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Passivity-based Control of Euler-Lagrange Systems **Passivity-based Control of Euler-Lagrange Systems** **Exterior Differential Systems and Euler-Lagrange Partial Differential Equations** *An Introduction to Lagrangian Mechanics* **Euler-Lagrange-Gleichungen in der angewandten Analysis** *Exterior Differential Systems and Euler-Lagrange Partial Differential Equations* *Orbits minimaler Wirkung* Kinematic Control of Redundant Robot Arms Using Neural Networks *Nonlinear Control of Engineering Systems* *Distributed Average Tracking in Multi-agent Systems* The Action Principle and Partial Differential Equations **Optimal Control Systems** Dynamical Systems VII A Student's Guide to Lagrangians and Hamiltonians **Exterior Differential Systems and the Calculus of Variations** **Symmetrien und die Erhaltungsgrößen der Mechanik** **Control Strategy for Time-Delay Systems** **PID Passivity-Based Control of Nonlinear Systems with Applications** *Fundamentals of Robotic Mechanical Systems* **Special Properties of Second-order Dynamical Systems** *Dynamical Systems and Differential Geometry via MAPLE* **Nonlinear and Adaptive Control** **System, Structure and Control 2004** *Exterior Differential Systems and the Calculus of Variations* **Non-linear Control for Underactuated Mechanical Systems** *Symplectic Topology* *and Measure Preserving Dynamical Systems* Modern Anti-windup Synthesis *Advances in Neural Networks – ISNN 2016* **Adaptive-Robust Control with Limited Knowledge on Systems Dynamics** Dynamical Systems and Geometric Mechanics **The Inverse Problem of the Calculus of Variations** **Introduction to the Modern Theory of Dynamical Systems** **CONTROL SYSTEMS, ROBOTICS AND AUTOMATION – Volume XIII** *Qualitative Theory of ODEs: An Introduction to Dynamical Systems Theory* **Recent Advances In Circuits And Systems** **Implicit First Order Dynamical Systems with Two State Parameters** **Impulsive and Hybrid Dynamical Systems** **Geometric Control of Mechanical Systems** *Modelling and Control of Mechanical Systems* Analysis and Control of Underactuated Mechanical Systems

This book provides a wide variety of state-space--based numerical algorithms for the synthesis of feedback algorithms for linear systems with input saturation. Specifically, it addresses and solves the anti-windup problem, presenting the objectives and terminology of the problem, the mathematical tools behind anti-windup algorithms, and more than twenty algorithms for anti-windup synthesis, illustrated with examples. Luca Zaccarian and Andrew Teel's modern method--combining a state-space approach with algorithms generated by solving linear matrix inequalities--treats MIMO and SISO systems with equal ease. The book, aimed at control engineers as well as graduate students, ranges from very simple anti-windup construction to sophisticated anti-windup algorithms for nonlinear systems. Describes the fundamental objectives and principles behind anti-windup synthesis for control systems with actuator saturation Takes a modern, state-space approach to synthesis that applies to both SISO and MIMO systems Presents algorithms as linear matrix inequalities that can be readily solved with widely available software Explains mathematical concepts that motivate synthesis algorithms Uses nonlinear performance curves to quantify performance relative to disturbances of varying magnitudes Includes anti-windup algorithms for a class of Euler-Lagrange nonlinear systems Traces the history of anti-windup research through an extensive annotated bibliography Modern robotics dates from the late 1960s, when progress in the development of microprocessors made possible the computer control of a multiaxial manipulator. Since then, robotics has evolved to connect with many branches of science and engineering, and to encompass such diverse fields as computer vision, artificial intelligence, and speech recognition. This book deals with robots - such as remote manipulators, multifingered hands, walking machines, flight simulators, and machine tools - that rely on mechanical systems to perform their tasks. It aims to establish the foundations on which the design, control and implementation of the underlying mechanical systems are based. The treatment assumes familiarity with some calculus, linear algebra, and elementary mechanics; however, the elements of rigid-body mechanics and of linear transformations are reviewed in the first chapters, making the presentation self-contained. An extensive set of exercises is included. Topics covered include: kinematics and dynamics of serial manipulators with decoupled architectures; trajectory planning; determination of the angular velocity and angular acceleration of a rigid body from point data; inverse and direct kinematics manipulators; dynamics of general parallel manipulators of the platform type; and the kinematics and dynamics of rolling robots. Since the publication of