Linear Optimal Control Systems

Parallel Algorithms for Optimal Control of Large Scale Linear Systems
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Optimal Control
Optimal Control Systems

JAMARI REYNA

Parallel Algorithms for Optimal Control of Large Scale Linear Systems CRC Press

Successfully classroom-tested at the graduate level, Linear Control Theory: Structure, Robustness, and Optimization covers three major areas of control

engineering (PID control, robust control, and optimal control). It provides balanced coverage of elegant mathematical theory and useful engineering-oriented results. The first part of the book develops results relating to the design of PID and first-order controllers for continuous and discrete-time linear systems with possible delays. The second section deals with the robust stability and performance of systems under parametric and unstructured uncertainty. This section describes several elegant and sharp results, such as Kharitonov's theorem and its extensions, the edge theorem, and the mapping theorem. Focusing on the optimal control of linear systems, the third part discusses the standard theories of the linear quadratic regulator, Hinfinity and l1 optimal control, and associated results. Written by recognized leaders in the field, this book explains how control theory can be applied to the design of real-world systems. It shows that the techniques of three term controllers, along with the results on robust and optimal control, are invaluable to developing and solving research problems in many areas of engineering.

An Introduction to State-Space Methods
CRC Press
Preface; List of symbols; Introduction; Analysis of control systems; Multivariable systems; Vector

random processes; Performance; Robustness; The linear quadratic regulator; The Kalman filter; Linear quadratic Gaussian control; Control; Ful information control estimation; H [infinity symbol] output feedback; Controller order reduction; Appendix: Mathematical notes.

An Algorithm for Linear Optimal Control Systems with State Space Constraints

Springer Science & Business Media

At present, in order to resolve problems of ecology and to save mineral resources for future population generations, it is quite necessary to know how to maintain nature arrangement in an efficient way. It is possible to achieve a rational nature arrangement when analyzing solutions to problems concerned with optimal control of distributed systems and with optimization of modes in which main ground medium processes are functioning (motion of liquids, generation of temperature fields, mechanical deformation of multicomponent media). Such analysis becomes even more difficult because of heterogeneity of the region that is closest to the Earth surface, and thin inclusions/cracks in it exert their essential influence onto a state and development of the mentioned processes, especially in the cases of mining. Many researchers, for instance, A.N. Tikhonov - A.A. Samarsky [121],

L. Luckner - W.M. Shestakow [65], Tien-Mo Shih, K.L. Johnson [47], E. Sanchez-Palencia [94] and others stress that it is necessary to consider how thin inclusions/cracks exert their influences onto development of these processes, while such inclusions differ in characteristics from main media to a considerable extent (moisture permeability, permeability to heat, bulk density or shear strength may be mentioned). Xll An influence exerted from thin interlayers onto examined processes is taken into account sufficiently adequately by means of various constraints, namely, by the conjugation conditions [4, 8, 10, 15, 17-20, 22-26, 38, 44, 47, 52, 53, 68, 76, 77, 81, 83, 84, 90, 95, 96-100, 112-114, 117, 123].

Predictive Control for Linear and Hybrid Systems CRC Press CD-ROM contains: MATLAB codes of the OPTEST toolbox -- Code for examples, figures, and selected problems in text.

Kalman Filtering Wiley-Interscience This best-selling text focuses on the analysis and design of complicated dynamics systems. CHOICE called it “a high-level, concise book that could well be used as a reference by engineers, applied mathematicians, and undergraduates. The format is good, the presentation clear, the diagrams instructive, the examples and problems helpful...References

and a multiple-choice examination are included."
Equivalence of Quadratic Performance Indices for Linear Optimal Control Systems Springer Science & Business Media
Optimal control deals with the problem of finding a control law for a given system such that a certain optimality criterion is achieved. An optimal control is a set of differential equations describing the paths of the control variables that minimize the cost functional. This book, Continuous Time Dynamical Systems: State Estimation and Optimal Control with Orthogonal Functions, considers different classes of systems with quadratic performance criteria. It then attempts to find the optimal control law for each class of systems using orthogonal functions that can optimize the given performance criteria. Illustrated throughout with detailed examples, the book covers topics including: Block-pulse functions and shifted Legendre polynomials State estimation of linear time-invariant systems Linear optimal control systems incorporating observers Optimal control of systems described by integro-differential equations Linear-quadratic-Gaussian control Optimal control of singular systems Optimal control of time-delay systems with and without reverse time terms Optimal control of second-order nonlinear

