control problems for partial differential equations on reticulated domains

approximation and asymptotic analysis systems control foundations applications

optimization, optimal control and partial differential equations

finite element error analysis for parabolic partial differential equations

optimal control problems for partial differential equations on reticulated domains

control theory can be realized numerically. after reading this book, the reader will be familiar with the main principles of the numerical analysis of PDE-constrained optimization. — publisher's description.

alongside the main theme of the exposition is confined to brief introductions into the basic ideas in order to give the reader an impression of how the methods have found widespread applications in aeronautics, mechanical engineering, the life sciences, and many other disciplines. this book focuses on optimal control problems where the state equation is an elliptic or parabolic partial differential equation. included are topics such as the existence of optimal solutions, necessary optimality conditions and adjoint equations, second-order sufficient conditions, and analysis are introduced and explained as they are needed. many simple examples illustrate the theory and its hidden difficulties. this start to the book makes it fairly self-contained and suitable for advanced undergraduates or beginning graduate students.

domain decomposition methods in optimal control of partial differential equations

discretization strategies for optimal control problems with parabolic partial differential equations

control of coupled partial differential equations

regularization methods for ill-posed optimal control problems

optimal control of systems governed by partial differential equations
Approximation And Asymptotic Analysis Systems Control Foundations Applications

Optimal Control Problems for Partial Differential Equations on Reticulated Domains

Nonlinear Optimal Control Theory presents a deep, wide-ranging introduction to the mathematical theory of the optimal control problems for partial differential equations, with a focus on reticulated domains, which encompass both open and closed sets with complicated geometries. This volume offers a wide spectrum of aspects of the discipline, and is of interest to mathematicians and scientists working in the field.

Survey articles to make the material self-contained. To maintain the highest level of scientific quality, all manuscripts have been thoroughly reviewed.

The book presents an overview of the current state of the art in the theory of nonlinear optimal control problems for partial differential equations. It covers a variety of topics, including interior regularity and regularity of free boundaries, controllability and optimal control, and inverse problems covering different aspects of the theory, numerical methods, and applications. Besides a unified presentation of the most recent and relevant developments, this volume also presents some comparative historical remarks on the evolution of the field.

This edited volume comprises invited contributions from world-renowned researchers in the subject of control and inverse problems. There are several contributions on optimal control of systems governed by partial differential equations, which constitute a vibrant and emerging research area that has found numerous applications. A related problem of paramount importance is the optimal control problem for stochastic partial differential equations.

Estimation and Control Problems for Stochastic Partial Differential Equations

The development of a theory of optimal control (deterministic) requires the following initial data: (i) a control $u$ belonging to some set $U$ (the set of 'admissible controls'), (ii) for a given control $u$, the state $y(u)$ of the system which is to be controlled is given by the solution of an equation (*) $Ay(u)=\text{given}$, (iii) the observation $z(u)$ which is a function of $y(u)$ (assumed to be known and not depending on $u$), and (iv) the 'cost function' $J(u)$ ('economic function') which is defined in terms of a numerical function $z(u)$.

For a control $u$, the cost $J(u)=\tau(z(u))$, where $\tau$ is a functional defined on the space of observations $z$. Minimization of the cost $J(u)$ is equivalent to solving a 'direct problem' $Ay=u$ for given $z(u)$, which from a physical point of view is the main problem of this theory. A closely related problem is the 'adjoint problem' $A^*z=v(u)$ which plays an important role in the derivation of the 'optimality conditions' of the theory.

Optimal Control Problems Constrained by Stochastic Partial Differential Equations

The book presents a comprehensive overview of the latest developments in the field of optimal control of partial differential equations with stochastic inputs. It covers topics such as uncertainty quantification, risk-averse control, and robust control.

Optimal Control of Partial Differential Equations

Optimal Control Problems Involving Pointwise State Constraints: Regularization and Applications

Subject of this work is the analysis of numerical methods for the solution of optimal control problems involving pointwise state constraints. The focus is on the application of regularization techniques to ensure the stability and convergence of the numerical solutions.

Discretization Strategies for Optimal Control Problems with Parabolic Partial Differential Equations

This book provides a direct and comprehensive introduction to theoretical and numerical concepts in the field of optimal control of parabolic partial differential equations. It covers topics such as regularization techniques, error analysis, and convergence of numerical schemes.
Approximation And Asymptotic Analysis Systems Control Foundations Applications

Optimal Control Problems For Partial Differential Equations On Reticulated Domains

or semi-linear partial differential equations. Depending on the structure of the differential equation, different regularization techniques are employed, and their analysis leads to novel results such as rate of

Deterministic and Stochastic Optimal Control and Inverse Problems Ill-posed optimization problems appear in a wide range of mathematical applications, and their numerical solution requires the use of

theoretical guidance in solving their optimal control problems; and graduate-level seminar courses in nonlinear applied functional analysis.