the previous edition there have been numerous advances in both the applications of robotics (including in laprascopy, haptics, manufacturing, and most notably space exploration) as well as in the theoretical aspects (for example, the proof that Husty's 40th-degree polynomial is indeed minimal - mentioned as an open question in the previous edition). This book develops a general analysis and synthesis framework for impulsive and hybrid dynamical systems. Such a framework is imperative for modern complex engineering systems that involve interacting continuous-time and discrete-time dynamics with multiple modes of operation that place stringent demands on controller design and require implementation of increasing complexity--whether advanced high-performance tactical fighter aircraft and space vehicles, variable-cycle gas turbine engines, or air and ground transportation systems. Impulsive and Hybrid Dynamical Systems goes beyond similar treatments by developing invariant set stability theorems, partial stability, Lagrange stability, boundedness, ultimate boundedness, dissipativity theory, vector dissipativity theory, energy-based hybrid control, optimal control, disturbance rejection control, and robust control for nonlinear impulsive and hybrid dynamical systems. A major contribution to mathematical system theory and control system theory, this book is written from a system-theoretic point of view with the highest standards of exposition and rigor. It is intended for graduate students, researchers, and practitioners of engineering and applied mathematics as well as computer scientists, physicists, and other scientists who seek a fundamental understanding of the rich dynamical behavior of impulsive and hybrid dynamical systems. This book introduces new methods in the theory of partial differential equations derivable from a Lagrangian. These methods constitute, in part, an extension to partial differential equations of the methods of symplectic geometry and Hamilton-Jacobi theory for Lagrangian systems of ordinary differential equations. A distinguishing characteristic of this approach is that one considers, at once, entire families of solutions of the Euler-Lagrange equations, rather than restricting attention to single solutions at a time. The second part of the book develops a general theory of integral identities, the theory of "compatible currents," which extends the work of E. Noether. Finally, the third part introduces a new general definition of hyperbolicity, based on a quadratic form associated with the Lagrangian, which overcomes the obstacles arising from singularities of the characteristic variety that were encountered in previous approaches. On the basis of the new definition, the domain-of-dependence theorem and stability properties of solutions are derived. Applications to continuum mechanics are discussed throughout the book. The last chapter is devoted to the electrodynamics of nonlinear continuous media. The aim of the present book is to give a systematic treatment of the inverse problem of the calculus of variations, i.e. how to recognize whether a system of differential equations can be treated as a system for extremals of a variational functional (the Euler-Lagrange equations), using contemporary geometric methods. Selected applications in geometry, physics, optimal control, and general relativity are also considered. The book includes the following chapters: - Helmholtz conditions and the method of controlled Lagrangians (Bloch, Krupka, Zenkov) - The Sonin-Douglas's problem (Krupka) - Inverse variational problem and symmetry in action: The Ostrogradskyj relativistic third order dynamics (Matsyuk.) - Source forms and their variational completion (Voicu) - First-order variational sequences and the inverse problem of the calculus of variations (Urban, Volna) - The inverse problem of the calculus of variations on Grassmann fibrations (Urban). A collection of five surveys on dynamical systems, indispensable for graduate students and researchers in mathematics and theoretical physics. Written in the modern language of differential geometry, the book covers all the new differential geometric and Lie-algebraic methods currently used in the theory of integrable systems. The area of dynamical systems and differential geometry via MAPLE is a field which has become exceedingly technical in recent years. In the field, everything is structured for the benefit of optimizing evolutionary geometric aspects that describe significant physical or engineering phenomena. This book is structured in terms of the importance, accessibility and impact of theoretical notions capable of shaping a future mathematician-computer scientist possessing knowledge of evolutionary dynamical systems. It provides a self-contained and accessible introduction for graduate and advanced undergraduate students in mathematics, engineering, physics, and economic sciences. This book is suitable for both self-study for