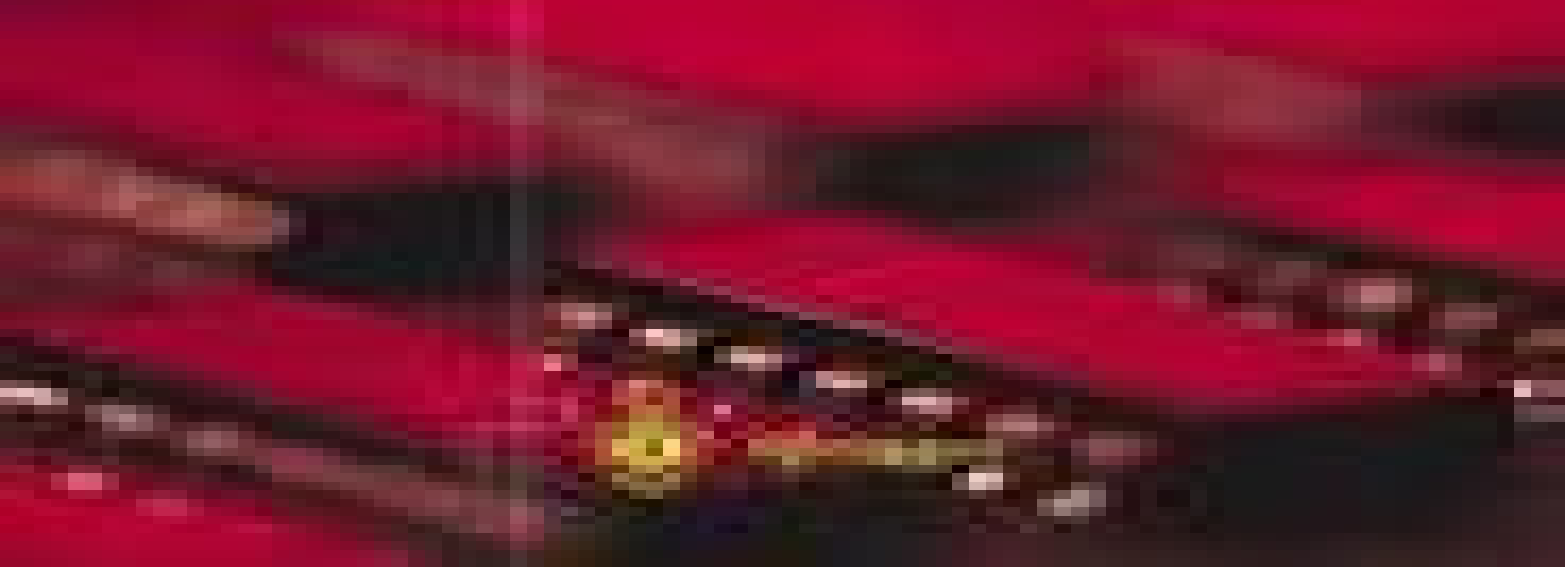
Adaptive Control of Nonsmooth Dynamic Systems



Nonsmooth Dynamical Systems

Iván Merillas Santos,Carles Batlle Arnau,Gerard Olivar Tost

Nonsmooth Dynamical Systems:

Nonsmooth Mechanics Bernard Brogliato,1999-03-30 Thank you for opening the second edition of this monograph which is devoted to the study of a class of nonsmooth dynamical systems of the general form i g x u 0 1 f x t 2 0 where x E JRn is the system s state vector u E JRm is the vector of inputs and the function f represents a unilateral constraint that is imposed on the state More precisely we shall restrict ourselves to a subclass of such systems namely mechanical systems subject to unilateral constraints on the position whose dynamical equations may be in a first instance written as ii g q q u 0 2 f q t 2 0 where q E JRn is the vector of generalized coordinates of the system and u is an in put or controller that generally involves a state feedback loop i e u u q q t z with z Z z q q t when the controller is a dynamic state feedback Mechanical systems composed of rigid bodies interacting fall into this subclass A general prop erty of systems as in 0 1 and 0 2 is that their solutions are nonsmooth with respect to time Nonsmoothness arises primarily from the occurence of impacts or collisions or percussions in the dynamical behaviour when the trajectories attain the surface f x t O They are necessary to keep the trajectories within the subspace x f x t 2 O of the system s state space **Numerical Methods for Nonsmooth Dynamical Systems** Vincent Acary,Bernard Brogliato,2008-01-30 This book concerns the numerical simulation of dynamical systems whose trajec ries may not be differentiable everywhere They are named nonsmooth dynamical systems They make an important class of systems rst because of the many app cations in which nonsmooth models are useful secondly because they give rise to new problems in various elds of science Usually nonsmooth dynamical systems are represented as differential inclusions complementarity systems evolution va ational inequalities each of these classes itself being split into several subclasses The book is divided into four parts the rst three parts being sketched in Fig 0 1 The aim of the rst part is to present the main tools from mechanics and applied mathematics which are necessary to understand how nonsmooth dynamical systems may be numerically simulated in a reliable way Many examples illustrate the th retical results and an emphasis is put on mechanical systems as well as on electrical circuits the so called Filippov s systems are also examined in some detail due to their importance in control applications The second and third parts are dedicated to a detailed presentation of the numerical schemes A fourth part is devoted to the presentation of the software platform Siconos This book is not a textbook on merical analysis of nonsmooth systems in the sense that despite the main results of numerical analysis convergence order of consistency etc being presented their proofs are not provided Nonsmooth Dynamical Systems Jan Awrejcewicz,Alexander F. Vakakis,Friedrich Pfeiffer,2005 Non-Smooth Dynamical Systems Markus Kunze,2014-01-15 The book provides a self contained introduction to the mathematical theory of non smooth dynamical problems as they frequently arise from mechanical systems with friction and or impacts It is aimed at applied mathematicians engineers and applied scientists in general who wish to learn the subject **Non-Smooth Dynamical Systems** Markus Kunze,2007-05-06 The book provides a self contained introduction to the mathematical theory of non smooth dynamical

