Variational Calculus And Optimal Control Optimization With Elementary Convexity Undergraduate Texts In Mathematics

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Foundations of Dynamic Economic Analysis - Michael R. Caputo 2005-01-17
Foundations of Dynamic Economic Analysis presents a modern and thorough exposition of the fundamental mathematical formalism used to study optimal control theory, i.e., continuous time dynamic economic processes, and to interpret dynamic economic behavior. The style of presentation, with its continual emphasis on the economic interpretation of mathematics and models, distinguishes it from several other excellent texts on the subject. This approach is aided dramatically by introducing the dynamic envelope theorem and the method of comparative dynamics early in the exposition. Accordingly, motivated and economically revealing proofs of the transversality conditions come about by use of the dynamic envelope theorem. Furthermore, such sequencing of the material naturally leads to the development of the primal-dual method of comparative dynamics and dynamic duality theory, two modern approaches used to tease out the empirical content of optimal control models. The stylistic approach ultimately draws attention to the empirical richness of optimal control theory, a feature missing in virtually all other textbooks of this type.
Optimal Control - Vladimir Vasilʹevich Beletskiĭ 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
Calculus of Variations and Optimal Control - Alexander Ioffe 2021-02-28
The calculus of variations is a classical area of mathematical analysis-300 years old-yet its myriad applications in science and technology continue to hold great interest and keep it an active area of research. These two volumes contain the referenced proceedings of the international conference on Calculus of Variations and Related Topics held at the Technion-Israel Institute of Technology in March 1998. The conference commemorated 300 years of work in the field and brought together many of its leading experts. The papers in the first volume focus on critical point theory and differential equations. The other volume deals with variational aspects of optimal control. Together they provide a unique opportunity to review the state-of-the-art of the calculus of variations, as presented by an international panel of masters in the field.
Turnpike Properties in the Calculus of Variations and Optimal Control - Alexander Zaslavski 2005-08-25
This book is devoted to the recent progress on the turnpike theory. The turnpike property was discovered by Paul A. Samuelson, who applied it to problems in mathematical economics in 1949. These properties were studied for optimal trajectories of models of economic dynamics determined by convex processes. In this monograph the author, a leading expert in modern turnpike theory, presents a number of results concerning the turnpike properties in the calculus of variations and optimal control which were obtained in the last ten years. These results show that the turnpike properties form a general phenomenon which holds for various classes of variational problems and optimal control problems. The book should help to correct the misapprehension that turnpike properties are only special features of some narrow classes of convex problems of mathematical economics. Audience This book is intended for mathematicians interested in optimal control, calculus of variations, game theory and mathematical economics.
Variational Methods in Shape Optimization Problems - Dorin Bucur 2006-09-13
Shape optimization problems are treated from the classical and modern perspectives Targets a broad audience of graduate students in pure and applied mathematics, as well as engineers requiring a solid mathematical basis for the solution of practical problems Requires only a standard knowledge in the calculus of variations, differential equations, and functional analysis Driven by several good examples and illustrations Poses some open questions.
Relaxation in Optimization Theory and Variational Calculus - Tomáš Roubiček 1997
Introduces applied mathematicians and graduate students to an original relaxation method based on a continuous extension of various optimization problems relating to convex compactification; it can be applied to problems in optimal control theory, the calculus of variations, and non-cooperative game theory. Reviews the background and summarizes the general theory of convex compactifications, then uses it to obtain convex, locally compact envelopes of the Lebesague and Sobolev spaces involved in concrete problems. The nontrivial envelopes cover the classical Young measures as well as various generalizations of them, which can record the limit behavior of fast oscillation and concentration effects. Annotation copyrighted by Book News, Inc., Portland, OR
Optimal Control in Thermal Engineering - Viorel Badescu 2018-07-19
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.
Constrained Optimization In The Calculus Of Variations and Optimal Control Theory - J Gregory 2018-01-18
The major purpose of this book is to present the theoretical ideas and the analytical and numerical methods to enable the reader to understand and efficiently solve these important optimizational problems.The first half of this book should serve as the major component of a classical one or two semester course in the calculus of variations and optimal control theory. The second half of the book will describe the current research of the authors which is directed to solving these problems numerically. In particular, we present new reformulations of constrained problems which leads to unconstrained problems in the calculus of variations and new general, accurate and efficient numerical methods to solve the reformulated problems. We believe that these new methods will allow the reader to solve important problems.
Dynamic Optimization, Second Edition - Morton I. Kamien 2013-04-17
Since its initial publication, this text has defined courses in dynamic optimization taught to economics and management science students. The two-part treatment covers the calculus of variations and optimal control. 1998 edition.
Nonconvex Optimal Control and Variational Problems - Alexander Zaslavski 2014-02-17
Nonconvex Optimal Control and Variational Problems is an important contribution to the existing literature in the field and is devoted to the presentation of progress made in the last 15 years of research in the area of optimal control and the calculus of variations. This volume contains a

