

Optimal Shape Design For Elliptic Systems

Jacques Simon

Optimal Shape Design For Elliptic Systems:

Optimal Shape Design for Elliptic Systems O. Pironneau,2012-12-06 The study of optimal shape design can be arrived at by asking the following question What is the best shape for a physical system This book is an applications oriented study of such physical systems in particular those which can be described by an elliptic partial differential equation and where the shape is found by the minimum of a single criterion function There are many problems of this type in high technology industries In fact most numerical simulations of physical systems are solved not to gain better understanding of the phenomena but to obtain better control and design Problems of this type are described in Chapter 2 Traditionally optimal shape design has been treated as a branch of the calculus of variations and more specifically of optimal control This subject interfaces with no less than four fields optimization optimal control partial differential equations PDEs and their numerical solutions this is the most difficult aspect of the subject Each of these fields is reviewed briefly PDEs Chapter 1 optimization Chapter 4 optimal control Chapter 5 and numerical methods Chapters 1 and 4 Optimal Shape Design for Elliptic Systems Professor of Mathematics O Pironneau,1983-12-01 **Multigrid Methods for Optimal Shape Design Governed by Elliptic Systems** Eyal Arian,1994 **Optimization of Elliptic Systems** Pekka Neittaanmaki,Jürgen Sprekels,Dan Tiba,2007-01-04 The present monograph is intended to provide a comprehensive and accessible introduction to the optimization of elliptic systems This area of mathematical research which has many important applications in science and technology has experienced an impressive development during the past two decades There are already many good textbooks dealing with various aspects of optimal design problems In this regard we refer to the works of Pironneau 1984 Haslinger and Neittaanmaki 1988 1996 Sokolowski and Zolksio 1992 Litvinov 2000 Allaire 2001 Mohammadi and Pironneau 2001 Delfour and Zolksio 2001 and Makinen and Haslinger 2003 Already Lions I9681 devoted a major part of his classical monograph on the optimal control of partial differential equations to the optimization of elliptic systems Let us also mention that even the very first known problem of the calculus of variations the brachistochrone studied by Bernoulli back in 1696 is in fact a shape optimization problem The natural richness of this mathematical research subject as well as the extremely large field of possible applications has created the unusual situation that although many important results and methods have already been est lished there are still pressing unsolved questions In this monograph we aim to address some of these open problems as a consequence there is only a minor overlap with the textbooks already existing in the field **From Convexity to Nonconvexity** R.P. Gilbert,Panagiotis D. Panagiotopoulos,Panos M. Pardalos,2013-12-01 This collection of papers is dedicated to the memory of Gaetano Fichera a great mathematician and also a good friend to the editors Regrettably it took an unusual amount of time to bring this collection out This was primarily due to the fact that the main editor who had collected all of the materials for this volume P D Panagiotopoulos died unexpectedly during the period when we were editing the manuscript The other two editors in appreciation of Panagiotopoulos contribution to this field believe it is therefore

fitting that this collection be dedicated to his memory also The theme of the collection is centered around the seminal research of G Fichera on the Signorini problem Variants on this idea enter in different ways For example by bringing in friction the problem is no longer self adjoint and the minimization formulation is not valid A large portion of this collection is devoted to survey papers concerning hemivariational methods with a main point of its application to nonsmooth mechanics Hemivariational inequali ties which are a generalization of variational inequalities were pioneered by Panagiotopoulos There are many applications of this theory to the study of non convex energy functionals occurring in many branches of mechanics An area of concentration concerns contact problems in particular quasistatic and dynamic contact problems with friction and damage Nonsmooth optimization methods which may be divided into the main groups of subgradient methods and bundle methods are also discussed in this collection **Optimization of Structural Topology, Shape, and Material** Martin P. Bendsoe,2013-03-14 In the past the possibilities of structural optimization were restricted to an optimal choice of profiles and shape Further improvement can be obtained by selecting appropriate advanced materials and by optimizing the topology i e finding the best position and arrangement of structural elements within a construction The optimization of structural topology permits the use of optimization algorithms at a very early stage of the design process The method presented in this book has been developed by Martin Bendsoe in cooperation with other researchers and can be considered as one of the most effective approaches to the optimization of layout and material design **Shapes and Geometries** M. C. Delfour,J.-P. Zolesio,2011-01-01 Presents the latest groundbreaking theoretical foundation to shape optimization in a form accessible to mathematicians scientists and engineers *Fast Solution of Discretized Optimization Problems* Karl-Heinz Hoffmann,Ronald W. Hoppe,Volker Schulz,2012-12-06 Differential equations partial as well as ordinary are one of the main tools for the modeling of real world application problems Pursuing the ultimate aim of influencing these systems in a desired way one is confronted with the task of optimizing discretized models This volume contains selected papers presented at the International Work shop on Fast Solution of Discretized Optimization Problems which took place at the Weierstrass Institute for Applied Analysis and Stochastics in Berlin from May 08 until May 12 2000 The conference was attended by 59 scientists from 10 countries The scientific program consisted of 8 invited lectures presented by H G Bock IWR Heidelberg M Heinkenschloss Rice University Houston K Kunisch University of Graz U Langer University Linz B Mohammadi University of Montpellier J Petersson University of Linkoping E Sachs University of Trier F Troltzsch Technical University of Chemnitz and 28 contributed talks The aim of this workshop was to foster the exchange of ideas between the still comparatively separated disciplines of nonlinear optimiza tion on the one side and numerical methods for differential equations on the other side This is necessary for the successful solution of various current optimization problems in practical applications shape optimization topology optimization pro cess optimization Therefore the organizing committee as well as the speakers have come from both these communities **Composite Media And Homogenization Theory** Workshop on Composite Media and

