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An Introduction to Optimal Control Problems in Life Sciences and Economics - Springer 2012-04-24

Optimal Control Problems for Partial Differential Equations on Reticulated Domains - Peter I. Kogut 2011-09-09

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

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

Optimal Control of Random Sequences in Problems with Constraints - A.B. Piunovskiy 2012-12-06

Controlled stochastic processes with discrete time form a very interest ing and meaningful field of research which attracts widespread attention. At the same time these processes are used for solving of many applied problems in the queueing theory, in mathematical economics. in the theory of controlled technical systems, etc. . In this connection, methods of the theory of controlled processes constitute the every day instrument of many specialists working in the areas mentioned. The present book is devoted to the rather new area, that is, to the optimal control theory with functional constraints. This theory is close to the theory of multicriteria optimization. The compromise between the mathematical rigor and the big number of meaningful examples makes the book attractive for professional mathematicians and for specialists who ap ply mathematical methods in different specific problems. Besides. the book contains setting of many new interesting problems for further invf'stigatioll. The book can form the basis of special courses in the theory of controlled stochastic processes for students and post-graduates specializing in the ap plied mathematics and in the control theory of complex systf'ms. The grounding of graduating students of mathematical department is sufficient for the perfect understanding of all the material. The book con tains the extensive Appendix where the necessary knowledge ill Borel spaces and in convex analysis is collected. All the meaningful examples can be also understood by readers who are not deeply grounded in mathematics.

Introduction to Optimal Control - Ian McCausland 1977

Nonlinear Optimal Control Theory - Leonard David Berkovitz 2012-08-25

Nonlinear Optimal Control Theory presents a deep, wide-ranging introduction to the mathematical theory of the optimal control of processes governed by ordinary differential equations and certain types of differential equations with memory. Many examples illustrate the mathematical issues that need to be addressed when using 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 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 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.

Deterministic and Stochastic Optimal Control - Wendell H. Fleming 2012-12-06

This book may be regarded as consisting of two parts. In Chapters I-IV we pre sent what we regard as essential topics in an introduction to deterministic optimal control theory. This material has been used by the authors for one semester graduate-level courses at Brown University and the University of Kentucky. The simplest problem in calculus of variations is taken as the point of departure, in Chapter I. Chapters II, III, and IV deal with necessary conditions for an opti mum, existence and regularity theorems for optimal controls, and the method of dynamic programming. The beginning reader may find it useful first to learn the main results, corollaries, and examples. These tend to be found in the earlier parts of each chapter. We have deliberately postponed some difficult technical proofs to later parts of these chapters. In the second part of the book we give an introduction to stochastic optimal control for Markov diffusion processes. Our treatment follows the dynamic pro gramming method, and depends on the intimate relationship between second order partial differential equations of parabolic type and stochastic differential equations. This relationship is reviewed in Chapter V, which may be read inde pendently of Chapters I-IV. Chapter VI is based to a considerable extent on the authors' work in stochastic control since 1961. It also includes two other topics important for applications, namely, the solution to the stochastic linear regulator and the separation principle.

Optimal Control - Leslie M. Hocking 1991

Systems that evolve with time occur frequently in nature and modelling the behavior of such systems provides an important application of mathematics. These systems can be completely deterministic, but it may be possible too to control their behavior by intervention through "controls". The theory of optimal control is concerned with determining such controls which, at minimum cost, either direct the system along a given trajectory or enable it to reach a given point in its state space. This textbook is a straightforward introduction to the theory of optimal control with an emphasis on presenting many different applications. Professor Hocking has taken pains to ensure that the theory is developed to display the main themes of the arguments but without using sophisticated mathematical tools. Problems in this setting can arise across a wide range of subjects and there are illustrative examples of systems from fields as diverse as

dynamics, economics, population control, and medicine. Throughout there are many worked examples, and numerous exercises (with solutions) are provided.

