Optimal Control And Viscosity Solutions Of Hamilto

Semiconcave Functions, Hamilton-Jacobi Equations, and Optimal Control Piermarco Cannarsa,Carlo Sinestrari.2007-12-31 * A comprehensive and systematic exposition of the properties of semiconcave functions and their various applications, particularly to optimal control problems, by leading experts in the field * A central role in the present work is reserved for the study of singularities * Graduate students and researchers in optimal control, the calculus of variations, and PDEs will find this book useful as a reference work on modern dynamic programming for nonlinear control systems

Viscosity Solutions and Applications Martino Bardi,Michael G. Crandall,Lawrence C. Evans,Halil M. Soner,Panagiotis E. Souganidis.2006-11-13 The volume comprises five extended surveys on the recent theory of viscosity solutions of fully nonlinear partial differential equations, and some of its most relevant applications to optimal control theory for deterministic and stochastic systems, front propagation, geometric motions and mathematical finance. The volume forms a state-of-the-art reference on the subject of viscosity solutions, and the authors are among the most prominent specialists. Potential readers are researchers in nonlinear PDE's, systems theory, stochastic processes.

Optimal Control, Stabilization and Nonsmooth Analysis Marcio S. de Queiroz,Michael Malisoff,Peter Wolenski.2004-04-20 This edited book contains selected papers presented at the Louisiana Conference on Mathematical Control Theory (MCT'03), which brought together over 35 prominent world experts in mathematical control theory and its applications. The book forms a well-integrated exploration of those areas of mathematical control theory in which nonsmooth analysis is having a major impact. These include necessary and sufficient conditions in optimal control, Lyapunov characterizations of stability, input-to-state stability, the construction of feedback mechanisms, viscosity solutions of Hamilton-Jacobi equations, invariance, approximation theory, impulsive systems, computational issues for nonlinear systems, and other topics of interest to mathematicians and control engineers. The book has a strong interdisciplinary component and was designed to facilitate the interaction between leading mathematical experts in nonsmooth analysis and engineers who are increasingly using nonsmooth analytic tools.

Mathematics Applied to Engineering, Modelling, and Social Issues Frank T. Smith,Hemen Dutta,John N. Mordeson.2019-03-14 This book presents several aspects of research on mathematics that have significant applications in engineering, modelling and social matters, discussing a number of current and future social issues and problems in which mathematical tools can be beneficial. Each chapter enhances our understanding of the research problems in a particular an area of study and highlights the latest advances made in that area. The self-contained contributions make the results and problems discussed accessible to readers, and provides references to enable those interested to follow subsequent studies in still developing fields. Presenting real-world applications, the book is a valuable resource for graduate students, researchers and educators. It appeals to general readers curious about the practical applications of mathematics in diverse scientific areas and social problems.

Nonlinear Optimal Control Theory Leonard David Berkovitz,Negash G. Medhin.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.

Hamilton-Jacobi Equations: Approximations, Numerical Analysis and Applications Yves Achdou,Guy Barles,Hitoshi Ishii,Grigory L. Litvinov.2013-05-24 These Lecture Notes contain the material relative to the courses given at the CIME summer school held in Cetraro, Italy from August 29 to September 3, 2011. The topic was Hamilton-Jacobi Equations: Approximations, Numerical Analysis and Applications. The courses dealt mostly with the following subjects: first order and second order Hamilton-Jacobi-Bellman equations, properties of viscosity solutions, asymptotic behaviors, mean field games, approximation and numerical methods, idempotent analysis. The content of the courses ranged from an introduction to viscosity solutions to quite advanced topics, at the cutting edge of research in the field. We believe that they opened perspectives on new and delicate issues. These lecture notes contain four contributions by Yves Achdou (Finite Difference Methods for Mean Field Games), Guy Barles (An Introduction to the Theory of Viscosity Solutions for First-order Hamilton-Jacobi Equations and Applications), Hitoshi Ishii (A Short Introduction to Viscosity Solutions and the Large Time Behavior of Solutions of Hamilton-Jacobi Equations) and Grigory Litvinov (Idempotent/Tropical Analysis, the Hamilton-Jacobi and Bellman Equations).