Homogenization Theory 1993, Trieste, Italy,Gianni Dal Maso,1995 A rigorous mathematical treatment of the properties of composite materials has been made possible by recent mathematical results in the fields of partial differential equations and the calculus of variations The progress in the mathematical models for composite media has led to a deeper understanding of the overall behaviour of composite structures and to significant applications in physics and engineering including a new approach to optimal design problems Many new relevant results are presented in this volume which contains 16 invited papers from the Second Workshop on Composite Media and Homogenization Theory held at the International Centre for Theoretical Physics in Trieste Italy from September 20 to October 1 1993 Topics include homogenization of problems singularly depending on small or large parameters homogenization of nonlinear problems optimal bounds for effective moduli asymptotic analysis of problems in perforated domains laminate structures in phase transitions optimal design and relaxation Mathematicians and engineers interested in mathematical models of composite materials will find this book to be an important reference   **Fluid Flow** L.C. Wrobel,C.A. Brebbia,2016-11-21 No detailed description available for Fluid Flow   **Topology Optimization in Structural Mechanics** G.I.N. Rozvany,2014-05-04 Topology optimization is a relatively new and rapidly expanding field of structural mechanics It deals with some of the most difficult problems of mechanical sciences but it is also of considerable practical interest because it can achieve much greater savings than mere cross section or shape optimization   *Control of Boundaries and Stabilization* Jacques Simon,2006-02-06 The present proceedings volume is devoted to two subjects Stabilization with emphasis on exact controllability considering a physical system such as a vibrating plate one can reach a steady state in a finite time by acting on the boundary Control of boundaries given a physical system find the geometry of the domain optimal shape which minimizes a cost related to the solution of a boundary value problem in this domain for example find a minimum drag profile Many lectures included mathematical analysis as well as engineering applications and numerical simulation   *Nonlinear Analysis, Differential Equations and Control* F.H. Clarke,R.J. Stern,2012-12-06 Recent years have witnessed important developments in those areas of the mathematical sciences where the basic model under study is a dynamical system such as a differential equation or control process Many of these recent advances were made possible by parallel developments in nonlinear and nonsmooth analysis The latter subjects in general terms encompass differential analysis and optimization theory in the absence of traditional linearity convexity or smoothness assumptions In the last three decades it has become increasingly recognized that nonlinear and nonsmooth behavior is naturally present and prevalent in dynamical models and is therefore significant theoretically This point of view has guided us in the organizational aspects of this ASI Our goals were twofold We intended to achieve cross fertilization between mathematicians who were working in a diverse range of problem areas but who all shared an interest in nonlinear and nonsmooth analysis More importantly it was our goal to expose a young international audience mainly graduate students and recent Ph D s to these important subjects In that regard there were heavy pedagogical demands placed upon the twelve

