Numerical Optimization Nocedal Solution

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Complexity in Numerical Optimization Cambridge University Press
A Relaxation Based Approach to Optimal Control of Hybrid and Switched Systems proposes a unified approach to effective and numerically tractable relaxation schemes for optimal control problems of hybrid and switched systems. The book gives an overview of the existing (conventional and newly developed) relaxation techniques associated with the conventional systems described by ordinary differential equations. Next, it constructs a self-contained relaxation theory for optimal control processes governed by various types (sub-classes) of general hybrid and switched systems. It contains all mathematical tools necessary for an adequate understanding and using of the sophisticated relaxation techniques. In addition, readers will find many practically oriented optimal control problems related to the new class of dynamic systems. All in all, the book follows engineering and numerical concepts. However, it can also be considered as a mathematical compendium that contains the necessary formal results and important algorithms related to the modern relaxation theory. Illustrates the use of the relaxation approaches in engineering optimization Presents application of the relaxation methods in computational schemes for a numerical treatment of the sophisticated hybrid/switched optimal control problems Offers a rigorous and self-contained mathematical tool for an adequate understanding and practical use of the relaxation techniques Presents an extension of the relaxation methodology to the new class of applied dynamic systems, namely, to hybrid and switched control systems
Introduction to Nonlinear Optimization Linköping University Electronic Press
During the last decades, motion planning for autonomous systems has become an important area of research. The high interest is not the least due to the development of systems such as self-driving cars, unmanned aerial vehicles and robotic manipulators. The objective in optimal motion planning problems is to find feasible motion plans that also optimize a performance measure. From a control perspective, the problem is an instance of an optimal control problem. This thesis addresses optimal motion planning problems for complex dynamical systems that operate in unstructured environments, where no prior reference such as road-lane information is available. Some example scenarios are autonomous docking of vessels in harbors and autonomous parking of self-driving tractor-trailer vehicles at loading sites. The focus is to develop optimal motion planning algorithms that can reliably be applied to these types of problems. This is achieved by combining recent ideas from automatic control, numerical optimization and robotics. The first contribution is a systematic approach for computing local solutions to motion planning problems in challenging unstructured environments. The solutions are computed by combining homotopy methods and direct optimal control techniques. The general principle is to define a homotopy that transforms, or preferably relaxes, the original problem to an easily solved problem. The approach is demonstrated in motion planning problems in 2D and 3D environments, where the presented method outperforms a state-of-the-art asymptotically optimal motion planner based on random sampling. The second contribution is an optimization-based framework for automatic generation of motion primitives for lattice-based motion planners. Given a family of systems, the user only needs to specify which principle types of motions that are relevant for the considered system family. Based on the selected principle motions and a selected system instance, the framework computes a library of motion primitives by simultaneously optimizing the motions and the terminal states. The final contribution of this thesis is a motion planning framework that combines the strengths of sampling-based planners with direct optimal control in a novel way. The sampling-based planner is applied to the problem in a first step using a discretized search space, where the system dynamics and objective function are chosen to coincide with those used in a second step based on optimal control. This combination ensures that the sampling-based motion planner provides a feasible motion plan which is highly suitable as warm-start to the optimal control step. Furthermore, the second step is modified such that it also can be applied in a receding-horizon fashion, where the proposed combination of methods is used to provide theoretical guarantees in terms of recursive feasibility, worst-case objective function value and convergence to the terminal state. The proposed motion planning framework is successfully applied to several problems in challenging unstructured environments for tractor-trailer vehicles. The framework is also applied and tailored for maritime navigation for vessels in archipelagos and harbors, where it is able to compute energy-efficient trajectories which complies with the international regulations for preventing collisions at sea.
Nonlinear Optimization Springer
This textbook on nonlinear optimization focuses on model building, real world problems, and applications of optimization models to natural and social sciences. Organized into two parts, this book may be used as a primary text for courses on convex optimization and non-convex optimization. Definitions, proofs, and numerical methods are well illustrated and all chapters contain compelling exercises. The exercises emphasize fundamental theoretical results on optimality and duality theorems, numerical methods with or without constraints, and derivative-free optimization. Selected solutions are given. Applications to theoretical results and numerical methods are highlighted to help students comprehend methods and techniques.
Numerical Optimization Cambridge University Press
Optimization is an important tool used in decision science and for the analysis of physical systems used in engineering. One can trace its roots to the Calculus of Variations and the work of Euler and Lagrange. This natural and reasonable approach to mathematical programming covers numerical methods for finite-dimensional optimization problems. It begins with very simple ideas progressing through more complicated concepts, concentrating on methods for both unconstrained and constrained optimization.
Numerical Optimization Springer Science & Business Media
Broad-spectrum approach to important topic. Explores the classic theory of minima and maxima, classical calculus of variations, simplex technique and linear programming, optimality and dynamic programming, more. 1969 edition.
Convex Optimization Cambridge University Press
Computational complexity, originated from the interactions between computer science and numerical optimization, is one of the major theories that have revolutionized the approach to solving optimization problems and to analyzing their intrinsic difficulty.The main focus of complexity is the study of whether existing algorithms are efficient for the solution of problems, and which problems are likely to be tractable.The quest for developing efficient algorithms leads also to elegant general approaches for solving optimization problems, and reveals surprising connections among problems and their solutions.This book is a collection of articles on recent complexity developments in numerical optimization. The topics covered include complexity of approximation algorithms, new polynomial time algorithms for convex quadratic minimization, interior point algorithms, complexity issues regarding test generation of NP-hard problems, complexity of scheduling problems, min-max, fractional combinatorial optimization, fixed point computations and network flow problems.The collection of articles provide a broad spectrum of the direction in which research is going and help to elucidate the nature of computational complexity in optimization. The book will be a valuable source of information to faculty, students and researchers in numerical optimization and related areas.
Nonlinear Optimization Springer
This book provides an introduction to the mathematical theory of optimization. It emphasizes the convergence theory of nonlinear optimization algorithms and applications of nonlinear optimization to combinatorial optimization. Mathematical Theory of Optimization includes recent developments in