Optimal Control of Stochastic Difference Volterra Equations - Leonid Shaikhet 2014-11-27

This book showcases a subclass of hereditary systems, that is, systems with behaviour depending not only on their current state but also on their past history; it is an introduction to the mathematical theory of optimal control for stochastic difference Volterra equations of neutral type. As such, it will be of much interest to researchers interested in modelling processes in physics, mechanics, automatic regulation, economics and finance, biology, sociology and medicine for all of which such equations are very popular tools. The text deals with problems of optimal control such as meeting given performance criteria, and stabilization, extending them to neutral stochastic difference Volterra equations. In particular, it contrasts the difference analogues of solutions to optimal control and optimal estimation problems for stochastic integral Volterra equations with optimal solutions for corresponding problems in stochastic difference Volterra equations. Optimal Control of Stochastic Difference Volterra Equations commences with an historical introduction to the emergence of this type of equation with some additional mathematical preliminaries. It then deals with the necessary conditions for optimality in the control of the equations and constructs a feedback control scheme. The approximation of stochastic quasilinear Volterra equations with quadratic performance functionals is then considered. Optimal stabilization is discussed and the filtering problem formulated. Finally, two methods of solving the optimal control problem for partly observable linear stochastic processes, also with quadratic performance functionals, are developed. Integrating the author's own research within the context of the current state-of-the-art of research in difference equations, hereditary systems theory and optimal control, this book is addressed to specialists in mathematical optimal control theory and to graduate students in pure and applied mathematics and control engineering.

Nonlinear and Optimal Control Systems - Thomas L. Vincent 1997-06-23

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.

Lectures on the Calculus of Variations and Optimal Control Theory -

Laurence Chisholm Young 2000

This book is divided into two parts. The first addresses the simpler variational problems in parametric and nonparametric form. The second covers extensions to optimal control theory. The author opens with the study of three classical problems whose solutions led to the theory of calculus of variations. They are the problem of geodesics, the brachistochrone, and the minimal surface of revolution. He gives a detailed discussion of the Hamilton-Jacobi theory, both in the parametric and nonparametric forms. This leads to the development of sufficiency theories describing properties of minimizing extremal arcs. Next, the author addresses existence theorems. He first develops Hilbert's basic existence theorem for parametric problems and studies some of its consequences. Finally, he develops the theory of generalized curves and "automatic" existence theorems. In the second part of the book, the author discusses optimal control problems. He notes that originally these problems were formulated as problems of Lagrange and Mayer in terms of differential constraints. In the control formulation, these constraints are expressed in a more convenient form in terms of control functions. After pointing out the new phenomenon that may arise, namely, the lack of controllability, the author develops the maximum principle and illustrates this principle by standard examples that show the switching phenomena that may occur. He extends the theory of geodesic coverings to optimal control problems. Finally, he extends the problem to generalized optimal control problems and obtains the corresponding existence theorems.

Optimal Control - Vladimir Vasil□evich Belet□s□ki□ 2001-03

From the reviews: "The style of the book reflects the author’s wish to assist in the effective learning of optimal control by suitable choice of topics, the mathematical level used, and by including numerous illustrated examples. . . .In my view the book suits its function and purpose, in that it gives a student a comprehensive coverage of optimal control in an easy-to-read fashion." –Measurement and Control

An Introduction to Optimal Control Problems in Life Sciences and Economics - Sebastian Ani□a 2011-05-05

Combining control theory and modeling, this textbook introduces and builds on methods for simulating and tackling concrete problems in a variety of applied sciences. Emphasizing "learning by doing," the authors focus on examples and applications to real-world problems. An elementary presentation of advanced concepts, proofs to introduce new ideas, and carefully presented MATLAB® programs help foster an understanding of the basics, but also lead the way to new, independent research. With minimal prerequisites and exercises in each chapter, this work serves as an excellent textbook and reference for graduate and advanced

undergraduate students, researchers, and practitioners in mathematics, physics, engineering, computer science, as well as biology, biotechnology, economics, and finance.

Optimal Control Theory - L.D. Berkovitz 2013-03-14

This book is an introduction to the mathematical theory of optimal control of processes governed by ordinary differential eq- tions. It is intended for students and professionals in mathematics and in areas of application who want a broad, yet relatively deep, concise and coherent introduction to the subject and to its relati- ship with applications. In order to accommodate a range of mathema- cal interests and backgrounds among readers, the material is arranged so that the more advanced mathematical sections can be omitted wi- out loss of continuity. For readers primarily interested in appli- tions a recommended minimum course consists of Chapter I, the sections of Chapters II, III, and IV so recommended in the introductory sec tions of those chapters, and all of Chapter V. The introductory sec tion of each chapter should further guide the individual reader toward material that is of interest to him. A reader who has had a good course in advanced calculus should be able to understand the defini tions and statements of the theorems and should be able to follow a substantial portion of the mathematical development. The entire book can be read by someone familiar with the basic aspects of Lebesque integration and functional analysis. For the reader who wishes to find out more about applications we recommend references [2], [13], [33], [35], and [50], of the Bibliography at the end of the book.