number of results concerning well-posedness of optimal control and variational problems, nonoccurrence of the Lavrentiev phenomenon for optimal control and variational problems, and turnpike properties of approximate solutions of variational problems. Chapter 1 contains an introduction as well as examples of select topics. Chapters 2-5 consider the well-posedness condition using fine tools of general topology and porosity. Chapters 6-8 are devoted to the nonoccurrence of the Lavrentiev phenomenon and contain original results. Chapter 9 focuses on infinite-dimensional linear control problems, and Chapter 10 deals with “good” functions and explores new understandings on the questions of optimality and variational problems. Finally, Chapters 11-12 are centered around the turnpike property, a particular area of expertise for the author. This volume is intended for mathematicians, engineers, and scientists interested in the calculus of variations, optimal control, optimization, and applied functional analysis, as well as both undergraduate and graduate students specializing in those areas. The text devoted to Turnpike properties may be of particular interest to the economics community.

Optimization and Approximation - Pablo Pedregal 2017-09-07

This book provides a basic, initial resource, introducing science and engineering students to the field of optimization. It covers three main areas: mathematical programming, calculus of variations and optimal control, highlighting the ideas and concepts and offering insights into the importance of optimality conditions in each area. It also systematically presents affordable approximation methods. Exercises at various levels have been included to support the learning process.

Turnpike Conditions in Infinite Dimensional Optimal Control - Alexander J. Zaslavski 2019-07-23

This book provides a comprehensive study of turnpike phenomenon arising in optimal control theory. The focus is on individual (non-generic) turnpike results which are both mathematically significant and have numerous applications in engineering and economic theory. All results obtained in the book are new. New approaches, techniques, and methods are rigorously presented and utilize research from finite-dimensional variational problems and discrete-time optimal control problems to find the necessary conditions for the turnpike phenomenon in infinite dimensional spaces. The semigroup approach is employed in the discussion as well as PDE descriptions of continuous-time dynamics. The main results on sufficient and necessary conditions for the turnpike property are completely proved and the numerous illustrative examples support the material for the broad spectrum of experts. Mathematicians interested in the calculus of variations, optimal control and in applied functional analysis will find this book a useful guide to the turnpike phenomenon in infinite dimensional spaces. Experts in economic and engineering modeling as well as graduate students will also benefit from the developed techniques and obtained results.

Optimal Control Systems - D. Subbaram Naidu 2018-10-03

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.

A Variational Approach to Optimal Control of ODEs - Pablo Pedregal 2022-07-26

This self-contained book presents in a unified, systematic way the basic principles of optimal control governed by ODEs. Using a variational perspective, the author incorporates important restrictions like constraints for control and state, as well as the state system itself, into the equivalent variational reformulation of the problem. The fundamental issues of existence of optimal solutions, optimality conditions, and numerical approximation are then examined from this variational viewpoint. Inside, readers will find a unified approach to all the basic issues of optimal control, academic and real-world examples testing the book’s variational approach, and a rigorous treatment stressing ideas and arguments rather than the underlying mathematical formalism. A Variational Approach to Optimal Control of ODEs is mainly for applied analysts, applied mathematicians, and control engineers, but will also be helpful to other scientists and engineers who want to understand the basic principles of optimal control governed by ODEs. It requires no prerequisites in variational problems or expertise in numerical approximation. It can be used for a first course in optimal control.

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.