global convergence, the Powell conjecture, semidefinite programming, and relaxation techniques for designs of approximation solutions of combinatorial optimization problems.

Primal-dual Interior-Point Methods Butterworth-Heinemann

This book provides a comprehensive introduction to nonlinear programming, featuring a broad range of applications and solution methods in the field of continuous optimization. It begins with a summary of classical results on unconstrained optimization, followed by a wealth of applications from a diverse mix of fields, e.g. location analysis, traffic planning, and water quality management, to name but a few. In turn, the book presents a formal description of optimality conditions, followed by an in-depth discussion of the main solution techniques. Each method is formally described, and then fully solved using a numerical example.

Practical Mathematical Optimization Springer Nature

This book presents basic optimization principles and gradient-based algorithms to a general audience, in a brief and easy-to-read form. It enables professionals to apply optimization theory to engineering, physics, chemistry, or business economics.

Mathematical Theory of Optimization Princeton University Press

This accessible textbook demonstrates how to recognize, simplify, model and solve optimization problems - and apply these principles to new projects.

Nonlinear Optimization Springer

Surveys the theory and history of the alternating direction method of multipliers, and discusses its applications to a wide variety of statistical and machine learning problems of recent interest, including the lasso, sparse logistic regression, basis pursuit, covariance selection, support vector machines, and many others.

Optimal Control of Partial Differential Equations Springer Science & Business Media

Optimization methodologies are fundamental instruments to tackle the complexity of today's engineering processes. Engineering Optimization 2014 is dedicated to optimization methods in engineering, and contains the papers presented at the 4th International Conference on Engineering Optimization (ENGOPT2014, Lisbon, Portugal, 8-11 September 2014). The book will be of interest to engineers, applied mathematicians, and computer scientists working on research, development and practical applications of optimization methods in engineering.