systems Hierarchical control of linear time-invariant and time-varying systems *Concepts of General System Theory in the Linear Optimal Control Problem* CRC Press This book is based on lectures from a one-year course at the Far Eastern Federal University (Vladivostok, Russia) as well as on workshops on optimal control offered to students at various mathematical departments at the university level. The main themes of the theory of linear and nonlinear systems are considered, including the basic problem of establishing the necessary and sufficient conditions of optimal processes. In the first part of the course, the theory of linear control systems is constructed on the basis of the separation theorem and the concept of a reachability set. The authors prove the closure of a reachability set in the class of piecewise continuous controls, and the problems of controllability, observability, identification, performance and terminal control are also considered. The second part of the course is devoted to nonlinear control systems. Using the method of variations and the Lagrange multipliers rule of nonlinear problems, the authors prove the Pontryagin maximum principle for problems with mobile ends of trajectories. Further exercises and a large number of additional

tasks are provided for use as practical training in order for the reader to consolidate the theoretical material.

Optimal Control Springer Science & Business Media

Designed for one-semester introductory senior-or graduate-level course, the authors provide the student with an introduction of analysis techniques used in the design of nonlinear and optimal feedback control systems. There is special emphasis on the fundamental topics of stability, controllability, and optimality, and on the corresponding geometry associated with these topics. Each chapter contains several examples and a variety of exercises.

Optimal Control and Estimation Springer

Linear Optimal Control SystemsLinear Optimal Control SystemsWiley-Interscience

Structure, Robustness, and Optimization CRC Press

Linear optimal control theory has produced an important synthesis technique for the design of linear multivariable systems. In the present study, efficient design procedures, based on the general optimal theory, have been developed. These procedures make use of design techniques which are similar to the conventional methods of control system analysis. Specifically, a scalar expression is developed which relates the closed-loop poles of the multi-controller, multi-output optimal system to the

weighting parameters of a quadratic performance index. Methods analogous to the root locus and Bode plot techniques are then developed for the systematic analysis of this expression. Examples using the aircraft longitudinal equations of motion to represent the object to be controlled are presented to illustrate design procedures which can be carried out in either the time or frequency domains. Both the model-in -the-performance-index and model-following concepts are employed in several of the examples to illustrate the model approach to optimal design.

Linear Systems and Optimal Control

Cambridge University Press

The theory of optimal control systems has grown and flourished since the 1960's. Many texts, written on varying levels of sophistication, have been published on the subject. Yet even those purportedly designed for beginners in the field are often riddled with complex theorems, and many treatments fail to include topics that are essential to a thorough grounding in the various aspects of and approaches to optimal control. Optimal Control Systems provides a comprehensive but accessible treatment of the subject with just the right degree of mathematical rigor to be complete but practical. It provides a solid bridge between "traditional" optimization using the

calculus of variations and what is called "modern" optimal control. It also treats both continuous-time and discrete-time optimal control systems, giving students a firm grasp on both methods. Among this book's most outstanding features is a summary table that accompanies each topic or problem and includes a statement of the problem with a step-by-step solution. Students will also gain valuable experience in using industry-standard MATLAB and SIMULINK software, including the Control System and Symbolic Math Toolboxes. Diverse applications across fields from power engineering to medicine make a foundation in optimal control systems an essential part of an engineer's background. This clear, streamlined presentation is ideal for a graduate level course on control systems and as a quick reference for working engineers.

Cambridge University Press

The lectures gathered in this volume present some of the different aspects of Mathematical Control Theory. Adopting the point of view of Geometric Control Theory and of Nonlinear Control Theory, the lectures focus on some aspects of the Optimization and Control of nonlinear, not necessarily smooth, dynamical systems. Specifically, three of the five lectures discuss respectively: logic-

based switching control, sliding mode control and the input to the state stability paradigm for the control and stability of nonlinear systems. The remaining two lectures are devoted to Optimal Control: one investigates the connections between Optimal Control Theory, Dynamical Systems and Differential Geometry, while the second presents a very general version, in a non-smooth context, of the Pontryagin Maximum Principle. The arguments of the whole volume are self-contained and are directed to everyone working in Control Theory. They offer a sound presentation of the methods employed in the control and optimization of nonlinear dynamical systems.