problems as they frequently arise from mechanical systems with friction and or impacts It is aimed at applied mathematicians engineers and applied scientists in general who wish to learn the subject On Controllability of Smooth and Nonsmooth Dynamical Systems Jerzy Sztajnic,Stanislaw Walczak,1986 Modeling with Nonsmooth Dynamics Mike R. Jeffrey,2020-02-22 This volume looks at the study of dynamical systems with discontinuities Discontinuities arise when systems are subject to switches decisions or other abrupt changes in their underlying properties that require a non smooth definition A review of current ideas and introduction to key methods is given with a view to opening discussion of a major open problem in our fundamental understanding of what nonsmooth models are What does a nonsmooth model represent an approximation a toy model a sophisticated qualitative capturing of empirical law or a mere abstraction Tackling this question means confronting rarely discussed indeterminacies and ambiguities in how we define simulate and solve nonsmooth models The author illustrates these with simple examples based on genetic regulation and investment games and proposes precise mathematical tools to tackle them The volume is aimed at students and researchers who have some experience of dynamical systems whether as a modelling tool or studying theoretically Pointing to a range of theoretical and applied literature the author introduces the key ideas needed to tackle nonsmooth models but also shows the gaps in understanding that all researchers should be bearing in mind Mike Jeffrey is a researcher and lecturer at the University of Bristol with a background in mathematical physics specializing in dynamics singularities and asymptotics **Modeling and numerical study of nonsmooth dynamical systems** Iván Merillas Santos,Carles Batlle Arnau,Gerard Olivar Tost,2006 **A Variational Approach to Nonsmooth Dynamics** Samir Adly,2018-02-19 This brief examines mathematical models in nonsmooth mechanics and nonregular electrical circuits including evolution variational inequalities complementarity systems differential inclusions second order dynamics Lur e systems and Moreau s sweeping process The field of nonsmooth dynamics is of great interest to mathematicians mechanicians automatic controllers and engineers The present volume acknowledges this transversality and provides a multidisciplinary view as it outlines fundamental results in nonsmooth dynamics and explains how to use them to study various problems in engineering In particular the author explores the question of how to redefine the notion of dynamical systems in light of modern variational and nonsmooth analysis With the aim of bridging between the communities of applied mathematicians engineers and researchers in control theory and nonlinear systems this brief outlines both relevant mathematical proofs and models in unilateral mechanics and electronics

Non-Smooth Deterministic or Stochastic Discrete Dynamical Systems Jerome Bastien,Frederic Bernardin,Claude-Henri Lamarque,2013-03-18 This book contains theoretical and application oriented methods to treat models of dynamical systems involving non smooth nonlinearities The theoretical approach that has been retained and underlined in this work is associated with differential inclusions of mainly finite dimensional dynamical systems and the introduction of maximal monotone operators graphs in order to describe models of impact or friction The authors of this book