Lecture Notes Containing an Elementary Introduction to Optimal Control - John Markus Blatt 1981

An Introduction to Applied Optimal Control - Knowles 1982-03-18

An Introduction to Applied Optimal Control

The Calculus of Variations and Optimal Control - George Leitmann 2013-06-29

When the Tyrian princess Dido landed on the North African shore of the Mediterranean sea she was welcomed by a local chieftain. He offered her all the land that she could enclose between the shoreline and a rope of knotted cowhide. While the legend does not tell us, we may assume that Princess Dido arrived at the correct solution by stretching the rope into the shape of a circular arc and thereby maximized the area of the land upon which she was to found Carthage. This story of the founding of Carthage is apocryphal. Nonetheless it is probably the first account of a problem of the kind that inspired an entire mathematical discipline, the calculus of variations and its extensions such as the theory of optimal control. This book is intended to present an introductory treatment of the calculus of

variations in Part I and of optimal control theory in Part II. The discussion in Part I is restricted to the simplest problem of the calculus of variations. The topic is entirely classical; all of the basic theory had been developed before the turn of the century. Consequently the material comes from many sources; however, those most useful to me have been the books of Oskar Bolza and of George M. Ewing. Part II is devoted to the elementary aspects of the modern extension of the calculus of variations, the theory of optimal control of dynamical systems.

Stochastic Optimal Control in Infinite Dimension - Giorgio Fabbri 2017-06-22

Providing an introduction to stochastic optimal control in infinite dimension, this book gives a complete account of the theory of second-order HJB equations in infinite-dimensional Hilbert spaces, focusing on its applicability to associated stochastic optimal control problems. It features a general introduction to optimal stochastic control, including basic results (e.g. the dynamic programming principle) with proofs, and provides examples of applications. A complete and up-to-date exposition of the existing theory of viscosity solutions and regular solutions of second-order HJB equations in Hilbert spaces is given, together with an extensive survey of other methods, with a full bibliography. In particular, Chapter 6, written by M. Fuhrman and G. Tessitore, surveys the theory of regular solutions of HJB equations arising in infinite-dimensional stochastic control, via BSDEs. The book is of interest to both pure and applied researchers working in the control theory of stochastic PDEs, and in PDEs in infinite dimension. Readers from other fields who want to learn the basic theory will also find it useful. The prerequisites are: standard functional analysis, the theory of semigroups of operators and its use in the study of PDEs, some knowledge of the dynamic programming approach to stochastic optimal control problems in finite dimension, and the basics of stochastic analysis and stochastic equations in infinite-dimensional spaces.

Introduction to Optimal Control Theory - Jack Macki 2012-12-06

This monograph is an introduction to optimal control theory for systems governed by vector ordinary differential equations. It is not intended as a state-of-the-art handbook for researchers. We have tried to keep two types of reader in mind: (1) mathematicians, graduate students, and advanced undergraduates in mathematics who want a concise introduction to a field which contains nontrivial interesting applications of mathematics (for example, weak convergence, convexity, and the theory of ordinary differential equations); (2) economists, applied scientists, and engineers who want to understand some of the mathematical foundations. of optimal control theory. In general, we have emphasized motivation and explanation, avoiding the "definition-axiom-theorem-proof" approach. We

make use of a large number of examples, especially one simple canonical example which we carry through the entire book. In proving theorems, we often just prove the simplest case, then state the more general results which can be proved. Many of the more difficult topics are discussed in the "Notes" sections at the end of chapters and several major proofs are in the Appendices. We feel that a solid understanding of basic facts is best attained by at first avoiding excessive generality. We have not tried to give an exhaustive list of references, preferring to refer the reader to existing books or papers with extensive bibliographies. References are given by author's name and the year of publication, e.g., Waltman [1974].

Optimal Control of ODEs and DAEs - Matthias Gerdts 2012-01-01

The intention of this textbook is to provide both, the theoretical and computational tools that are necessary to investigate and to solve optimal control problems with ordinary differential equations and differential-algebraic equations. An emphasis is placed on the interplay between the continuous optimal control problem, which typically is defined and analyzed in a Banach space setting, and discrete optimal control problems, which are obtained by discretization and lead to finite dimensional optimization problems.