Variational Calculus, Optimal Control and Applications - Leonhard Bittner 2012-12-06

The 12th conference on "Variational Calculus, Optimal Control and Applications" took place September 23-27, 1996, in Trassenheide on the Baltic Sea island of Use dom. Seventy mathematicians from ten countries participated. The preceding eleven conferences, too, were held in places of natural beauty throughout West Pomerania; the first time, in 1972, in Zinnowitz, which is in the immediate area of Trassenheide. The conferences were founded, and led ten times, by Professor Bittner (Greifswald) and Professor KlCitzler (Leipzig), who both celebrated their 65th birthdays in 1996. The 12th conference in Trassenheide, was, therefore, also dedicated to L. Bittner and R. Klotzler. Both scientists made a lasting impression on control theory in the former GDR. Originally, the conferences served to promote the exchange of research results. In the first years, most of the lectures were theoretical, but in the last few conferences practical applications have been given more attention. Besides their pioneering theoretical works, both honorees have also always dealt with applications problems. L. Bittner has, for example, examined optimal control of nuclear reactors and associated safety aspects. Since 1992 he has been working on applications in optimal control in flight dynamics. R. Klotzler recently applied his results on optimal autobahn planning to the south tangent in Leipzig. The contributions published in these proceedings reflect the trend to practical problems; starting points are often questions from flight dynamics.

Introduction to the Calculus of Variations and Control with Modern Applications - John A. Burns 2013-08-28

Introduction to the Calculus of Variations and Control with Modern Applications provides the fundamental background required to develop rigorous necessary conditions that are the starting points for theoretical and numerical approaches to modern variational calculus and control problems. The book also presents some classical sufficient conditions a

Introduction to Optimization - Pablo Pedregal 2003-11-03

This undergraduate textbook introduces students of science and engineering to the fascinating field of optimization. It is a unique book that brings together the subfields of mathematical programming,

variational calculus, and optimal control, thus giving students an overall view of all aspects of optimization in a single reference. As a primer on optimization, its main goal is to provide a succinct and accessible introduction to linear programming, nonlinear programming, numerical optimization algorithms, variational problems, dynamic programming, and optimal control. Prerequisites have been kept to a minimum, although a basic knowledge of calculus, linear algebra, and differential equations is assumed.

Variational Calculus and Optimal Control - John L. Troutman 2012-09-30

An introduction to the variational methods used to formulate and solve mathematical and physical problems, allowing the reader an insight into the systematic use of elementary (partial) convexity of differentiable functions in Euclidian space. By helping students directly characterize the solutions for many minimization problems, the text serves as a prelude to the field theory for sufficiency, laying as it does the groundwork for further explorations in mathematics, physics, mechanical and electrical engineering, as well as computer science.

Variational Calculus, Optimal Control, and Applications - Rolf Klötzler 1998

On the Convexification of Optimal Control Problems of Flight Dynamics.- Restricted Optimal Transportation Flows.- Relaxation Gaps in Optimal Control Processes with State Constraints.- Optimal Shape Design for Elliptic Hemivariational Inequalities in Nonlinear Elasticity.- A Discretization for Control Problems with optimality test.- Smooth and Nonsmooth Optimal Lipschitz Control - a Model Problem.- Suboptimality Theorems in Optimal Control.- A Second Order Sufficient Condition for Optimality in Nonlinear Control - the Conjugate Point Approach.- Extremal Problems for Elliptic Systems.- Existence Results for Some Nonconvex Optimization Problems Governed by Nonlinear Processes.- Multiobjective Optimal Control Problems.- Existence Principles and the Theory of Extremal Problems.- Hamilton-Jacobi-Bellman Equations and Optimal Control.- Output Target Control and Uncertain Infinite-Dimensional Systems.- Sensitivity Analysis of Stiff and Non-stiff Initial-value Problems.- Algorithm of Real-Time Minimization of Control Norm for Incompletely Determined Linear Control Systems.- Set-valued Calculus and Dynamic Programming in Problems of Feedback Control.- Strong Observability of Time-dependent Linear Systems.- Sensitivity Analysis and Real-Time Control of Nonlinear Optimal Control Systems via Nonlinear Programming Methods.- Accelerating Multiple Shooting for State-constrained Trajectory Optimization Problems.- SQP Methods and their Application to Numerical Optimal Control.- Predictor-Corrector Continuation Method for Optimal Control Problems.- Time Invariant Global Stabilization of a Mobile Robot.- Competitive Running on a Hilly Track.- Convex Domains of Given Diameter with Greatest Volume.- Isoperimetric and Isodiametric Area-minimal Plane Convex Figures.- Minimizing the Noise of an Aircraft during Landing Approach.- Real-Time Computation of Strategies of Differential Games with Applications to Collision Avoidance.- The Use of Screening for the Control of an Endemic Disease.- Optimal Control of Sloshing Liquids.- Free Surface Waves in a Wave Tank.- Efficient Convexification of Flight Path Optimization Problems.- Determining the Controllability Region for the Re-entry of an Apollo-type Spacecraft.