students and professors with a background in differential geometry and for teaching a semester-long introductory graduate course in dynamical systems and differential geometry via MAPLE. The book investigates the role of artificial input delay in approximating unknown system dynamics, referred to as time-delayed control (TDC), and provides novel solutions to current design issues in TDC. Its central focus is on designing adaptive-switching gain-based robust control (ARC) for a class of Euler–Lagrange (EL) systems with minimal or no knowledge of the system dynamics parameters. The newly proposed TDC-based ARC tackles the commonly observed over- and under-estimation issues in switching gain. The consideration of EL systems lends a practical perspective on the proposed methods, and each chapter is supplemented by relevant experimental data. The book offers a unique resource for researchers in the areas of ARC and TDC alike, and covers the state of the art, new algorithms, and future directions. 15 0. PRELIMINARIES a) Notations from Manifold Theory b) The Language of Jet Manifolds c) Frame Manifolds d) Differentia! Ideals e) Exterior Differential Systems EULER-LAGRANGE EQUATIONS FOR DIFFERENTIAL SYSTEMS ~liTH ONE I. 32 INDEPENDENT VARIABLE a) Setting up the Problem; Classical Examples b) Variational Equations for Integral Manifolds of Differential Systems c) Differential Systems in Good Form; the Derived Flag, Cauchy Characteristics, and Prolongation of Exterior Differential Systems d) Derivation of the Euler-Lagrange Equations; Examples e) The Euler-Lagrange Differential System; Non-Degenerate Variational Problems; Examples FIRST INTEGRALS OF THE EULER-LAGRANGE SYSTEM; NOETHER'S II. 1D7 THEOREM AND EXAMPLES a) First Integrals and Noether's Theorem; Some Classical Examples; Variational Problems Algebraically Integrable by Quadratures b) Investigation of the Euler-Lagrange System for Some Differential-Geometric Variational Pro~lems: 2 i) (K ds for Plane Curves; i i) Affine Arclength; 2 iii) f K ds for Space Curves; and iv) Delauney Problem. II I. EULER EQUATIONS FOR VARIATIONAL PROBLEfiJS IN HOMOGENEOUS SPACES 161 a) Derivation of the Equations: i) Motivation; i i) Review of the Classical Case; iii) the Genera 1 Euler Equations 2 K /2 ds b) Examples:

i) the Euler Equations Associated to f for lEn; but for Curves in i i) Some Problems as in i) sn; Non- Curves in iii) Euler Equations Associated to degenerate Ruled Surfaces IV. Die Freidlin-Wentzell-Theorie untersucht die Auswirkungen von zufälligen Störungen auf ein dynamisches System. Für stochastische Differentialgleichungen mit additivem oder multiplikativem Rauschen liefert sie ein Wirkungsintegral, dessen Minima kritische Übergänge beschreiben. Zur Bestimmung dieser kritischen Übergänge diskutiert Julia Schäpers einerseits bekannte Methoden aus der Fachliteratur und stellt andererseits einen neuartigen Ansatz vor, mit dem Orbits minimaler Wirkung als heterokline Verbindungen zwischen zwei stationären Zuständen eines Hamilton-Systems berechnet werden können. Diese neue Methode unterzieht sie einer genauen Fehleranalyse und erprobt sie an einer Reihe von Beispielen praktisch. This practical yet rigorous book provides a development of nonlinear, Lyapunov-based tools and their use in the solution of control-theoretic problems. Rich in motivating examples and new design techniques, the text balances theoretical foundations and real-world implementation. This book deals with the application of modern control theory to some important underactuated mechanical systems, from the inverted pendulum to the helicopter model. It will help readers gain experience in the modelling of mechanical systems and familiarize with new control methods for non-linear systems. Studienarbeit aus dem Jahr 2011 im Fachbereich Mathematik - Analysis, Universität Rostock (Institut für Mathematik), Veranstaltung: Mathematisches Seminar - Angewandte Analysis, Sprache: Deutsch, Abstract: In diesem Seminar geht es um die mathematische Modellierung und Optimierung von Windkraftanlagen bzw. Windrädern. Dazu wird es notwendig sein einführend auf die Mechanik einzugehen. Die Mechanik handelt von der Dynamik der Teilchen, starren Körpern oder auch kontinuierlichen Medien. Die Mechanik hat durch die Mechanik Newtons eine enorme Rolle für die Mathematik, Technik und Naturwissenschaften zugesprochen bekommen. Die Entwicklung von Differentialgleichungen wurde durch die Behandlung der Mechanik angeregt. Heutzutage ist der Einfluss sogar auf die Gruppendarstellung, Geometrie und Topologie nachweisbar, wobei sich diese Entwicklungen wieder auf die anderen Wissenschaften auswirk(t)en. Für dieses Seminar interessante Formulierungen der Mechanik sind einerseits die durch Lagrange und andererseits die durch Hamilton. Diese sind umfassender als die Formulierung der Mechanik Newtons, da sie auch Feldtheorien und Zwangsbedingungen berücksichtigen. Dabei unterliegen diese zwei Formulierungen unterschiedlicher