Calculus of Variations and Optimal Control Theory - Daniel Liberzon 2012

This textbook offers a concise yet rigorous introduction to calculus of variations and optimal control theory, and is a self-contained resource for graduate students in engineering, applied mathematics, and related subjects. Designed specifically for a one-semester course, the book begins with calculus of variations, preparing the ground for optimal control. It then gives a complete proof of the maximum principle and covers key topics such as the Hamilton-Jacobi-Bellman theory of dynamic programming and linear-quadratic optimal control. Calculus of Variations and Optimal Control Theory also traces the historical development of the subject and features numerous exercises, notes and references at the end of each chapter, and suggestions for further study. Offers a concise yet rigorous introduction Requires limited background in control theory or advanced mathematics Provides a complete proof of the maximum principle Uses consistent notation in the exposition of classical and modern topics Traces the historical development of the subject Solutions manual (available only to teachers) Leading universities that have adopted this book include: University of Illinois at Urbana-Champaign ECE 553: Optimum Control Systems Georgia Institute of Technology ECE 6553: Optimal Control and Optimization University of Pennsylvania ESE 680: Optimal Control Theory University of Notre Dame EE 60565: Optimal Control

Primer on Optimal Control Theory - Jason L. Speyer 2010-05-13

A rigorous introduction to optimal control theory, which will enable

engineers and scientists to put the theory into practice.

An Introduction to Optimal Control Theory - Aaron Strauss 2012-12-06

This paper is intended for the beginner. It is not a state of-the-art paper for research workers in the field of control theory. Its purpose is to introduce the reader to some of the problems and results in control theory, to illustrate the application of these re sults, and to provide a guide for his further reading on this subject. I have tried to motivate the results with examples, especial ly with one canonical, simple example described in §3. Many results, such as the maximum principle, have long and difficult proofs. I have omitted these proofs. In general I have included only the proofs which are either (1) not too difficult or (2) fairly enlightening as to the nature of the result. I have, however, usually attempted to draw the strongest conclusion from a given proof. For example, many existing proofs in control theory for compact targets and uniqueness of solutions also hold for closed targets and non-uniqueness. Finally, at the end of each section I have given references to generalizations and origins of the results discussed in that section. I make no claim of completeness in the references, however, as I have often been content merely to refer the reader either to an exposition or to a paper which has an extensive bibliography. IV These 1ecture notes are revisions of notes I used for aseries of nine 1ectures on contro1 theory at the International Summer Schoo1 on Mathematica1 Systems and Economics held in Varenna, Ita1y, June 1967.

Optimal Control with Engineering Applications - Hans Peter Geering 2007-03-01

This book introduces a variety of problem statements in classical optimal control, in optimal estimation and filtering, and in optimal control problems with non-scalar-valued performance criteria. Many example problems are solved completely in the body of the text. All chapter-end exercises are sketched in the appendix. The theoretical part of the book is based on the calculus of variations, so the exposition is very transparent and requires little mathematical rigor.

Optimal Control Theory - Donald E. Kirk 2012-04-26

Upper-level undergraduate text introduces aspects of optimal control theory: dynamic programming, Pontryagin's minimum principle, and numerical techniques for trajectory optimization. Numerous figures, tables. Solution guide available upon request. 1970 edition.

Optimal Control - Michael Athans 2013-04-26

Geared toward advanced undergraduate and graduate engineering students, this text introduces the theory and applications of optimal control. It serves as a bridge to the technical literature, enabling students to evaluate the implications of theoretical control work, and to judge the

merits of papers on the subject. Rather than presenting an exhaustive treatise, Optimal Control offers a detailed introduction that fosters careful thinking and disciplined intuition. It develops the basic mathematical background, with a coherent formulation of the control problem and discussions of the necessary conditions for optimality based on the maximum principle of Pontryagin. In-depth examinations cover applications of the theory to minimum time, minimum fuel, and to quadratic criteria problems. The structure, properties, and engineering realizations of several optimal feedback control systems also receive attention. Special features include numerous specific problems, carried through to engineering realization in block diagram form. The text treats almost all current examples of control problems that permit analytic solutions, and its unified approach makes frequent use of geometric ideas to encourage students' intuition.