master the mathematical numerical and modeling tools in a particular way so that they can propose all aspects of the approach in both a deterministic and stochastic context in order to describe real stresses exerted on physical systems Such tools are very powerful for providing reference numerical approximations of the models Such an approach is still not very popular nevertheless even though it could be very useful for many models of numerous fields e g mechanics vibrations etc This book is especially suited for people both in research and industry interested in the modeling and numerical simulation of discrete mechanical systems with friction or impact phenomena occurring in the presence of classical linear elastic or non classical constitutive laws delay memory effects etc It aims to close the gap between highly specialized mathematical literature and engineering applications as well as to also give tools in the framework of non smooth stochastic differential systems thus applications involving stochastic excitations earthquakes road surfaces wind models etc are considered Contents 1 Some Simple Examples 2 Theoretical Deterministic Context 3 Stochastic Theoretical Context 4 Riemannian Theoretical Context 5 Systems with Friction 6 Impact Systems 7 Applications Extensions About the Authors J r me Bastien is Assistant Professor at the University Lyon 1 Centre de recherche et d Innovation sur le sport in France Fr d ric Bernardin is a Research Engineer at D partement Laboratoire de Clermont Ferrand DLCF Centre d Etudes Techniques de l Equipement CETE Lyon France Claude Henri Lamarque is Head of Laboratoire G omat riaux et G nie Civil LGCB and Professor at Ecole des Travaux Publics de l Etat ENTPE Vaulx en Velin France **Adaptive Control of Nonsmooth Dynamic Systems** Gang Tao,Frank L. Lewis,2013-04-17 A complete reference to adaptive control of systems with nonsmooth industrial nonlinearities such as backlash dead zones component failure friction hysteresis saturation and time delays Actuator nonlinearities are ubiquitous in engineering practice and limit control system performance While standard feedback control alone cannot handle these nonsmooth nonlinearities effectively this book shows how such nonlinear characteristics can be compensated for by using adaptive and intelligent control techniques This allows desired system performance to be achieved in the presence of uncertain nonlinearities With surveys of literature and summaries of various design methods the contributors present new solutions to some important issues in adaptive control of systems with various sorts of nonsmooth nonlinearities The book motivates more research activities in the field of adaptive control of nonsmooth nonlinear industrial systems by formulating several challenging open problems in related areas Numerical Methods for Optimal Control of Nonsmooth Dynamical Systems Armin Nurkanović,2023 **Dynamics and Bifurcations of Non-Smooth Mechanical Systems** Remco I. Leine,Henk Nijmeijer,2013-03-19 This monograph combines the knowledge of both the field of nonlinear dynamics and non smooth mechanics presenting a framework for a class of non smooth mechanical systems using techniques from both fields The book reviews recent developments and opens the field to the nonlinear dynamics community This book addresses researchers and graduate students in engineering and mathematics interested in the modelling simulation and dynamics of non smooth systems and nonlinear dynamics **Discontinuous Dynamical Systems on Time-varying Domains** Albert C.

J. Luo,2009-11-06 Discontinuous Dynamical Systems on Time varying Domains is the first monograph focusing on this topic While in the classic theory of dynamical systems the focus is on dynamical systems on time invariant domains this book presents discontinuous dynamical systems on time varying domains where the corresponding switchability of a flow to the time varying boundary in discontinuous dynamical systems is discussed From such a theory principles of dynamical system interactions without any physical connections are presented Several discontinuous systems on time varying domains are analyzed in detail to show how to apply the theory to practical problems The book can serve as a reference book for researchers advanced undergraduate and graduate students in mathematics physics and mechanics Dr Albert C J Luo is a professor at Southern Illinois University Edwardsville USA His research is involved in the nonlinear theory of dynamical systems His main contributions are in the following aspects a stochastic and resonant layer theory in nonlinear Hamiltonian systems singularity on discontinuous dynamical systems and approximate nonlinear theories for a deformable body

Global Analysis of Dynamic Models in Economics and Finance Gian Italo Bischi,Carl Chiarella,Iryna Sushko,2012-08-07 The essays in this special volume survey some of the most recent advances in the global analysis of dynamic models for economics finance and the social sciences They deal in particular with a range of topics from mathematical methods as well as numerous applications including recent developments on asset pricing heterogeneous beliefs global bifurcations in complementarity games international subsidy games and issues in economic geography A number of stochastic dynamic models are also analysed The book is a collection of essays in honour of the 60th birthday of Laura Gardini **Advanced Topics in Nonsmooth Dynamics** Remco Leine,Vincent Acary,Olivier Brüls,2018-06-07 This book discusses emerging topics in the area of nonsmooth dynamics research such as numerical methods for nonsmooth systems impact laws for multi collisions nonlinear vibrations and control of nonsmooth systems It documents original work of researchers at the European Network for NonSmooth Dynamics ENNSD which provides a cooperation platform for researchers in the field and promotes research focused on nonsmooth dynamics and its applications Since the establishment of the network in 2012 six ENNSD symposia have been organized at different European locations The network brings together 40 specialists from 9 different countries in and outside Europe and a wealth of scientific knowledge has been gathered and developed by this group of experts in recent years The book is of interest to both new and experienced researchers in the field of nonsmooth dynamics Each chapter is written in such a way as to provide an introduction to the topic for researchers from other fields **Tools and Algorithms for the Construction and Analysis of Systems** Arie Gurfinkel,Marijn Heule,2025-04-30 The open access book set LNCS 15696 15697 and 15698 constitutes the proceedings of the 31st International Conference on Tools and Algorithms for the Construction and Analysis of Systems TACAS 2025 which was held as part of the International Joint Conferences on Theory and Practice of Software ETAPS 2025 during May 3 8 2025 in Hamilton Canada The 46 papers presented were carefully reviewed and selected from 148 submissions The proceedings also include 14 papers from the