Betrachtungweisen der Mechanik. Während die Hamiltonsche Mechanik unmittelbar auf dem Energiekonzept beruht und eng in Verbindung mit der Quantenmechanik und allgemeinen Relativitätstheorie steht, ist die Lagrangesche Mechanik auf Variationsprinzipien begründet, die direkt zur allgemeinen Relativitätstheorie führt. Diese Variationsprinzipien sind Koordinatensystemunabhängig. Die Variationsrechnung beschäftigt sich mit reellen Funktionalen, deren Argumente Funktionen sind. Diese können etwa Integrale über eine unbekannte Funktion und ihre Ableitungen sein. Dabei interessiert man sich für stationäre Funktionale, also solche, für die das Funktional ein Maximum, ein Minimum oder einen Sattelpunkt annimmt. Es gibt zwei Arten von Variationsprinzipien. Einerseits gibt es die Differentialprinzipien, zu denen das D' Alambertsche Prinzip zu zählen ist. Andererseits existieren auch Integralprinzipien. Es soll in den folgenden Kapiteln vor allem darum gehen, dass eine Einführung in die Mechanik und einige Anwendungsbeispiele gegeben werden sollen. This Encyclopedia of Control Systems, Robotics, and Automation is a component of the global Encyclopedia of Life Support Systems EOLSS, which is an integrated compendium of twenty one Encyclopedias. This 22-volume set contains 240 chapters, each of size 5000-30000 words, with perspectives, applications and extensive illustrations. It is the only publication of its kind carrying state-of-the-art knowledge in the fields of Control Systems, Robotics, and Automation and is aimed, by virtue of the several applications, at the following five major target audiences: University and College Students, Educators, Professional Practitioners, Research Personnel and Policy Analysts, Managers, and Decision Makers and NGOs. This volume provides a general picture of the current trends in the area of automatic control, with particular emphasis on practical problems in the mechanical field. For this reason, besides theoretical contributions, it presents selected lectures on recent developments interesting from an industrial point of view, such as automotive, robotics, motion control, and electrical drives. Contents:Interconnected Mechanical Systems, Part I: Geometry of Interconnection and Implicit Hamiltonian SystemsInterconnected Mechanical Systems, Part II: The Dynamics of Spatial Mechanical NetworksA Network-Theoretical and Diakoptical Approach to Multi-Body SystemsReview of Results on Variable Structure Control for Application to Mechanical SystemsOn the Controllability and Observability Function of Nonlinear ControlPassivity-Based Control of Euler–Lagrange Systems: Applications to Robots, AC Motors and Power ConvertersThe Analysis of Motorcycle Dynamics and ControlA Mechanical

Network Approach to Performance Capabilities of Passive SuspensionsFuzzy Logic Control of a Variable Displacement Hydraulic PumpExperimental Identification of Robot ManipulatorsSome Results in the Control of Flexible Mechanical SystemsThe Perfect Tracking Problem for Nonminimum Phase Systems: Applications to Flexible-Link RobotsOn Some Structural Properties of General Manipulation SystemsDesign of Parallel Force/Position Controllers and Observers for Robot ManipulatorsMotion Equations of Mechanical Systems Subject to ImpactsHybrid Feedback Strategies for the Control of Juggling RobotsInvariant Manifolds: A Tool for StabilisationInvariant Manifold Techniques for Control of Underactuated Mechanical SystemsDiscontinuous Control of the Nonholonomic IntegratorComputational Models for the Simulation of Contact Phenomena in Multibody Systems Readership: Engineers (automatic control). Reviews:“This collection will be of interest to anyone working in the area of mechanical systems and their control.”Mathematics Abstracts Explore the foundational and advanced subjects associated with proportional-integral-derivative controllers from leading authors in the field In PID Passivity-Based Control of Nonlinear Systems with Applications, expert researchers and authors Drs. Romeo Ortega, Jose Guadalupe Romero, Pablo Borja, and Alejandro Donaire deliver a comprehensive and detailed discussion of the most crucial and relevant concepts in the analysis and design of proportional-integral-derivative controllers using passivity techniques. The accomplished authors present a formal treatment of the recent research in the area and offer readers practical applications of the developed methods to physical systems, including electrical, mechanical, electromechanical, power electronics, and process control. The book offers the material with minimal mathematical background, making it relevant to a wide audience. Familiarity with the theoretical tools reported in the control systems literature is not necessary to understand the concepts contained within. You’ll learn about a wide range of concepts, including disturbance rejection via PID control, PID control of mechanical systems, and Lyapunov stability of PID controllers. Readers