Optimal Control of Partial Differential Equations - Fredi Tröltzsch 2010

Optimal control theory is concerned with finding control functions that minimize cost functions for systems described by differential equations. This book focuses on optimal control problems where the state equation is an elliptic or parabolic partial differential equation. It includes topics on the existence of optimal solutions.

Control and Optimal Control Theories with Applications - D N Burghes 2004-12-15

This sound introduction to classical and modern control theory concentrates on fundamental concepts. Employing the minimum of mathematical elaboration, it investigates the many applications of control theory to varied and important present-day problems, e.g. economic growth, resource depletion, disease epidemics, exploited population, and rocket trajectories. An original feature is the amount of space devoted to the important and fascinating subject of optimal control. The work is divided into two parts. Part one deals with the control of linear time-continuous systems, using both transfer function and state-space methods. The ideas of controllability, observability and minimality are discussed in comprehensible fashion. Part two introduces the calculus of variations, followed by analysis of continuous optimal control problems. Each topic is individually introduced and carefully explained with illustrative examples and exercises at the end of each chapter to help and test the reader's understanding. Solutions are provided at the end of the book. Investigates the many applications of control theory to varied and important present-day problems Deals with the control of linear time-continuous systems, using both transfer function and state-space methods Introduces the calculus of variations, followed by analysis of continuous optimal control problems

Optimal Control: Novel Directions and Applications - Daniela Tonon 2017-09-01

Focusing on applications to science and engineering, this book presents the results of the ITN-FP7 SADCO network's innovative research in optimization and control in the following interconnected topics: optimality conditions in optimal control, dynamic programming approaches to optimal feedback synthesis and reachability analysis, and computational developments in model predictive control. The novelty of the book resides in the fact that it has been developed by early career researchers, providing a good balance between clarity and scientific rigor. Each chapter features an introduction addressed to PhD students and some original contributions aimed at specialist researchers. Requiring only a graduate mathematical background, the book is self-contained. It will be of particular interest to graduate and advanced undergraduate students, industrial practitioners and to senior scientists wishing to update their knowledge.

Singular Optimal Control Problems - David John Bell 1975

In this book, we study theoretical and practical aspects of computing methods for mathematical modelling of nonlinear systems. A number of computing techniques are considered, such as methods of operator approximation with any given accuracy; operator interpolation techniques including a non-Lagrange interpolation; methods of system representation subject to constraints associated with concepts of causality, memory and stationarity; methods of system representation with an accuracy that is the best within a given class of models; methods of covariance matrix estimation; methods for low-rank matrix approximations; hybrid methods based on a combination of iterative procedures and best operator approximation; and methods for information compression and filtering under condition that a filter model should satisfy restrictions associated with causality and different types of memory. As a result, the book represents a blend of new methods in general computational analysis, and specific, but also generic, techniques for study of systems theory ant its particular branches, such as optimal filtering and information compression. - Best operator approximation, - Non-Lagrange interpolation, - Generic Karhunen-Loeve transform - Generalised low-rank matrix approximation - Optimal data compression - Optimal nonlinear filtering

An Introduction to Optimal Control Theory - Onésimo Hernández-Lerma 2023-02-21

This book introduces optimal control problems for large families of deterministic and stochastic systems with discrete or continuous time parameter. These families include most of the systems studied in many disciplines, including Economics, Engineering, Operations Research, and Management Science, among many others. The main objective is to give a

concise, systematic, and reasonably self contained presentation of some key topics in optimal control theory. To this end, most of the analyses are based on the dynamic programming (DP) technique. This technique is applicable to almost all control problems that appear in theory and applications. They include, for instance, finite and infinite horizon control problems in which the underlying dynamic system follows either a deterministic or stochastic difference or differential equation. In the infinite horizon case, it also uses DP to study undiscounted problems, such as the ergodic or long-run average cost. After a general introduction to control problems, the book covers the topic dividing into four parts with different dynamical systems: control of discrete-time deterministic systems, discrete-time stochastic systems, ordinary differential equations, and finally a general continuous-time MCP with applications for stochastic differential equations. The first and second part should be accessible to undergraduate students with some knowledge of elementary calculus, linear algebra, and some concepts from probability theory (random variables, expectations, and so forth). Whereas the third and fourth part would be appropriate for advanced undergraduates or graduate students who have a working knowledge of mathematical analysis (derivatives, integrals, ...) and stochastic processes.