Optimal Control - Richard Vinter 2000-05-19

“Each chapter contains a well-written introduction and notes. They include the author's deep insights on the subject matter and provide historical comments and guidance to related literature. This book may well become an important milestone in the literature of optimal control." —Mathematical Reviews “Thanks to a great effort to be self-contained, [this book] renders accessibly the subject to a wide audience. Therefore, it is recommended to all researchers and professionals interested in Optimal Control and its engineering and economic applications. It can serve as an excellent textbook for graduate courses in Optimal Control (with special emphasis on Nonsmooth Analysis)." —Automatica

Advances in Mathematical Modeling, Optimization and Optimal Control - Jean-Baptiste Hiriart-Urruty 2016-05-19

This book contains extended, in-depth presentations of the plenary talks from the 16th French-German-Polish Conference on Optimization, held in Kraków, Poland in 2013. Each chapter in this book exhibits a comprehensive look at new theoretical and/or application-oriented results in mathematical modeling, optimization, and optimal control. Students and researchers 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 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 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 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 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 on no-gap second order optimality conditions in the calculus of variations and optimal control, and a discussion of their further development.

Optimization and Optimal Control - Altannar Chinchuluun 2010-08-05

Optimization and optimal control are the main tools in decision making. Because of their numerous applications in various disciplines, research in these areas is accelerating at a rapid pace. “Optimization and Optimal Control: Theory and Applications” brings together the latest developments in these areas of research as well as presents applications of these results to a wide range of real-world problems. This volume can serve as a useful resource for researchers, practitioners, and advanced graduate students of mathematics and engineering working in research areas where results in optimization and optimal control can be applied.

Optimization and Differentiation - Simon Serovajsky 2017-09-13

Optimization and Differentiation is an introduction to the application of optimization control theory to systems described by nonlinear partial differential equations. As well as offering a useful reference work for researchers in these fields, it is also suitable for graduate students of optimal control theory.

Optimal Control and Forecasting of Complex Dynamical Systems - Ilya Grigorenko 2006

This important book reviews applications of optimization and optimal control theory to modern problems in physics, nano-science and finance. The theory presented here can be efficiently applied to various problems, such as the determination of the optimal shape of a laser pulse to induce certain excitations in quantum systems, the optimal design of nanostructured materials and devices, or the control of chaotic systems and minimization of the forecast error for a given forecasting model (for example, artificial neural networks). Starting from a brief review of the history of variational calculus, the book discusses optimal control theory and global optimization using modern numerical techniques. Key elements of chaos theory and basics of fractional derivatives, which are useful in control and forecast of complex dynamical systems, are presented. The coverage includes several interdisciplinary problems to demonstrate the efficiency of the presented algorithms, and different methods of forecasting complex dynamics are discussed.

Dynamic Programming and the Calculus of Variations - Dreyfus 1965-01-01

Dynamic Programming and the Calculus of Variations

Functional Analysis, Calculus of Variations and Optimal Control - Francis Clarke 2013-02-06

Functional analysis owes much of its early impetus to problems that arise in the calculus of variations. In turn, the methods developed there have been applied to optimal control, an area that also requires new tools, such as nonsmooth analysis. This self-contained textbook gives a complete course on all these topics. It is written by a leading specialist who is also a noted expositor. This book provides a thorough introduction to functional analysis and includes many novel elements as well as the standard topics. A short course on nonsmooth analysis and geometry completes the first half of the book whilst the second half concerns the calculus of variations and optimal control. The author provides a comprehensive course on these subjects, from their inception through to the present. A notable feature is the inclusion of recent, unifying developments on regularity, multiplier rules, and the Pontryagin maximum principle, which appear here for the first time in a textbook. Other major themes include existence and Hamilton-Jacobi methods. The many substantial examples, and the more than three hundred exercises, treat such topics as viscosity solutions, nonsmooth Lagrangians, the logarithmic Sobolev inequality, periodic trajectories, and systems theory. They also touch lightly upon several fields of application: mechanics, economics, resources, finance, control engineering. Functional Analysis, Calculus of Variations and Optimal Control is intended to support several different courses at the first-year or second-year graduate level, on functional analysis, on the calculus of variations and optimal control, or on some combination. For this reason, it has been organized with customization in mind. The text also has considerable value as a

reference. Besides its advanced results in the calculus of variations and optimal control, its polished presentation of certain other topics (for example convex analysis, measurable selections, metric regularity, and nonsmooth analysis) will be appreciated by researchers in these and related fields.

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.