Some Asymptotic Problems on the Theory of Viscosity Solutions of Hamilton-Jacobi Equations Son Nguyen Thai Tu.2022 Viscosity solutions arise naturally in many fields of study from engineering, physics, and operations research to economics. The study of viscosity solutions on its own has uncovered many new and interesting research problems, including the study of the asymptotic behavior of solutions with respect to the changing of parameters. In this dissertation, I present some new problems following the line of the asymptotic behavior of solutions. Each of the problems is related to the other through the old underlying theme of optimal control theory, yet presents many new problems on their own that are yet to be studied.The first direction is on homogenization of Hamilton-Jacobi equations. Using deep analysis of the dynamics of minimizers corresponding to the solution, I established in [113] the optimal rate of convergence under the multi-scale setting in one dimension, which could not be obtained by the previous pure PDEs technique. The second direction concerns various asymptotic problems for equations with state-constraint. In [75], my co-authors and I established some first quantitative results on the rate of convergence of the solution to the Hamilton-Jacobi equations with state-constraint on a nested domain setting. Utilizing the weak KAM theory, in [114], I established qualitatively various convergence results for the vanishing discount procedure with changing domains together with a new description of the regularity of the additive eigenvalues with respect to domain perturbation. Lastly, in [61], my co-author and I established the rate of convergence for the vanishing viscosity procedure, concerning the viscous state-constraint viscosity (large) solution that blows on the boundary of the underlying domain. This is the first-rate established for blow-up solutions in the literature as far as we know.

Stochastic Analysis, Control, Optimization and Applications William M. McEneaney,G. George Yin,Qing Zhang.2012-12-06 In view of Professor Wendell Fleming's many fundamental contributions, his profound influence on the mathematical and systems theory communi ties, his service to the profession, and his dedication to mathematics, we have invited a number of leading experts in the fields of control, optimiza tion, and stochastic systems to contribute to this volume in his honor on the occasion of his 70th birthday. These papers focus on various aspects of stochastic analysis, control theory and optimization, and applications. They include authoritative expositions and surveys as well as research papers on recent and important issues. The papers are grouped according to the following four major themes: (1) large deviations, risk sensitive and Hoc control, (2) partial differential equations and viscosity solutions, (3) stochastic control, filtering and parameter esti mation, and (4) mathematical finance and other applications. We express our deep gratitude to all of the authors for their invaluable contributions, and to the referees for their careful and timely reviews. We thank Harold Kushner for having graciously agreed to undertake the task of writing the foreword. Particular thanks go to H. Thomas Banks for his help, advice and suggestions during the entire preparation process, as well as for the generous support of the Center for Research in Scientific Computation. The assistance from the

Birkhauser professional staff is also greatly appreciated.

The Weak KAM Theorem in Lagrangian Dynamics Albert Fathi.2008-03-01 The famous KAM theorem due to Kolmogorov, Arnold and Moser has proved critical in the theory of dynamical systems. A large and influential theory has built up around this result and there are applications in various branches of mathematics, chaos theory and physics. Arising from a lecture course given by the author at ENS Lyon, this book is ideal for graduate students. It contains a great deal of background and motivational material to help students come to grips with this important topic. However, the appeal of the book will extent to researchers will find this to be a useful resource, not least because Fathi has included numerous references that point to further, more advanced reading.

Viscosity Solutions and Optimal Control Robert James Elliott.1987

Optimal Control and Viscosity Solutions of Hamilton-Jacobi-Bellman Equations Martino Bardi,Italo Capuzzo-Dolcetta.2008-01-11 This softcover book is a self-contained account of the theory of viscosity solutions for first-order partial differential equations of Hamilton–Jacobi type and its interplay with Bellman's dynamic programming approach to optimal control and differential games. It will be of interest to scientists involved in the theory of optimal control of deterministic linear and nonlinear systems. The work may be used by graduate students and researchers in control theory both as an introductory textbook and as an up-to-date reference book.