obtained. It will be useful for mathematicians interested in the development of the abstract Control Theory with applications to Nonlinear PDE, as well as physicists, engineers, and economists looking for

Paris on December 4th, 2000 in honor of Professor Alain Bensoussan are included.

extended texts of the lectures of Professors Jens Frehse, Hitashi Ishii, Jacques-Louis Lions, Sanjoy Mitter, Umberto Mosco, Bernt Oksendal, George Papanicolaou, A. Shiryaev, given in the Conference held in

Alain Bensoussan's contributions have been particularly important: filtering and control of stochastic systems, variationnal problems, applications to economy and finance, numerical analysis In particular, the

equally appealing.

optimization and control of infinite dimensional systems, typically represented by partial differential equations. Readers interested either in theory or in numerical simulation of such systems will find this book

acoustic micro-mechanical devices, or optimal control of crystal growth to the control of bodies immersed into a fluid, airfoil design, and much more. The book addresses advanced students and researchers in

topology optimization. Applications affected by these findings are distributed over all time and length scales starting with optimization and control of quantum mechanical systems, the design of piezoelectric

Control of Coupled Systems of Partial Differential Equations', held at the 'Mathematisches Forschungsinstitut Oberwolfach' in April 2005. With their articles, leading scientists cover a broad range of

Domains is an excellent reference tool for graduate students, researchers, and practitioners in mathematics and areas of engineering involving reticulated domains.

applications with a focus on structural network problems, they aim at combining techniques of homogenization and approximation. Optimal Control Problems for Partial Differential Equations on Reticulated

computing. In order to carry out model-reduction on these systems, the authors of this work have developed a method based on asymptotic analysis. Moving from abstract explanations to examples and

Optimal Control of Partial Differential Equations In the development of optimal control, the complexity of the systems to which it is applied has increased significantly, becoming an issue in scientific

mathematical physics. Specifically, the distributed parameter systems under consideration are represented by a set of field equations.

and/or integral equations involving two or more independent variables. The primary purpose of the dissertation is to investigate the application of optimal control theory to systems described by partial

algorithms in order to solve concrete problems. This volume offers a wide spectrum of aspects of the discipline and is of interest to mathematicians as well as to scientists working in the fields of applications.

transmission conditions along with some cost criteria to be minimized. The mathematical framework contains modelling and analysis of such systems as well as the numerical analysis and implemention of

material properties and specific industrial processes. All of these applications involve the analytical and numerical treatment of nonlinear partial differential equations with nonhomogeneous boundary or

that researchers focus their interest on challenging problems such as the study of controlled fluid-structure interactions, flexible structures, noise reduction, smart materials, the optimal design of shapes and

the application of PDE-based control theory and the corresponding numerical algorithms to industrial problems has become more and more important in recent years. This development is reflected by the fact

Advances in Mathematical Modeling, Optimization and Optimal Control This volume contains the contributions of participants of the conference "Optimal Control of Partial Differential Equations" held at

readers with the foundation to deal with other types of control problems, such as those governed by stochastic differential equations, partial differential equations, and differential games.

governed by ordinary, integrodifferential, and delay systems. It also discusses Hamilton-Jacobi theory. By providing a sufficient and rigorous treatment of finite dimensional control problems, the book equips

optimal control techniques in diverse areas. Drawing on classroom-tested material from Purdue University and North Carolina State University, the book gives a unified account of bounded state problems

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Approximation And Asymptotic Analysis Systems Control Foundations Applications

In order to carry out model-reduction on these systems, the authors of this work have developed a method based on asymptotic analysis. Moving from abstract explanations to examples...

The SQP method for optimal control problems with mixed constraints.

In the development of optimal control, the complexity of the systems to which it is applied has increased significantly, becoming an issue...

Optimal Control Problems For Partial Differential Equations On Reticulated Domains

rehabilitation technology, in particular in human movement analysis, therapy and improvement by means of medical devices. The final chapter, by Nikolai Osmolovskii and Helmut Maurer provides a survey...

optimization problems for variational inequalities are considered. The next chapter, by Katja Mombaur is devoted to applications of optimal control and inverse optimal control in the field of medical and...

the operator version of a first order in time partial differential inclusion and its time discretization. In the chapter by Günter Leugering, Jan Sokołowski and Antoni Żochowski, nonsmooth shape...

chapter by Martin Burger provides an overview of recent developments related to Bregman distances, which is an important tool in inverse problems and image processing. The chapter by Piotr Kalita studies...

involved in image processing, partial differential inclusions, shape optimization, or optimal control theory and its applications to medical and rehabilitation technology, will find this book valuable. The first...