will also benefit from the inclusion of: A thorough introduction to a class of physical systems described in the port-Hamiltonian form and a presentation of the systematic procedures to design PID-PBC for them An exploration of the applications to electrical, electromechanical, and process control systems of Lyapunov stability of PID controllers Practical discussions of the regulation and tracking of bilinear systems via PID control and their application to power electronics and thermal process control A concise treatment of the characterization of passive outputs, incremental models, and Port Hamiltonian and Euler-Lagrange systems Perfect for senior undergraduate and graduate students studying control systems, PID Passivity-Based Control will also earn a place in the libraries of engineers who practice in this area and seek a one-stop and fully updated reference on the subject. An Introduction to Lagrangian Mechanics begins with a proper historical perspective on the Lagrangian method by presenting Fermat's Principle of Least Time (as an introduction to the Calculus of Variations) as well as the principles of Maupertuis, Jacobi, and d'Alembert that preceded Hamilton's formulation of the Principle of Least Action, from which the Euler?Lagrange equations of motion are derived. Other additional topics not traditionally presented in undergraduate textbooks include the treatment of constraint forces in Lagrangian Mechanics; Routh's procedure for Lagrangian systems with symmetries; the art of numerical analysis for physical systems; variational formulations for several continuous Lagrangian systems; an introduction to elliptic functions with applications in Classical Mechanics; and Noncanonical Hamiltonian Mechanics and perturbation theory.This textbook is suitable for undergraduate students who have acquired the mathematical skills needed to complete a course in Modern Physics. The essence of this work is the control of electromechanical systems, such as manipulators, electric machines, and power converters. The common thread that links together the results presented here is the passivity property, which is at present in numerous electrical and mechanical systems, and which has great relevance in control engineering at this time. Amongst other topics, the authors cover: Euler-Lagrange Systems, Mechanical Systems, Generalised AC Motors, Induction Motor Control, Robots with AC Drives, and Perspectives and Open Problems. The authors have extensive experience of research and application in the field of control of electromechanical systems, which they have summarised here in this self-contained volume. While written in a strictly mathematical way, it is also elementary, and will be accessible to a wide-ranging audience, including graduate students as well as practitioners and researchers in this field. The papers in this volume were presented at the AMS-IMS-SIAM Joint Summer Research Conference on Symplectic Topology and Measure Preserving Dynamical Systems held in Snowbird, Utah in July 2007. The aim of the conference was to bring together specialists of symplectic topology and of measure preserving dynamics to try to connect these two subjects. One of the motivating conjectures at the interface of these two fields is the question of whether the group of area preserving homeomorphisms of the 2-disc is or is not simple. For diffeomorphisms it was known that the kernel of the Calabi invariant is a normal proper subgroup, so the group of area preserving diffeomorphisms is not simple. Most articles are related to understanding these and related questions in the framework of modern symplectic topology. This monograph provides readers with tools for the analysis, and control of systems with fewer control inputs than degrees of freedom to be controlled, i.e., underactuated systems. The text deals with the consequences of a lack of a general theory that would allow methodical treatment of such systems and the ad hoc approach to control design that often results, imposing a level of organization whenever the latter is lacking. The authors take as their starting point the construction of a graphical characterization or control flow diagram reflecting the transmission of generalized forces through the degrees of freedom. Underactuated systems are classified according to the three main structures by which this is found to happen—chain, tree, and isolated vertex—and control design procedures proposed. The procedure is applied to several well-known examples of underactuated systems: acrobot; pendubot; Tora system; ball and beam; inertia wheel; and robotic arm with elastic joint. The text is illustrated with MATLABsup®/sup/Simulink® simulations that demonstrate the effectiveness of the methods detailed./ppReaders interested in aircraft, vehicle control or various forms of walking robot will be able to learn from iUnderactuated Mechanical Systems Inhaltsangabe:Einleitung: Das Thema dieser fachwissenschaftlichen Arbeit