Functional Analysis, Calculus of Variations and Optimal Control - Francis Clarke 2013-02-06

Functional analysis owes much of its early impetus to problems that arise in the calculus of variations. In turn, the methods developed there have been applied to optimal control, an area that also requires new tools, such as nonsmooth analysis. This self-contained textbook gives a complete course on all these topics. It is written by a leading specialist who is also a noted expositor. This book provides a thorough introduction to functional analysis and includes many novel elements as well as the standard topics. A short course on nonsmooth analysis and geometry completes the first half of the book whilst the second half concerns the calculus of variations and optimal control. The author provides a comprehensive course on these subjects, from their inception through to the present. A notable feature is the inclusion of recent, unifying developments on regularity, multiplier rules, and the Pontryagin maximum principle, which appear here for the first time in a textbook. Other major themes include existence and Hamilton-Jacobi methods. The many substantial examples, and the more than three hundred exercises, treat such topics as viscosity solutions, nonsmooth Lagrangians, the logarithmic Sobolev inequality, periodic trajectories, and systems theory. They also touch lightly upon several fields of application: mechanics, economics, resources, finance, control engineering. Functional Analysis, Calculus of Variations and Optimal Control is intended to support several different courses at the first-year or second-year graduate level, on functional analysis, on the calculus of variations and optimal control, or on some combination. For this reason, it has been organized with customization in mind. The text also has considerable value as a reference. Besides its advanced results in the calculus of variations and optimal control, its polished presentation of certain other topics (for example convex analysis, measurable selections, metric regularity, and nonsmooth analysis) will be appreciated by researchers in these and related fields.

Variational Calculus with Elementary Convexity - J.L. Troutman 2012-12-06

The calculus of variations, whose origins can be traced to the works of Aristotle and Zenodoros, is now Ii vast repository supplying fundamental tools of exploration not only to the mathematician, but-as evidenced by current literature-also to those in most branches of science in which mathematics is applied. (Indeed, the macroscopic statements afforded by variational principles may provide the only valid mathematical formulation of many physical laws.) As such, it retains the spirit of natural philosophy common to most mathematical investigations prior to this century. How ever, it is a discipline in which a single symbol (b) has at times been assigned almost mystical powers of operation and discernment, not readily subsumed into the formal structures of modern mathematics. And it is a field for which it is generally supposed that most questions motivating interest in the subject will probably not be answerable at the introductory level of their formulation. In earlier articles,1,2 it was shown through several examples that a complete characterization of the solution of optimization problems may be available by elementary methods, and it is the purpose of this work to explore further the convexity which underlay these individual successes in the context of a full introductory treatment of the theory of the variational calculus. The required convexity is that determined through Gateaux variations, which can be defined in any real linear space and which provide an unambiguous foundation for the theory.

Optimal Control and the Calculus of Variations - Enid R. Pinch 1995

A paperback edition of this successful textbook for final year undergraduate mathematicians and control engineering students, this book contains exercises and many worked examples, with complete solutions and hints making it ideal not only as a class textbook but also for individual study. The intorduction to optimal control begins by considering the problem of minimizing a function of many variables, before moving on to the main subject: the optimal control of systems governed by ordinary differential equations.

Optimal Control of Dynamic Operations Research Models - Michael M. Connors 1967

The book is a survey of the application of variational methods to dynamic operations research models, resulting from a study, under Ford Foundation grants, done at the Graduate School of Business, Stanford University.

Optimal Control - Bulirsch 2013-03-08

"Optimal Control" reports on new theoretical and practical advances essential for analysing and synthesizing optimal controls of dynamical systems governed by partial and ordinary differential equations. New necessary and sufficient conditions for optimality are given. Recent advances in numerical methods are discussed. These have been achieved through new techniques for solving large-sized nonlinear programs with sparse Hessians, and through a combination of direct and indirect methods for solving the multipoint boundary value problem. The book also focuses on the construction of feedback controls for nonlinear systems and highlights advances in the theory of problems with uncertainty. Decomposition methods of nonlinear systems and new techniques for constructing feedback controls for state- and control constrained linear quadratic systems are presented. The book offers solutions to many complex practical optimal control problems.

Relaxation in Optimization Theory and Variational Calculus - Tomáš Roubíček 2020-11-09

The relaxation method has enjoyed an intensive development during many decades and this new edition of this comprehensive text reflects in particular the main achievements in the past 20 years. Moreover, many further improvements and extensions are included, both in the direction of optimal control and optimal design as well as in numerics and applications in materials science, along with an updated treatment of the abstract parts of the theory.