Optimization for Data Analysis CRC Press

Numerical algorithms for efficiently solving optimal control problems are important for commonly used advanced control strategies, such as model predictive control (MPC), but can also be useful for advanced estimation techniques, such as moving horizon estimation (MHE). In MPC, the control input is computed by solving a constrained finite-time optimal control (CFTOC) problem on-line, and in MHE the estimated states are obtained by solving an optimization problem that often can be formulated as a CFTOC problem. Common types of optimization methods for solving CFTOC problems are interior-point (IP) methods, sequential quadratic programming (SQP) methods and active-set (AS) methods. In these types of methods, the main computational effort is often the computation of the second-order search directions. This boils down to solving a sequence of systems of equations that correspond to unconstrained finite-time optimal control (UFTOC) problems. Hence, high-performing second-order methods for CFTOC problems rely on efficient numerical algorithms for solving UFTOC problems. Developing such algorithms is one of the main focuses in this thesis. When the solution to a CFTOC problem is computed using an AS type method, the aforementioned system of equations is only changed by a low-rank modification between two AS iterations. In this thesis, it is shown how to exploit these structured modifications while still exploiting structure in the UFTOC problem using the Riccati recursion. Furthermore, direct (non-iterative) parallel algorithms for computing the search directions in IP, SQP and AS methods are proposed in the thesis. These algorithms exploit, and retain, the sparse structure of the UFTOC problem such that no dense system of equations needs to be solved serially as in many other algorithms. The proposed algorithms can be applied recursively to obtain logarithmic computational complexity growth in the prediction horizon length. For the case with linear MPC problems, an alternative approach to solving the CFTOC problem on-line is to use multiparametric quadratic programming (mp-QP), where the corresponding CFTOC problem can be solved explicitly off-line. This is referred to as explicit MPC. One of the main limitations with mp-QP is the amount of memory that is required to store the parametric solution. In this thesis, an algorithm for decreasing the required amount of memory is proposed. The aim is to make mp-QP and explicit MPC more useful in practical applications, such as embedded systems with limited memory resources. The proposed algorithm exploits the structure from the QP problem in the parametric solution in order to reduce the memory footprint of general mp-QP solutions, and in particular, of explicit MPC solutions. The algorithm can be used directly in mp-QP solvers, or as a post-processing step to an existing solution.

Exploiting Direct Optimal Control for Motion Planning in Unstructured Environments Walter de Gruyter GmbH & Co KG

This book has become the standard for a complete, state-of-the-art description of the methods for unconstrained optimization and systems of nonlinear equations. Originally published in 1983, it provides information needed to understand both the theory and the practice of these methods and provides pseudocode for the problems. The algorithms covered are all based on Newton's method or "quasi-Newton" methods, and the heart of the book is the material on computational methods for multidimensional unconstrained optimization and nonlinear equation problems. The republication of this book by SIAM is driven by a continuing demand for specific and sound advice on how to solve real problems. The level of presentation is consistent throughout, with a good mix of examples and theory, making it a valuable text at both the graduate and undergraduate level. It has been praised as excellent for courses with approximately the same name as the book title and would also be useful as a supplemental text for a nonlinear programming or a numerical analysis course. Many exercises are provided to illustrate and develop the ideas in the text. A large appendix provides a mechanism for class projects and a reference for readers who want the details of the algorithms. Practitioners may use this book for self-study and reference. For complete understanding, readers should have a background in calculus and linear algebra. The book does contain background material in multivariable calculus and numerical linear algebra.