Optimal Control - Leonid T. Ashchepkov 2022-01-12

This textbook, now in its second edition, results from lectures, practical problems, and workshops on Optimal Control, given by the authors at Irkutsk State University, Far Eastern Federal University (both in Vladivostok, Russia), and Kwangwoon University (Seoul, South Korea). In this work, the authors cover the theory of linear and nonlinear systems, touching on the basic problem of establishing the necessary and sufficient conditions of optimal processes. Readers will find two new chapters, with results of potential interest to researchers with a focus on the theory of optimal control, as well as to those interested in applications in Engineering and related sciences. In addition, several improvements have been made through the text. This book is structured in three parts. Part I starts with a gentle introduction to the basic concepts in Optimal Control. In Part II, 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 reachability set in the class of piecewise continuous controls and touch on the problems of controllability, observability, identification, performance, and terminal control. Part III, in its turn, 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. Problem sets at the end of chapters and a list of

additional tasks, provided in the appendix, are offered for students seeking to master the subject. The exercises have been chosen not only as a way to assimilate the theory but also as to induct the application of such knowledge in more advanced problems.

Practical Methods for Optimal Control and Estimation Using Nonlinear Programming - John T. Betts 2010-01-01

A focused presentation of how sparse optimization methods can be used to solve optimal control and estimation problems.

Optimal Control in Thermal Engineering - Viorel Badescu 2017-03-14

This book is the first major work covering applications in thermal engineering and offering a comprehensive introduction to optimal control theory, which has applications in mechanical engineering, particularly aircraft and missile trajectory optimization. The book is organized in three parts: The first part includes a brief presentation of function optimization and variational calculus, while the second part presents a summary of the optimal control theory. Lastly, the third part describes several applications of optimal control theory in solving various thermal engineering problems. These applications are grouped in four sections: heat transfer and thermal energy storage, solar thermal engineering, heat engines and lubrication.Clearly presented and easy-to-use, it is a valuable resource for thermal engineers and thermal-system designers as well as postgraduate students.

An Introduction to Optimal Control of FBSDE with Incomplete Information - Guangchen Wang 2018-05-16

This book focuses on maximum principle and verification theorem for incomplete information forward-backward stochastic differential equations (FBSDEs) and their applications in linear-quadratic optimal controls and mathematical finance. Lots of interesting phenomena arising from the area of mathematical finance can be described by FBSDEs. Optimal control problems of FBSDEs are theoretically important and practically relevant. A standard assumption in the literature is that the stochastic noises in the model are completely observed. However, this is rarely the case in real world situations. The optimal control problems under complete information are studied extensively. Nevertheless, very little is known about these problems when the information is not complete. The aim of this book is to fill this gap. This book is written in a style suitable for graduate students and researchers in mathematics and engineering with basic knowledge of stochastic process, optimal control and mathematical finance.

Deterministic Optimal Control - H. Gardner Moyer 2003-03

This textbook is intended for physics students at the senior and graduate level. The first chapter employs Huygens' theory of wavefronts and wavelets to derive Hamilton's equations and the Hamilton-Jacobi equation.

The final section presents a step-by-step precedure for the quanitzation of a Hamiltonian system. The remarkable congruence between particle dynaics and wave packets is shown. The second chapter presents sufficiency conditions for the standard case, broken, and singular extremals. Chapter III presents four schemes that can yield formal integrals of of Hamilton's equations- Killing's, Noether's, Poisson's, and Jacobi's. Chapter IV discusses iterative, numerical algorithms that converge to extremals. Three discontinuous problems are solved in Chapter V - refraction, jump discontinuities specified for state variables, and inequality contrainsts on state variables. The book contains many exercises and examples, in particular the geodesics of a Riemannian manifold.

Optimal Control of PDEs under Uncertainty - Jesús Martínez-Frutos 2018-08-30

This book provides a direct and comprehensive introduction to theoretical and numerical concepts in the emerging field of optimal control of partial differential equations (PDEs) under uncertainty. The main objective of the book is to offer graduate students and researchers a smooth transition from optimal control of deterministic PDEs to optimal control of random PDEs. Coverage includes uncertainty modelling in control problems, variational formulation of PDEs with random inputs, robust and risk-averse formulations of optimal control problems, existence theory and numerical resolution methods. The exposition focusses on the entire path, starting from uncertainty modelling and ending in the practical implementation of numerical schemes for the numerical approximation of the considered problems. To this end, a selected number of illustrative examples are analysed in detail throughout the book. Computer codes, written in MatLab, are provided for all these examples. This book is adressed to graduate students and researches in Engineering, Physics and Mathematics who are interested in optimal control and optimal design for random partial differential equations.