Optimal Control Of Singularly Perturbed Linear Systems And Applications Springer This book is devoted to the development of optimal control theory for finite dimensional systems governed by deterministic and stochastic differential equations driven by vector measures. The book deals with a broad class of controls, including regular controls (vector-valued measurable functions), relaxed controls (measure-valued functions) and controls determined by vector measures, where both fully and partially observed control problems are considered. In the past few decades, there have been remarkable advances in the field of

systems and control theory thanks to the unprecedented interaction between mathematics and the physical and engineering sciences. Recently, optimal control theory for dynamic systems driven by vector measures has attracted increasing interest. This book presents this theory for dynamic systems governed by both ordinary and stochastic differential equations, including extensive results on the existence of optimal controls and necessary conditions for optimality. Computational algorithms are developed based on the optimality conditions, with numerical results presented to demonstrate the applicability of the theoretical results developed in the book. This book will be of interest to researchers in optimal control or applied functional analysis interested in applications of vector measures to control theory, stochastic systems driven by vector measures, and related topics. In particular, this self-contained account can be a starting point for further advances in the theory and applications of dynamic systems driven and controlled by vector measures.

The Time Optimal and Norm Optimal Problems Elsevier

Many practical control problems are dominated by characteristics such as state, input and operational constraints,

alternations between different operating regimes, and the interaction of continuous-time and discrete event systems. At present no methodology is available to design controllers in a systematic manner for such systems. This book introduces a new design theory for controllers for such constrained and switching dynamical systems and leads to algorithms that systematically solve control synthesis problems. The first part is a self-contained introduction to multiparametric programming, which is the main technique used to study and compute state feedback optimal control laws. The book's main objective is to derive properties of the state feedback solution, as well as to obtain algorithms to compute it efficiently. The focus is on constrained linear systems and constrained linear hybrid systems. The applicability of the theory is demonstrated through two experimental case studies: a mechanical laboratory process and a traction control system developed jointly with the Ford Motor Company in Michigan.

An Introduction to the Theory and Its Applications Courier Corporation

From the very beginning in the late 1950s of the basic ideas of optimal control, attitudes toward the topic in the scientific and

engineering community have ranged from an excessive enthusiasm for its reputed capability ofsolving almost any kind of problem to an (equally) unjustified rejection of it as a set of abstract mathematical concepts with no real utility. The truth, apparently, lies somewhere between these two extremes. Intense research activity in the field of optimization, in particular with reference to robust control issues, has caused it to be regarded as a source of numerous useful, powerful, and flexible tools for the control system designer. The new stream of research is deeply rooted in the well-established framework of linear quadratic gaussian control theory, knowledge ofwhich is an essential requirement for a fruitful understanding of optimization. In addition, there appears to be a widely shared opinion that some results of variational techniques are particularly suited for an approach to nonlinear solutions for complex control problems. For these reasons, even though the first significant achievements in the field were published some forty years ago, a new presentation ofthe basic elements ofclassical optimal control theory from a tutorial point of view seems meaningful and contemporary. This text draws heavily on the content ofthe Italian language textbook "Con trollo

ottimo" published by Pitagora and used in a number of courses at the Politec nico of Milan.

Linear Control Theory Courier Corporation

With a simple approach that includes real-time applications and algorithms, this book covers the theory of model predictive control (MPC).

Optimal and Robust Control Springer Nature

Graduate-level text provides introduction to optimal control theory for stochastic systems, emphasizing application of basic concepts to real problems.

Optimal Control 1973.

Parallel Algorithms for Optimal Control of Large Scale Linear Systems is a comprehensive presentation for both linear and bilinear systems. The parallel algorithms presented in this book are applicable to a wider class of practical systems than those served by traditional methods for large scale singularly perturbed and weakly coupled systems based on the power-series expansion methods. It is intended for scientists and advance graduate students in electrical engineering and computer science who deal with parallel algorithms and control systems, especially large scale systems. The material presented is both comprehensive and unique.

Linear Optimal Control Systems Courier Corporation

Highlighing the Hamiltonian approach

to singularly perturbed linear optimal control systems, this volume develops parallel algorithms in independent slow and fast time scales to solve various optimal linear control and filtering problems.
Continuous Time Dynamical Systems
Cambridge Scholars Publishing
Individual turnpike results are of great interest due to their numerous applications in engineering and in economic theory; in this book the study is focused on new results of turnpike phenomenon in linear optimal control problems. The book is intended for engineers as well as for mathematicians interested in the calculus of variations, optimal control and in applied functional analysis. Two large classes of problems are studied in more depth. The first class studied in Chapter 2 consists of linear control problems with periodic nonsmooth convex integrands. Chapters 3-5 consist of linear control problems with autonomous convex smooth integrands. Chapter 6 discusses a turnpike property for dynamic zero-sum games with linear constraints. Chapter 7 examines genericity results. In Chapter 8, the description of structure of variational problems with extended-valued integrands is obtained. Chapter 9 ends the exposition with a study of turnpike phenomenon for dynamic games with extended value

integrands.

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