Non-Smooth and Complementarity-Based Distributed Parameter Systems - Michael Hintermüller 2021

Many of the most challenging problems in the applied sciences involve non-differentiable structures as well as partial differential operators, thus leading to non-smooth distributed parameter systems. This edited volume aims to establish a theoretical and numerical foundation and develop new algorithmic paradigms for the treatment of non-smooth phenomena and associated parameter influences. Other goals include the realization and further advancement of these concepts in the context of robust and hierarchical optimization, partial differential games, and nonlinear partial differential complementarity problems, as well as their validation in the context of complex applications. Areas for which applications are considered include optimal control of multiphase fluids and of superconductors, image processing, thermoforming, and the formation of rivers and networks. Chapters are written by leading researchers and present results obtained in the first funding phase of the DFG Special Priority Program on Nonsmooth and Complementarity Based Distributed Parameter Systems: Simulation and Hierarchical Optimization that ran from 2016 to 2019.

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

Variational Calculus and Optimal Control - John L. Troutman 2012-12-06
An introduction to the variational methods used to formulate and solve mathematical and physical problems, allowing the reader an insight into the systematic use of elementary (partial) convexity of differentiable functions in Euclidian space. By helping students directly characterize the solutions for many minimization problems, the text serves as a prelude to the field theory for sufficiency, laying as it does the groundwork for further explorations in mathematics, physics, mechanical and electrical engineering, as well as computer science.

Introduction to the Calculus of Variations and Control with Modern Applications - John A. Burns 2013-08-28
Introduction to the Calculus of Variations and Control with Modern Applications provides the fundamental background required to develop rigorous necessary conditions that are the starting points for theoretical and numerical approaches to modern variational calculus and control problems. The book also presents some classical sufficient conditions and discusses the importance of distinguishing between the necessary and sufficient conditions. In the first part of the text, the author develops the calculus of variations and provides complete proofs of the main results. He explains how the ideas behind the proofs are essential to the development of modern optimization and control theory. Focusing on optimal control problems, the second part shows how optimal control is a natural extension of the classical calculus of variations to more complex problems. By emphasizing the basic ideas and their mathematical development, this book gives you the foundation to use these mathematical tools to then tackle new problems. The text moves from simple to more complex problems, allowing you to see how the fundamental theory can be modified to address more difficult and advanced challenges. This approach helps you understand how to deal with future problems and applications in a realistic work environment.

Optimal Control Theory - Zhongjing Ma 2021
This book focuses on how to implement optimal control problems via the variational method. It studies how to implement the extrema of functional by applying the variational method and covers the extrema of functional with different boundary conditions, involving multiple functions and with certain constraints etc. It gives the necessary and sufficient condition for the (continuous-time) optimal control solution via the variational method, solves the optimal control problems with different boundary conditions, analyzes the linear quadratic regulator & tracking problems respectively in detail, and provides the solution of optimal control problems with state constraints by applying the Pontryagin's minimum principle which is developed based upon the calculus of variations. And the developed results are applied to implement several classes of popular optimal control problems and say minimum-time, minimum-fuel and minimum-energy problems and so on. As another key branch of optimal control methods, it also presents how to solve the optimal control problems via dynamic programming and discusses the relationship between the variational method and dynamic programming for comparison. Concerning the system involving individual agents, it is also worth to study how to implement the decentralized solution for the underlying optimal control problems in the framework of differential games. The equilibrium is implemented by applying both Pontryagin's minimum principle and dynamic programming. The book also analyzes the discrete-time version for all the above materials as well since the discrete-time optimal control problems are very popular in many fields.

Turnpike Phenomenon and Symmetric Optimization Problems - Alexander J. Zaslavski
Written by a leading expert in turnpike phenomenon, this book is devoted to the study of symmetric optimization, variational and optimal control problems in infinite dimensional spaces and turnpike properties of their approximate solutions. The book presents a systematic and comprehensive study of general classes of problems in optimization, calculus of variations, and optimal control with symmetric structures from the viewpoint of the turnpike phenomenon. The author establishes generic existence and well-posedness results for optimization problems and individual (not generic) turnpike results for variational and optimal control problems. Rich in impressive theoretical results, the author presents applications to crystallography and discrete dispersive dynamical systems which have prototypes in economic growth theory. This book will be useful for researchers interested in optimal control, calculus of variations turnpike theory and their applications, such as mathematicians, mathematical economists, and researchers in crystallography, to name just a few.