ist sicherlich kein rein mathematisches, kommt der Hauptgegenstand doch aus der Physik. Die klassische Mechanik als Teil der theoretischen Physik eröffnet aber eine Vielzahl von Anwendungszusammenhängen f r die mathematischen Disziplinen. Die im Zentrum der Mechanik stehenden konservativen Systeme von Massenpunkten weisen bezüglich spezieller Transformationen Symmetrien auf, aus denen sich Erhaltungsgrößen ableiten lassen. Dieses Phänomen ist das eigentliche Thema dieser Arbeit. Hinführend soll jedoch erst die zugrundeliegende Theorie besprochen werden. Im ersten Kapitel wird der Begriff der Symmetrie definiert. Dabei wird die Gruppentheorie allerdings ausgelassen, da diese, trotz ihrer Relevanz bezüglich des Symmetriebegriffs in der Mathematik, f r die Untersuchungen in dieser Arbeit nicht benötigt wird. Das zweite Kapitel bietet eine kurze Einführung in die NEWTONsche Mechanik. Es werden grundlegende Begriffe und Größen eingeführt, z. B. Begriffe wie Ort, Zeit, Massenpunkt oder Größen wie Impuls, Kraft, kinetische und potentielle Energie. Am Ende des zweiten Kapitels stehen

Koordinatentransformationen im Blickpunkt, da sich durch die Einführung geeigneter allgemeiner Koordinaten das Auffinden der die Bahnkurven der Massenpunkte beschreibenden Funktionen vereinfachen 1ässt. Die im dritten Kapitel hergeleitete EULER-Differentialgleichung ist als notwendige Bedingung an die Bahnkurve ein nicht zu vernachlässigender Bestandteil der Mechanik. Die Herleitung ergibt sich anschaulich aus dem sog. Brachistochronenproblem, das von JACOB BERNOULLI formuliert wurde. Mit der im vierten Kapitel definierten LAGRANGE-Funktion und dem darauf folgenden HAMITLONSchen Prinzip hat man zusammen mit den Ergebnissen des dritten Kapitels Instrumente, um die Bewegungsgleichungen von Massenpunkten nur mit Hilfe der Kenntnis über kinetische und potentielle Energie eines Massenpunktsystems zu bestimmen: die EULER-LAGRANGE-Gleichung. Sie wird am Ende des Kapitels auf einige ausgesuchte physikalische Probleme angewendet. Das fünfte Kapitel bildet den Höhepunkt dieser Arbeit. Mit Hilfe des HAMILTONschen Prinzips aus dem vorigen Kapitel und des Theorems von EMMY NOETHER lassen sich Erkenntnisse über den Zusammenhang der LAGRANGE-Funktion mit Erhaltungsgrößen gewinnen. Die nachfolgenden Symmetriebetrachtungen und die daraus folgenden Erhaltungsgrößen bilden schließlich den Abschluss dieser [...] Recent Advances in Circuits and Systems brings you a balanced, state-of-the-art presentation of the latest concepts, methods, algorithms, techniques, procedures and applications of the fascinating field of Circuits and Systems. Written by eminent, leading, international experts, the contributors provide up-to-date aspects of topics discussed and present fresh, original insights into their own experience with Circuits and Systems.The main aim of this book is to present most of the new trends and recent advances of the impressive evolution in the discipline of circuits and systems. Special emphasis is given in the interaction between the classic areas of systems theory (feedback control, circuits design, electronics, etc) and the modern techniques of computational intelligence (neural networks, genetic algorithms, fuzzy logic and expert systems) since this fertile interaction promises to open up new horizons in circuits and systems theory.This book is composed of four parts. Part I is devoted to Circuits and Electronics and also includes Power Systems. Part II refers to Systems Theory and Control (H infinity problems, feedback control, non-linear systems, robust stability and robust control, multivariable systems, hybrid systems and hydraulic systems). Part III presents the latest developments in the Robotics (theory and applications) while Part IV is devoted to Computational Intelligence in

Systems Theory. Presents pioneering and comprehensive work on engaging movement in robotic arms, with a specific focus on neural networks This book presents and investigates different methods and schemes for the control of robotic arms whilst exploring the field from all angles. On a more specific level, it deals with the dynamic-neural-network based kinematic control of redundant robot arms by using theoretical tools and simulations. Kinematic Control of Redundant Robot Arms Using Neural Networks is divided into three parts: Neural Networks for Serial Robot Arm Control; Neural Networks for Parallel Robot Control; and Neural Networks for Cooperative Control. The book starts by covering zeroing neural networks for control, and follows up with chapters on adaptive dynamic programming neural networks for control; projection neural networks for robot arm control; and neural learning and control co-design for robot arm control. Next, it looks at robust neural controller design for robot arm control and teaches readers how to use neural networks to avoid robot singularity. It then instructs on neural network based Stewart platform control and neural