An Introduction To Viscosity Solutions for Fully Nonlinear PDE with Applications to Calculus of Variations in L∞ Nikos Katzourakis.2014-11-26 The purpose of this book is to give a quick and elementary, yet rigorous, presentation of the rudiments of the so-called theory of Viscosity Solutions which applies to fully nonlinear 1st and 2nd order Partial Differential Equations (PDE). For such equations, particularly for 2nd order ones, solutions generally are non-smooth and standard approaches in order to define a weak solution do not apply: classical, strong almost everywhere, weak, measure-valued and distributional solutions either do not exist or may not even be defined. The main reason for the latter failure is that, the standard idea of using integration-by-parts in order to pass derivatives to smooth test functions by duality, is not available for non-divergence structure PDE.

Controlled Markov Processes E. B. Dynkin,A. A. Yushkevich.1979 This book is devoted to the systematic exposition of the contemporary theory of controlled Markov processes with discrete time parameter or in another termi nology multistage Markovian decision processes. We discuss the applications of this theory to various concrete problems. Particular attention is paid to mathe matical models of economic planning, taking account of stochastic factors. The authors strove to construct the exposition in such a way that a reader interested in the applications can get through the book with a minimal mathe matical apparatus. On the other hand, a mathematician will find, in the appropriate chapters, a rigorous theory of general control models, based on advanced measure theory, analytic set theory, measurable selection theorems, and so forth. We have abstained from the manner of presentation of many mathematical monographs, in which one presents immediately the most general situation and only then discusses simpler special cases and examples. Wishing to separate out difficulties, we introduce new concepts and ideas in the simplest setting, where they already begin to work. Thus, before considering control problems on an infinite time interval, we investigate in detail the case of the finite interval. Here we first study in detail models with finite state and action spaces-a case not requiring a departure from the realm of elementary mathematics, and at the same time illustrating the most important principles of the theory.

Applied Stochastic Control of Jump Diffusions Bernt Øksendal,Agnès Sulem.2007-04-26 Here is a rigorous introduction to the most important and useful solution methods of various types of stochastic control problems for jump diffusions and its applications. Discussion includes the dynamic programming method and the maximum principle method, and their relationship. The text emphasises real-world applications, primarily in finance. Results are illustrated by examples, with end-of-chapter exercises including complete solutions. The 2nd edition adds a chapter on optimal control of stochastic partial differential equations driven by Lévy processes, and a new section on optimal stopping with delayed information. Basic knowledge of stochastic analysis, measure theory and partial differential equations is assumed.

Reinforcement Learning for Optimal Feedback Control Rushikesh Kamalapurkar,Patrick Walters,Joel Rosenfeld,Warren Dixon.2018-05-10 Reinforcement Learning for Optimal Feedback Control develops model-based and data-driven reinforcement learning methods for solving optimal control problems in nonlinear deterministic dynamical systems. In order to achieve learning under uncertainty, data-driven methods for identifying system models in real-time are also developed. The book illustrates the advantages gained from the use of a model and the use of previous experience in the form of recorded data through simulations and experiments. The book's focus on deterministic systems allows for an in-depth Lyapunov-based analysis of the performance of the methods described during the learning phase and during execution. To yield an approximate optimal controller, the authors focus on theories and methods that fall under the umbrella of actor–critic methods for machine learning. They concentrate on establishing stability during the learning phase and the execution phase, and adaptive model-based and data-driven reinforcement learning, to assist readers in the learning process, which typically relies on instantaneous input-output measurements. This monograph provides academic researchers with backgrounds in diverse disciplines from aerospace engineering to computer science, who are interested in optimal reinforcement learning functional analysis and functional approximation theory, with a good introduction to the use of model-based methods. The thorough treatment of an advanced treatment to control will also interest practitioners working in the chemical-process and power-supply industry.