speakers of the ASI in meeting the needs of such a gathering The talks while exposing current areas of research activity were required to be as introductory and comprehensive as possible It is our belief that these goals were achieved and that these proceedings bear this out Each of the twelve speakers presented a mini course of four or five hours duration **Calculus of Variations and Differential Equations** Alexander Ioffe,Simeon Reich,I Shafrir,1999-07-15 The calculus of variations is a classical area of mathematical analysis 300 years old yet its myriad applications in science and technology continue to hold great interest and keep it an active area of research These two volumes contain the refereed proceedings of the international conference on Calculus of Variations and Related Topics held at the Technion Israel Institute of Technology in March 1998 The conference commemorated 300 years of work in the field and brought together many of its leading experts The papers in the first volume focus on critical point theory and differential equations The other volume deals with variational aspects of optimal control Together they provide a unique opportunity to review the state of the art of the calculus of variations as presented by an international panel of masters in the field **Functional Micro- and Nanosystems** Karl-Heinz Hoffmann,2013-03-09 The 4th caesarium brought together world known experts reporting the state of the art of Functional Micro and Nanosystems Its purpose was to identify and open up new research directions in this rapidly evolving new area and to discuss the potential with respect to applications in automotive biochemical and information technology Thin film technologies are an attractive approach to incorporate functional properties into micro or nano systems The continuing development towards smaller structures is driven by the use of higher driving frequencies and thus smaller wavelengths the growing integration of different functions the higher degree of parallelism and size requirements for the detection of bio molecules Hence this new technology opens up new possibilities in terms of high frequency wireless data transmission over long distances sensors showing high spatial and time resolution and new devices to process biological optical and electrical signals The Shapes of Things Shawn W. Walker,2015-06-25 Many things around us have properties that depend on their shape for example the drag characteristics of a rigid body in a flow This self contained overview of differential geometry explains how to differentiate a function in the calculus sense with respect to a shape variable This approach which is useful for understanding mathematical models containing geometric partial differential equations PDEs allows readers to obtain formulas for geometric quantities such as curvature that are clearer than those usually offered in differential geometry texts Readers will learn how to compute sensitivities with respect to geometry by developing basic calculus tools on surfaces and combining them with the calculus of variations Several applications that utilize shape derivatives and many illustrations that help build intuition are included *Numerical Analysis of Electromagnetic Fields* Pei-bai Zhou,2012-12-06 Numerical methods for solving boundary value problems have developed rapidly Knowledge of these methods is important both for engineers and scientists There are many books published that deal with various approximate methods such as the finite element method the boundary element method and so on However there is no textbook that includes all of these methods

This book is intended to fill this gap The book is designed to be suitable for graduate students in engineering science for senior undergraduate students as well as for scientists and engineers who are interested in electromagnetic fields Objective Numerical calculation is the combination of mathematical methods and field theory A great number of mathematical concepts principles and techniques are discussed and many computational techniques are considered in dealing with practical problems The purpose of this book is to provide students with a solid background in numerical analysis of the field problems The book emphasizes the basic theories and universal principles of different numerical methods and describes why and how different methods work Readers will then understand any methods which have not been introduced and will be able to develop their own new methods Organization Many of the most important numerical methods are covered in this book All of these are discussed and compared with each other so that the reader has a clear picture of their particular advantage disadvantage and the relation between each of them The book is divided into four parts and twelve chapters

Computational Mathematics Driven by Industrial Problems R. Burkard,P. Deuflhard,A. Jameson,J.-L. Lions,G. Strang,2007-05-06 These lecture notes by very authoritative scientists survey recent advances of mathematics driven by industrial application showing not only how mathematics is applied to industry but also how mathematics has drawn benefit from interaction with real word problems The famous David Report underlines that innovative high technology depends crucially for its development on innovation in mathematics The speakers include three recent presidents of ECMI one of ECCOMAS in Europe and the president of SIAM   **Advanced Methods for Practical Applications in Fluid Mechanics** Steven Jones,2012-03-14 Whereas the field of Fluid Mechanics can be described as complicated mathematically challenging and esoteric it is also imminently practical It is central to a wide variety of issues that are important not only technologically but also sociologically This book highlights a cross section of methods in Fluid Mechanics each of which illustrates novel ideas of the researchers and relates to one or more issues of high interest during the early 21st century The challenges include multiphase flows compressibility nonlinear dynamics flow instability changing solid fluid boundaries and fluids with solid like properties The applications relate problems such as weather and climate prediction air quality fuel efficiency wind or wave energy harvesting landslides erosion noise abatement and health care   Applied Shape Optimization for Fluids Bijan Mohammadi,Olivier Pironneau,2010 Contents PREFACE ACKNOWLEDGEMENTS 1 Introduction 2 Optimal shape design 3 Partial differential equations for fluids 4 Some numerical methods for fluids 5 Sensitivity evaluation and automatic differentiation 6 Parameterization and implementation issues 7 Local and global optimization 8 Incomplete sensitivities 9 Consistent approximations and approximate gradients 10 Numerical results on shape optimization 11 Control of unsteady flows 12 From airplane design to microfluidic 13 Toplogical optimization for fluids 14 Conclusion and perspectives INDEX

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