CALCULUS OF VARIATIONS
AND
OPTIMAL CONTROL THEORY

Calculus Of Variations And Optimal Control Theory

Laurence Chisholm Young

Calculus Of Variations And Optimal Control Theory:

   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   Calculus of Variations and Optimal Control Theory Daniel Liberzon,2012-01-08 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   **A Primer on the Calculus of Variations and Optimal Control Theory** Mike Mesterton-Gibbons,2009 The calculus of variations is used to find functions that optimize quantities expressed in terms of integrals Optimal control theory seeks to find functions that minimize cost integrals for systems described by differential equations This book is an

introduction to both the classical theory of the calculus of variations and the more modern developments of optimal control theory from the perspective of an applied mathematician It focuses on understanding concepts and how to apply them The range of potential applications is broad the calculus of variations and optimal control theory have been widely used in numerous ways in biology criminology economics engineering finance management science and physics Applications described in this book include cancer chemotherapy navigational control and renewable resource harvesting The prerequisites for the book are modest the standard calculus sequence a first course on ordinary differential equations and some facility with the use of mathematical software It is suitable for an undergraduate or beginning graduate course or for self study It provides excellent preparation for more advanced books and courses on the calculus of variations and optimal control theory **The Calculus of Variations and Optimal Control** George Leitmann,1981-05-31 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 **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 **Calculus of Variations and Optimal Control Theory** Magnus R. Hestenes,1969 **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 Othermajor 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   Calculus of Variations and Optimal Control Theory Magnus Rudolph Hestenes,1966   *Lectures on the Calculus of Variations and Optimal Control Theory* Laurence C. Young,1962   **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   **Lectures on the Calculus of Variations and Optimal Control Theory** L. C. Young,2024-10-30 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   **Calculus of Variations and Optimal Control Theory - A Concise Introduction Instructor's Manual** Daniel Liberzon,2012-01-01 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 **Calculus of Variations and Optimal Control Theory** Joseph H. Connell,1966

Optimal Control Bulirsch,Miele,Stoer,Well,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 **Lectures on the Calculus of Variations and Optimal Control Theory Calculus of Variations and Optimal Control Theory** Laurence Chisholm Young,1969 **Lectures on the Calculus of Variations and Optimal Control Theory** L. C. Young, The Calculus of Variations and Optimal Control Theory Kuro Aksara,2024-06-14 Calculus of variations and optimal control theory L. C. Young,1980 **Constrained Optimization in the Calculus of Variations and Optimal Control Theory** John Gregory,C. Lin,2012-09-17 A major problem in current applied mathematics is the lack of efficient and accurate techniques to solve optimization problems in the calculus of variations and optimal control theory This is surprising since problems occur throughout many areas of applied mathematics engineering physical sciences economics and biomedicine For instance these techniques are used to solve rocket trajectory problems current flow problems in electronics manufacturing and financial risk problems in investing The authors have written a unique book to remedy this problem The first half of the book contains classical material in the field the second half unique theoretical and numerical methods for constrained problems **Constrained Optimization in the Calculus of**

Variations and Optimal Control Theory John Gregory,C. Lin,1992-05-31 A major problem in current applied mathematics is the lack of efficient and accurate techniques to solve optimization problems in the calculus of variations and optimal control theory This is surprising since problems occur throughout many areas of applied mathematics engineering physical sciences economics and biomedicine For instance these techniques are used to solve rocket trajectory problems current flow problems in electronics manufacturing and financial risk problems in investing The authors have written a unique book to remedy this problem The first half of the book contains classical material in the field the second half unique theoretical and numerical methods for constrained problems

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