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

Generalized Solutions of Hamilton-Jacobi Equations Pierre-Louis Lions.1982

Stochastic Differential Systems, Stochastic Control Theory and Applications Wendell Fleming,Pierre-Louis Lions.2012-12-06 This IMA Volume in Mathematics and its Applications STOCHASTIC DIFFERENTIAL SYSTEMS, STOCHASTIC CONTROL THEORY AND APPLICATIONS is the proceedings of a workshop which was an integral part of the 1986-87 IMA program on STOCHASTIC DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS. We are grateful to the Scientific Committee: Daniel Stroock (Chairman) WendeIl Flerning Theodore Harris Pierre-Louis Lions Steven Orey George Papanicolaou for planning and implementing an exciting and stimulating year-long program. We es pecially thank WendeIl Fleming and Pierre-Louis Lions for organizing an interesting and productive workshop in an area in which mathematics is beginning to make significant contributions to real-world problems. George R. Seil Hans Weinberger PREFACE This volume is the Proceedings of a Workshop on Stochastic Differential Systems, Stochastic Control Theory, and Applications held at IMA June 9-19,1986. The Workshop Program Commit tee consisted of W.H. Fleming and P.-L. Lions (co-chairmen), J. Baras, B. Hajek, J.M. Harrison, and H. Sussmann. The Workshop emphasized topics in the following four areas. (1) Mathematical theory of stochastic differential systems, stochastic control and nonlinear filtering for Markov diffusion processes. Connections with partial differential equations. (2) Applications

of stochastic differential system theory, in engineering and management sci ence. Adaptive control of Markov processes. Advanced computational methods in stochas tic control and nonlinear filtering. (3) Stochastic scheduling, queueing networks, and related topics. Flow control, multiarm bandit problems, applications to problems of computer networks and scheduling of complex manufacturing operations.
Stochastic Optimal Control in Infinite Dimension Giorgio Fabbri,Fausto Gozzi,Andrzej Święch.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.
Variational Calculus, Optimal Control and Applications Leonhard Bittner,Roland Bulirsch,Knut Heier,Werner Schmidt.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.
Fully Nonlinear Elliptic Equations Luis A. Caffarelli,Xavier Cabré.1995 The goal of the book is to extend classical regularity theorems for solutions of linear elliptic partial differential equations to the context of fully nonlinear elliptic equations. This class of equations often arises in control theory, optimization, and other applications. The authors give a detailed presentation of all the necessary techniques. Instead of treating these techniques in their greatest generality, they outline the key ideas and prove the results needed for developing the subsequent theory. Topics discussed in the book include the theory of viscosity solutions for nonlinear equations, the Alexandroff estimate and Krylov-Safonov Harnack-type inequality for viscosity solutions, uniqueness theory for viscosity solutions, Evans and Krylov regularity theory for convex fully nonlinear equations, and regularity theory for fully nonlinear equations with variable coefficients.
Constrained Hamilton-Jacobi Equations and Further Applications Via Optimal Control Theory Yeon Eung Kim.2019 In this dissertation, two research directions are presented. The first direction is on the study of the constrained Hamilton-Jacobi equation \begin{equation*} \begin{cases} u_t=H(Du)+R(x, I(t)) & \text{in }\R^n \times (0,\infty), \\ \sup_{\R^n} u(\cdot, t)=0 & \text{on }[0,\infty), \end{cases} \end{equation*} with initial conditions $I(0)=I_0>0$, $u(x,0)=u_0(x)$ on $\R^n$. Here (u, I) is a pair of unknowns and a Hamiltonian H and a reaction term R are given. Moreover, $I(t)$ is an unknown constraint (Lagrange multiplier) that constrains the supremum of u to be always zero. We construct a solution in the viscosity setting using the fixed point argument when the reaction term $R(x, I)$ is strictly decreasing in I. We also discuss both uniqueness and nonuniqueness. For uniqueness, a certain structural assumption on $R(x, I)$ is needed. We also provide an example with infinitely many solutions when the reaction