Software Verification competition which was held as part of TACAS The papers were organized in topical sections as follows Part I Program analysis ATP and rewriting model checking LTL verification Part II SAT and SMT solving proofs and certificates synthesis equivalence checking games Part III Verification quantum and GPU 14th Competition on Software Verification SV COMP 2025 Smooth and Nonsmooth High Dimensional Chaos and the Melnikov-Type Methods Jan Awrejcewicz,Mariusz M. Holicke,2007 This book focuses on the development of Melnikov type methods applied to high dimensional dynamical systems governed by ordinary differential equations Although the classical Melnikov s technique has found various applications in predicting homoclinic intersections it is devoted only to the analysis of three dimensional systems in the case of mechanics they represent one degree of freedom nonautonomous systems This book extends the classical Melnikov s approach to the study of high dimensional dynamical systems and uses simple models of dry friction to analytically predict the occurrence of both stick slip and slip slip chaotic orbits research which is very rarely reported in the existing literature even on one degree of freedom nonautonomous dynamics This pioneering attempt to predict the occurrence of deterministic chaos of nonlinear dynamical systems will attract many researchers including applied mathematicians physicists as well as practicing engineers Analytical formulas are explicitly formulated step by step even attracting potential readers without a rigorous mathematical background Sample Chapter s Chapter 1 A Role of the Melnikov Type Methods in Applied Sciences 137 KB Contents A Role of the Melnikov Type Methods in Applied Sciences Classical Melnikov Approach Homoclinic Chaos Criterion in a Rotated Froude Pendulum with Dry Friction Smooth and Nonsmooth Dynamics of a Quasi Autonomous Oscillator with Coulomb and Viscous Frictions Application of the MelnikovOCoGruendler Method to Mechanical Systems A Self Excited Spherical Pendulum A Double Self excited Duffing type Oscillator A Triple Self Excited Duffing type Oscillator Readership Graduate students and researchers in dynamical systems

Poincaré-Andronov-Melnikov Analysis for Non-Smooth Systems Michal Feckan,Michal Pospíšil,2016-06-07 Poincar Andronov Melnikov Analysis for Non Smooth Systems is devoted to the study of bifurcations of periodic solutions for general n dimensional discontinuous systems The authors study these systems under assumptions of transversal intersections with discontinuity switching boundaries Furthermore bifurcations of periodic sliding solutions are studied from sliding periodic solutions of unperturbed discontinuous equations and bifurcations of forced periodic solutions are also investigated for impact systems from single periodic solutions of unperturbed impact equations In addition the book presents studies for weakly coupled discontinuous systems and also the local asymptotic properties of derived perturbed periodic solutions The relationship between non smooth systems and their continuous approximations is investigated as well Examples of 2 3 and 4 dimensional discontinuous ordinary differential equations and impact systems are given to illustrate the theoretical results The authors use so called discontinuous Poincar mapping which maps a point to its position after one period of the periodic solution This approach is rather technical but it does produce results for general dimensions of spatial variables and

parameters as well as the asymptotical results such as stability instability and hyperbolicity Extends Melnikov analysis of the classic Poincar and Andronov staples pointing to a general theory for freedom in dimensions of spatial variables and parameters as well as asymptotical results such as stability instability and hyperbolicity Presents a toolbox of critical theoretical techniques for many practical examples and models including non smooth dynamical systems Provides realistic models based on unsolved discontinuous problems from the literature and describes how Poincar Andronov Melnikov analysis can be used to solve them Investigates the relationship between non smooth systems and their continuous approximations

Multibody Dynamics with Unilateral Contacts Friedrich Pfeiffer,Christoph Glocker,2000-11-10 The volume introduces basic concepts necessary for a modern treatment of inequality problems in finite degree of freedom dynamics Tools from convex analysis by now well established in non smooth mechanics are used to formulate the constitutive equations and impact laws The lectures cover a broad area of non smooth dynamics from primal and dual energy functions in variational and differential form to application problems as chimney dampers or vibration conveyors This includes frictional oscillations with bifurcation scenarios as well as analogies to small displacement quasi static problems The course is on an advanced level designed primarily for postgraduate students but should also be of value for scientists working on dynamic complementarity problems

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