Numerical Optimization Techniques North Holland

The Portable, Extensible Toolkit for Scientific Computation (PETSc) is an open-source library of advanced data structures and methods for solving linear and nonlinear equations and for managing discretizations. This book uses these modern numerical tools to demonstrate how to solve nonlinear partial differential equations (PDEs) in parallel. It starts from key mathematical concepts, such as Krylov space methods, preconditioning, multigrid, and Newton’s method. In PETSc these components are composed at run time into fast solvers. Discretizations are introduced from the beginning, with an emphasis on finite difference and finite element methodologies. The example C programs of the first 12 chapters, listed on the inside front cover, solve (mostly) elliptic and parabolic PDE problems. Discretization leads to large, sparse, and generally nonlinear systems of algebraic equations. For such problems, mathematical solver concepts are explained and illustrated through the examples, with sufficient context to speed further development. PETSc for Partial Differential Equations addresses both discretizations and fast solvers for PDEs, emphasizing practice more than theory. Well-structured examples lead to run-time choices that result in high solver performance and parallel scalability. The last two chapters build on the reader’s understanding of fast solver concepts when applying the Firedrake Python finite element solver library. This textbook, the first to cover PETSc programming for nonlinear PDEs, provides an on-ramp for graduate students and researchers to a major area of high-performance computing for science and engineering. It is suitable as a supplement for courses in scientific computing or numerical methods for differential equations.

Engineering Design Optimization Springer Science & Business Media

Papers from a workshop held at Cornell University, Oct. 1989, and sponsored by Cornell's Mathematical Sciences Institute. Annotation copyright Book News, Inc. Portland, Or.

Practical Optimization SIAM

This book provides the foundations of the theory of nonlinear optimization as well as some related algorithms and presents a variety of applications from diverse areas of applied sciences. The author combines three pillars of optimization?theoretical and algorithmic foundation, familiarity with various applications, and the ability to apply the theory and algorithms on actual problems?and rigorously and gradually builds the connection between theory, algorithms, applications, and implementation. Readers will find more than 170 theoretical, algorithmic, and numerical exercises that deepen and enhance the reader's understanding of the topics. The author includes offers several subjects not typically found in optimization books?for example, optimality conditions in sparsity-constrained optimization, hidden convexity, and total least squares. The book also offers a large number of applications discussed theoretically and algorithmically, such as circle fitting, Chebyshev center, the Fermat?Weber problem, denoising, clustering, total least squares, and orthogonal regression and theoretical and algorithmic topics demonstrated by the MATLAB? toolbox CVX and a package of m-files that is posted on the book?s web site.

Optimization Springer

Sensitivity analysis and optimal shape design are key issues in engineering that have been affected by advances in numerical tools currently available. This book, and its supplementary online files, presents basic optimization techniques that can be used to compute the sensitivity of a given design to local change, or to improve its performance by local optimization of these data. The relevance and scope of these techniques have improved dramatically in recent years because of progress in discretization strategies, optimization algorithms, automatic differentiation, software availability, and the power of personal computers. Numerical Methods in Sensitivity Analysis and Shape Optimization will be of interest to graduate students involved in mathematical modeling and simulation, as well as engineers and researchers in applied mathematics looking for an up-to-date introduction to optimization techniques, sensitivity analysis, and optimal design.

Engineering Optimization 2014 Springer Science & Business Media

This book presents basic optimization principles and gradient-based algorithms to a general audience, in a brief and easy-to-read form. It enables professionals to apply optimization theory to engineering, physics, chemistry, or business economics.

Numerical Optimization Cambridge University Press

There has been much recent progress in approximation algorithms for nonconvex continuous and discrete problems from both a theoretical and a practical perspective. In discrete (or combinatorial) optimization many approaches have been developed recently that link the discrete universe to the continuous universe through geomet ric, analytic, and algebraic techniques. Such techniques include global optimization formulations, semidefinite programming, and spectral theory. As a result new ap proximate algorithms have been discovered and many new computational approaches have been developed. Similarly, for many continuous nonconvex optimization prob lems, new approximate algorithms have been developed based on semidefinite pro gramming and new randomization techniques. On the other hand, computational complexity, originating from the interactions between computer science and numeri cal optimization, is one of the major theories that have revolutionized the approach to solving optimization problems and to analyzing their intrinsic difficulty. The main focus of complexity is the study of whether existing algorithms are efficient for the solution of problems, and which problems are likely to be tractable. The quest for developing efficient algorithms leads also to elegant general approaches for solving optimization problems, and reveals surprising connections among problems and their solutions. A conference on Approximation and Complexity in Numerical Optimization: Con tinuous and Discrete Problems was held during February 28 to March 2, 1999 at the Center for Applied Optimization of the University of Florida.