term is not strictly decreasing in I. Furthermore, the uniqueness of a pair (u, I) is achieved for one-dimensional case using the optimal control formula. The second direction is based on joint work with H. Tran and S. Tu is concerned with rate of convergence of viscosity solutions to state-constraint Hamilton-Jacobi equations defined in nested domains. In particular, we consider a sequence of balls $\{ B_k\}_{k \in \N}$ in $\R^n$ for the domain where a ball centered at the origin with radius k is denoted by B_k. We obtain rate of convergence of u_k which is a solution to the state-constraint problem in B_k, to u which is a solution to the corresponding problem in $\R^n$ using the optimal control formula. The rate we obtain is indeed optimal.
Semi-Lagrangian Approximation Schemes for Linear and Hamilton-Jacobi Equations Maurizio Falcone,Roberto Ferretti.2014-01-31 This largely self-contained book provides a unified framework of semi-Lagrangian strategy for the approximation of hyperbolic PDEs, with a special focus on Hamilton-Jacobi equations. The authors provide a rigorous discussion of the theory of viscosity solutions and the concepts underlying the construction and analysis of difference schemes; they then proceed to high-order semi-Lagrangian schemes and their applications to problems in fluid dynamics, front propagation, optimal control, and image processing. The developments covered in the text and the references come from a wide range of literature.
Optimal Control, Stabilization and Nonsmooth Analysis Marcio S. de Queiroz,Michael Malisoff,Peter Wolenski.2004-04-20 This edited book contains selected papers presented at the Louisiana Conference on Mathematical Control Theory (MCT'03), which brought together over 35 prominent world experts in mathematical control theory and its applications. The book forms a well-integrated exploration of those areas of mathematical control theory in which nonsmooth analysis is having a major impact. These include necessary and sufficient conditions in optimal control, Lyapunov characterizations of stability, input-to-state stability, the construction of feedback mechanisms, viscosity solutions of Hamilton-Jacobi equations, invariance, approximation theory, impulsive systems, computational issues for nonlinear systems, and other topics of interest to mathematicians and control engineers. The book has a strong interdisciplinary component and was designed to facilitate the interaction between leading mathematical experts in nonsmooth analysis and engineers who are increasingly using nonsmooth analytic tools.
Optimal Control and Viscosity Solutions of Hamilton-Jacobi-Bellman Equations Martino Bardi,Italo Capuzzo-Dolcetta.2009-05-21 This softcover book is a self-contained account of the theory of viscosity solutions for first-order partial differential equations of Hamilton–Jacobi type and its interplay with Bellman’s dynamic programming approach to optimal control and differential games. It will be of interest to scientists involved in the theory of optimal control of deterministic linear and nonlinear systems. The work may be used by graduate students and researchers in control theory both as an introductory textbook and as an up-to-date reference book.
Hybrid Systems, Optimal Control and Hybrid Vehicles Thomas J. Böhme,Benjamin Frank.2017-02-01 This book assembles new methods showing the automotive engineer for the first time how hybrid vehicle configurations can be modeled as systems with discrete and continuous controls. These hybrid systems describe naturally and compactly the networks of embedded systems which use elements such as integrators, hysteresis, state-machines and logical rules to describe the evolution of continuous and discrete dynamics and arise inevitably when modeling hybrid electric vehicles. They can throw light on systems which may otherwise be too complex or recondite. Hybrid Systems, Optimal Control and Hybrid Vehicles shows the reader how to formulate and solve control problems which satisfy multiple objectives which may be arbitrary and complex with contradictory influences on fuel consumption, emissions and drivability. The text introduces industrial engineers, postgraduates and researchers to the theory of hybrid optimal control problems. A series