Optimal Control with Engineering Applications - Hans P. Geering 2007-03-23

This book introduces a variety of problem statements in classical optimal control, in optimal estimation and filtering, and in optimal control problems with non-scalar-valued performance criteria. Many example problems are solved completely in the body of the text. All chapter-end exercises are sketched in the appendix. The theoretical part of the book is based on the calculus of variations, so the exposition is very transparent and requires little mathematical rigor.

Optimal Control Theory - Suresh P. Sethi 2022-01-03

This new 4th edition offers an introduction to optimal control theory and its

diverse applications in management science and economics. It introduces students to the concept of the maximum principle in continuous (as well as discrete) time by combining dynamic programming and Kuhn-Tucker theory. While some mathematical background is needed, the emphasis of the book is not on mathematical rigor, but on modeling realistic situations encountered in business and economics. It applies optimal control theory to the functional areas of management including finance, production and marketing, as well as the economics of growth and of natural resources. In addition, it features material on stochastic Nash and Stackelberg differential games and an adverse selection model in the principal-agent framework. Exercises are included in each chapter, while the answers to selected exercises help deepen readers' understanding of the material covered. Also included are appendices of supplementary material on the solution of differential equations, the calculus of variations and its ties to the maximum principle, and special topics including the Kalman filter, certainty equivalence, singular control, a global saddle point theorem, Sethi-Skiba points, and distributed parameter systems. Optimal control methods are used to determine optimal ways to control a dynamic system. The theoretical work in this field serves as the foundation for the book, in which the author applies it to business management problems developed from his own research and classroom instruction. The new edition has been refined and updated, making it a valuable resource for graduate courses on applied optimal control theory, but also for financial and industrial engineers, economists, and operational researchers interested in applying dynamic optimization in their fields.

Geometric Control Theory - Velimir Jurdjevic 1997

Geometric control theory is concerned with the evolution of systems subject to physical laws but having some degree of freedom through which motion is to be controlled. This book describes the mathematical theory inspired by the irreversible nature of time evolving events. The first part of the book deals with the issue of being able to steer the system from any point of departure to any desired destination. The second part deals with optimal control, the question of finding the best possible course. An overlap with mathematical physics is demonstrated by the Maximum principle, a fundamental principle of optimality arising from geometric control, which is applied to time-evolving systems governed by physics as well as to man-made systems governed by controls. Applications are drawn from geometry, mechanics, and control of dynamical systems. The geometric language in which the results are expressed allows clear visual interpretations and makes the book accessible to physicists and engineers as well as to mathematicians.

Optimal Control and Estimation - Robert F. Stengel 1994-09-20

"An excellent introduction to optimal control and estimation theory and its relationship with LQG design. . . . invaluable as a reference for those already familiar with the subject." — Automatica. This highly regarded graduate-level text provides a comprehensive introduction to optimal control theory for stochastic systems, emphasizing application of its basic concepts to real problems. The first two chapters introduce optimal control and review the mathematics of control and estimation. Chapter 3 addresses optimal control of systems that may be nonlinear and time-varying, but whose inputs and parameters are known without error. Chapter 4 of the book presents methods for estimating the dynamic states of a system that is driven by uncertain forces and is observed with random measurement error. Chapter 5 discusses the general problem of stochastic optimal control, and the concluding chapter covers linear time-invariant systems. Robert F. Stengel is Professor of Mechanical and Aerospace Engineering at Princeton University, where he directs the Topical Program on Robotics and Intelligent Systems and the Laboratory for Control and Automation. He was a principal designer of the Project Apollo Lunar Module control system. "An excellent teaching book with many examples and worked problems which would be ideal for self-study or for use in the classroom. . . . The book also has a practical orientation and would be of considerable use to people applying these techniques in practice." — Short Book Reviews, Publication of the International Statistical Institute. "An excellent book which guides the reader through most of the important concepts and techniques. . . . A useful book for students (and their teachers) and for those practicing engineers who require a comprehensive reference to the subject." — Library Reviews, The Royal Aeronautical Society.