Optimal Control of Distributed Systems

Nonlinear Optimal Control Theory

Optimal Control Problems in PDE and ODE Systems

While domain decomposition methods have a long history dating back well over one hundred years, it is only during the last decade that they have...

properties of solutions of evolution equations (R Latcu and M. Megan. R Luca and R Morozanu. R Faure). 2 -The controllability of Inflnlte dimensional and distributed parameter systems with the...

impact of a jet with two fluids on a porous wall). C. Lefter and D. Motreanu (nonlinear eigenvalue problems with discontinuities). I. Rus (maximum principles for elliptic systems). and on asymptotic XII...

in this volume. 1 -Variational methods in mechanics and physical models Here we mention the contributions of D. Cioranescu. P. Donato and H.I. Ene (fluid flows in dielectric porous media). R. Stavre (the...

Mathematical Control Theory for Stochastic Partial Differential Equations

This book collects research papers presented in the First Franco Romanian Conference on Optimization, Optimal Control and...

readers with variable mathematical backgrounds, from advanced undergraduate to Ph.D. levels and beyond. We believe that applied mathematicians, computational scientists, and engineers may find this...

concepts of OCPs for algebraic and dynamical systems; part II addresses OCPs involving linear PDEs (mostly elliptic and parabolic type) and quadratic cost functions; part III deals with more general classes of...

introductory chapter addresses a handful of representative OCPs and presents an overview of the associated mathematical issues. The rest of the book is organized into three parts: part I provides preliminary...

the system of optimality conditions, the proposition of suitable numerical methods, their formulation, their analysis, including their application to a broad set of problems of practical relevance. The first...

last few years at Politecnico di Milano, both at the undergraduate and graduate levels. The book covers the whole range spanning from the setup and the rigorous theoretical analysis of OCPs, the derivation of...

Optimal Control of Partial Differential Equations

This is a book on optimal control problems (OCPs) for partial differential equations (PDEs) that evolved from a series of courses taught by the authors in the...

problems have become increasingly important in recent years. This volume offers a wide spectrum of aspects of the discipline, and is of interest to mathematicians and scientists working in the field.

Optimal Control Problems Governed by Nonlinear Partial Differential Equations and Inclusions

The application of PDE-based control theory and the corresponding numerical algorithms to industrial...

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Approximation And Asymptotic Analysis Systems Control Foundations Applications

Given partial (perhaps noisy) observations of the true solution in a subdomain, we seek to “identify” the coefficient of the interaction term using an optimal control problem. Results for the optimal control pair are established. The optimality system is derived and then solved numerically using an iterative method with the Runge-Kutta fourth order scheme. Second, an unknown differential equations (ODEs). In each problem, an objective functional representing the goal of the control process is minimized. First, a system of ordinary differential equations which describe the interaction...
This method of solving this identification problem is based on Tikhonov's regularization and the optimal control for a fixed regularization parameter represents the approximate solution of the inverse problem. The existence and uniqueness of the optimal control are established, and an optimality system is derived. As the regularization parameter goes to zero, the identification problem is solved, and an example illustrating how to find a solution numerically is presented. Third, a problem involving optimal control of a convective velocity coefficient depending on space and time in a parabolic equation is treated. This work applies to a one dimensional fluid flow through a soil-packed tube in which a contaminant is initially distributed. The existence of an optimal control and an optimality system are derived. This problem requires more regularity on the control set which results in a PDE characterization of an optimal control.

Regularization Methods for Ill-Posed Optimal Control Problems

Optimal Control of Coupled Systems of Partial Differential Equations

The optimal control problems governed by partial differential equations have developed very fast in the last 30 years, and it has brought a promising and vital researching domain to the subject of mathematics. The optimal control problems governed by partial differential equations concern many applications in physics, chemistry, biology, etc., such as materials design, crystal growth, temperature control, petroleum exploitation, and so on. The partial differential equations involved in these problems include elliptic equations, parabolic equations and hyperbolic equations. Our objective of this book, which consists of three chapters, aims to introduce the analytical and numerical solutions of constrained optimal control problems of quasilinear parabolic systems.

Optimization, Optimal Control and Partial Differential Equations

This work is concerned with designing optimal order multigrid preconditioners for optimal control problems constrained by partial differential equations (PDEs). Two different optimal control problems are discussed in the dissertation. For the first problem, the PDE constraint is a linear parabolic equation and the control is the forcing term which is distributed in space and time, while for the second problem, the PDE constraint is an elliptic equation and the controls lie on the boundary. For the first problem (distributed optimal control problem constrained by a linear parabolic equation), standard space-time finite element discretizations (e.g., Crank-Nicolson discretization) lead to suboptimal results. For the boundary control of elliptic equations there is a clear distinction in terms of quality of the preconditioning between Dirichlet and Neumann boundary control, namely we observed what appear to be optimal order results for Neumann boundary control problem, while for Dirichlet boundary control the preconditioners appear to be suboptimal. In addition to the analysis of the multigrid preconditioners, the main contribution of this work for the first problem is to point out a discretization that leads to preconditioners that are of provably optimal order.