of novel algorithmic developments provides tools for solving engineering problems of growing complexity in the field of hybrid vehicles. Important topics of real relevance rarely found in text books and research publications—switching costs, sensitivity of discrete decisions and there impact on fuel savings, etc.—are discussed and supported with practical applications. These demonstrate the contribution of optimal hybrid control in predictive energy management, advanced powertrain calibration, and the optimization of vehicle configuration with respect to fuel economy, lowest emissions and smoothest drivability. Numerical issues such as computing resources, simplifications and stability are treated to enable readers to assess such complex systems. To help industrial engineers and managers with project decision-making, solutions for many important problems in hybrid vehicle control are provided in terms of requirements, benefits and risks.

Optimal Control of Viscous Flow S. S. Sritharan.1998-01-01 This book provides a well-crystalized theory and computational methods for optimal control of fluid dynamics.

Optimal Control and Viscosity Solutions of Hamilton-Jacobi-Bellman Equations Martino Bardi,Italo Capuzzo Dolcetta.1997 This book is a self-contained account of the theory of viscosity solutions for first-order partial differential equations of Hamiltona Jacobi type and its interplay with Bellmana (TM)s dynamic programming approach to optimal control and differential games, as it developed after the beginning of the 1980s with the pioneering work of M. Crandall and P.L. Lions. The book will be of interest to scientists involved in the theory of optimal control of deterministic linear and nonlinear systems. In particular, it will appeal to system theorists wishing to learn about a mathematical theory providing a correct framework for the classical method of dynamic programming as well as mathematicians interested in new methods for first-order nonlinear PDEs. The work may be used by graduate students and researchers in control theory both as an introductory textbook and as an up-to-date reference book. The exposition is self-contained, clearly written and mathematically precise. The exercises and open problemsa]will stimulate research in the field. The rich bibliography (over 530 titles) and the historical notes provide a useful guide to the area. a Mathematical Reviews With an excellent printing and clear structure (including an extensive subject and symbol registry) the book offers a deep insight into the praxis and theory of optimal control for the mathematically skilled reader. All sections close with suggestions for exercisesa]Finally, with more than 500 cited references, an overview on the history and the main works of this modern mathematical discipline is given. a ZAA The minimal mathematical background...the detailed and clear proofs, the elegant style of presentation, and the sets of proposed exercises at the end of each section recommend this book, in the first place, as a lecture course for graduate students and as a manual for beginners in the field. However, this status is largely extended by the presence of many advanced topics and results by the fairly comprehensive and up-to-date bibliography and, particularly, by the very pertinent historical and bibliographical comments at the end of each chapter. In my opinion, this book is yet another remarkable outcome of the brilliant Italian School of Mathematics. a Zentralblatt MATH The book is based on some lecture notes taught by the authors at several universities...and selected parts of it can be used for graduate courses in optimal control. But it can be also used as a reference text for researchers (mathematicians and engineers)...In writing this book, the authors lend a great service to the mathematical community providing an accessible and rigorous treatment of a difficult subject. a Acta Applicandae Mathematicae

Optimal Control of Hysteresis in Smart Actuators: A Viscosity Solutions Approach .2002 Hysteresis in smart materials hinders their wider applicability in actuators. The low dimensional hysteresis models for these materials are hybrid systems with both controlled switching and autonomous switching. In particular, they belong to the class of Duhem hysteresis models and can be formulated as systems with both continuous and switching controls. In this paper, we study the control methodology for smart actuators through the example of controlling a commercially available magnetostrictive actuator. For illustrative purposes, an infinite horizon optimal control problem is considered. We show that the value function satisfies a Hamilton-Jacobi-Bellman equation (HJB) of a hybrid form in the viscosity sense. We further prove uniqueness of the viscosity solution to the (HJB), and provide a numerical scheme to approximate the solution together with a sub-optimal controller synthesis method. Numerical and experimental results based on this approach are presented.

Controlled Diffusion Processes N. V. Krylov.2008-09-26 Stochastic control theory is a relatively young branch of mathematics. The beginning of its intensive development falls in the late 1950s and early 1960s. ~urin~ that period an extensive literature appeared on optimal stochastic control using the quadratic performance criterion (see references in Wonham [76]). At the same time, Girsanov [25] and Howard [26] made the first steps in constructing a general theory, based on Bellman's technique of dynamic programming, developed by him somewhat earlier [4]. Two types of engineering problems engendered two different parts of stochastic control theory. Problems of the first type are associated with multistep decision making in discrete time, and are treated in the theory of discrete stochastic dynamic programming. For more on this theory, we note in addition to the work of Howard and Bellman, mentioned above, the books by Derman [8], Mine and Osaki [55], and Dynkin and Yushkevich [12]. Another class of engineering problems which encouraged the development of the theory of stochastic control involves time continuous control of a dynamic system in the presence of random noise. The case where the system is described by a differential equation and the noise is modeled as a time continuous random process is the core of the optimal control theory of diffusion processes. This book deals with this latter theory.

Stochastic and Differential Games Martino Bardi,T.E.S. Raghavan,T. Parthasarathy.2012-12-06 The theory of two-person, zero-sum differential games started at the be ginning of the 1960s with the works of R. Isaacs in the United States and L.S. Pontryagin and his school in the former Soviet Union. Isaacs based his work on the Dynamic Programming method. He analyzed many special cases of the partial differential equation now called Hamilton Jacobi-Isaacs-briefiy HJI-trying to solve them explicitly and synthe sizing optimal feedbacks from the solution. He began a study of singular surfaces that was continued mainly by J. Breakwell and P. Bernhard and led to the explicit solution of some low-dimensional but highly nontriv ial games; a recent survey of this theory can be found in the book by J. Lewin entitled Differential Games (Springer, 1994). Since the early stages of the theory, several authors worked on making the notion of value of a differential game precise and providing a rigorous derivation of the HJI equation, which does not have a classical solution in most cases; we mention here the works of W. Fleming, A. Friedman (see his book, Differential Games, Wiley, 1971), P.P. Varaiya, E. Roxin, R.J. Elliott and N.J. Kalton, N.N. Krasovskii, and A.I. Subbotin (see their book Po sitional Differential Games, Nauka, 1974, and Springer, 1988), and L.D. Berkovitz. A major breakthrough was the introduction in the 1980s of two new notions of generalized solution for Hamilton-Jacobi equations, namely, viscosity solutions, by M.G. Crandall and P.-L.

Numerical Methods For Viscosity Solutions And Applications Maurizio Falcone,Charalampos Makridakis.2001-08-30 The volume contains twelve papers dealing with the approximation of first and second order problems which arise in many fields of application including optimal control, image processing, geometrical optics and front propagation. Some contributions deal with new algorithms and technical issues related to their implementation. Other contributions are more theoretical, dealing with the convergence of approximation schemes. Many test problems have been examined to evaluate the performances of the algorithms. The volume can attract readers involved in the numerical approximation of differential models in the above-mentioned fields of applications, engineers, graduate students as well as researchers in numerical analysis.

Controlled Markov Processes and Viscosity Solutions Wendell H. Fleming,Halil Mete Soner.2006-02-04 This book is an introduction to optimal stochastic control for continuous time Markov processes and the theory of viscosity solutions. It covers dynamic programming for deterministic optimal control problems, as well as to the corresponding theory of viscosity solutions. New chapters in this second edition introduce the role of stochastic optimal control in portfolio optimization and in pricing derivatives in incomplete markets and two-controller, zero-sum differential games.

Hamilton-Jacobi-Bellman Equations Dante Kalise,Karl Kunisch,Zhiping Rao.2018-08-06 Optimal feedback control arises in different areas such as aerospace engineering, chemical processing, resource economics, etc. In this context, the application of dynamic programming techniques leads to the solution of fully nonlinear Hamilton-Jacobi-Bellman equations. This book presents the state of the art in the numerical approximation of Hamilton-Jacobi-Bellman equations, including post-processing of Galerkin methods, high-order methods, boundary treatment in semi-Lagrangian schemes, reduced basis methods, comparison principles for viscosity solutions, max-plus methods, and the numerical approximation of Monge-Ampère equations. This book also features applications in the simulation of adaptive controllers and the control of nonlinear delay differential equations. Contents From a monotone probabilistic scheme to a probabilistic max-plus algorithm for solving Hamilton–Jacobi–Bellman equations Improving policies for Hamilton–Jacobi–Bellman equations by postprocessing Viability approach to simulation of an adaptive controller Galerkin approximations for the optimal control of nonlinear delay differential equations Efficient higher order time discretization schemes for Hamilton–Jacobi–Bellman equations based on diagonally implicit symplectic Runge–Kutta methods Numerical solution of the simple Monge–Ampere equation with nonconvex Dirichlet data on nonconvex domains On the notion of boundary conditions in comparison principles for viscosity solutions Boundary mesh refinement for semi-Lagrangian schemes A reduced basis method for the Hamilton–Jacobi–Bellman equation within the European Union Emission Trading Scheme

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.

Controlled Markov Processes and Viscosity Solutions Wendell Helms Fleming,H. Mete Soner.2006 This book is intended as an introduction to optimal stochastic control for continuous time Markov processes and to the theory of viscosity solutions. The authors approach stochastic control problems by the method of dynamic programming. The text provides an introduction to dynamic programming for deterministic optimal control problems, as well as to the corresponding theory of viscosity solutions. A new Chapter X gives an introduction to the role of stochastic optimal control in portfolio optimization and in pricing derivatives in incomplete markets. Chapter VI of the First Edition has been completely rewritten, to emphasize the relationships between logarithmic transformations and risk sensitivity. A new Chapter XI gives a concise introduction to two-controller, zero-sum differential games. Also covered are controlled Markov diffusions and viscosity solutions of Hamilton-Jacobi-Bellman equations. The authors have tried, through illustrative examples and selective material, to connect stochastic control theory with other mathematical areas (e.g. large deviations theory) and with applications to engineering, physics, management, and finance.; In this Second Edition, new material on applications to mathematical finance has been added. Concise introductions to risk-sensitive control theory, nonlinear H-infinity control and differential games are also included.

Optimal Control, Stabilization and Nonsmooth Analysis Marcio S. de Queiroz,Michael Malisoff,Peter Wolenski.2014-03-12 This edited book contains selected papers presented at the Louisiana Conference on Mathematical Control Theory (MCT'03), which brought together over 35 prominent world experts in mathematical control theory and its applications. The book forms a well-integrated exploration of those areas of mathematical control theory in which nonsmooth analysis is having a major impact. These include necessary and sufficient conditions in optimal control, Lyapunov characterizations of stability, input-to-state stability, the construction of feedback mechanisms, viscosity solutions of Hamilton-Jacobi equations, invariance, approximation theory, impulsive systems, computational issues for nonlinear systems, and other topics of interest to mathematicians and control engineers. The book has a strong interdisciplinary component and was designed to facilitate the interaction between leading mathematical experts in nonsmooth analysis and engineers who are increasingly using nonsmooth analytic tools.

An Invitation to Web Geometry Jorge Vitório Pereira,Luc Pirio.2015-02-23 This book takes an in-depth look at abelian relations of codimension one webs in the complex analytic setting. In its classical form, web geometry consists in the study of webs up to local diffeomorphisms. A significant part of the theory revolves around the concept of abelian relation, a particular kind of functional relation among the first integrals of the foliations of a web. Two main focuses of the book include how many abelian relations can a web carry and which webs are carrying the maximal possible number of abelian relations. The book offers complete proofs of both Chern’s bound and Trépreau’s algebraization theorem, including all the necessary prerequisites that go beyond elementary complex analysis or basic algebraic geometry. Most of the examples known up to date of non-algebraizable planar webs of maximal rank are discussed in detail. A historical account of the algebraization problem for maximal rank webs of codimension one is also presented.

Stochastic Controls Jiongmin Yong,Xun Yu Zhou.2012-12-06 As is well known, Pontryagin's maximum principle and Bellman's dynamic programming are the two principal and most commonly used approaches in solving stochastic optimal control problems. * An interesting phenomenon one can observe from the literature is that these two approaches have been developed separately and independently. Since both methods are used to investigate the same problems, a natural question one will ask is the fol lowing: (Q) What is the relationship betwccn the maximum principlc and dy namic programming in stochastic optimal controls? There did exist some researches (prior to the 1980s) on the relationship between these two. Nevertheless, the results usually werestated in heuristic terms and proved under rather restrictive assumptions, which were not satisfied in most cases. In the statement of a Pontryagin-type maximum principle there is an adjoint equation, which is an ordinary differential equation (ODE) in the (finite-dimensional) deterministic case and a stochastic differential equation (SDE) in the stochastic case. The system consisting of the adjoint equa tion, the original state equation, and the maximum condition is referred to as an (extended) Hamiltonian system. On the other hand, in Bellman's dynamic programming, there is a partial differential equation (PDE), of first order in the (finite-dimensional) deterministic case and of second or der in the stochastic case. This is known as a Hamilton-Jacobi-Bellman (HJB) equation.

Global Optimal Feedback Control of Nonlinear Systems and Viscosity Solutions of Hamilton-Jacobi-Bellman Equations Tayfun Çimen.2003

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