network based learning and control co-design for Stewart platform control. The book finishes with a section on zeroing neural networks for robot arm motion generation. Provides comprehensive understanding on robot arm control aided with neural networks Presents neural network-based control techniques for single robot arms, parallel robot arms (Stewart platforms), and cooperative robot arms Provides a comparison of, and the advantages of, using neural networks for control purposes rather than traditional control based methods Includes simulation and modelling tasks (e.g., MATLAB) for onward application for research and engineering development By focusing on robot arm control aided by neural networks whilst examining central topics surrounding the field, Kinematic Control of Redundant Robot Arms Using Neural Networks is an excellent book for graduate students and academic and industrial researchers studying neural dynamics, neural networks, analog and digital circuits, mechatronics, and mechanical engineering. In Exterior Differential Systems, the authors present the results of their ongoing development of a theory of the geometry of differential equations, focusing especially on Lagrangians and Poincaré-Cartan forms. They also cover certain aspects of the theory of exterior differential systems, which provides the language and techniques for the entire study. Because it plays a central role in uncovering geometric properties of differential equations, the method of equivalence is particularly emphasized. In addition, the authors discuss conformally invariant systems at length, including results on the classification and application of symmetries and conservation laws. The book also covers the Second Variation, Euler-Lagrange PDE systems, and higher-order conservation laws. This timely synthesis of partial differential equations and differential geometry will be of fundamental importance to both students and experienced researchers working in geometric analysis. Control Strategy for Time-Delay Systems Part I: Concepts and Theories covers all the important features of real-world practical applications which will be valuable to practicing engineers and specialists, especially given that delays are present in 99% of industrial processes. The book presents the views of the editors on promising research directions and future industrial applications in this area. Although the fundamentals of time-delay systems are discussed, the book focuses on the advanced modeling and control of such systems and will provide the analysis and test (or simulation) results of nearly every technique described. For this purpose, highly complex models are introduced to ?describe the mentioned new applications, which are characterized by ?time-varying delays with intermittent and stochastic nature, several types of nonlinearities, and the presence ?of different time-scales. Researchers, practitioners, and PhD students will gain insights into the prevailing trends in design and operation of real-time control systems, reviewing the shortcomings and future developments concerning practical system issues, such as standardization, protection, and design. Presents an overview of the most recent trends for time-delay systems Covers the important features of the real-world practical applications that can be valuable to practicing engineers and specialists Provides analysis and simulations results of the techniques described in the book This book presents a systematic study of an emerging field in the development of multi-agent systems. In a wide spectrum of applications, it is now common to see that multiple agents work cooperatively to accomplish a complex task. The book assists the implementation of such applications by promoting the ability of multi-agent systems to track — using local communication only — the mean value of signals of interest, even when these change rapidly with time and when no individual agent has direct access to the average signal across the whole team; for example, when a better estimation/control performance of multi-robot systems has to be guaranteed, it is desirable for each robot to compute or track the averaged changing measurements of all the robots at any time by communicating with only local neighboring robots. The book covers three factors in successful distributed average tracking: algorithm design via nonsmooth and extended PI control; distributed average tracking for double-integrator, general-linear, Euler–Lagrange, and input-saturated dynamics; and applications in dynamic region-following formation control and distributed convex optimization. The book presents both the theory and applications in a general but self-contained manner, making it easy to follow for newcomers to the topic. The content presented fosters research advances in distributed average tracking and inspires future research directions in the field in academia and industry. 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. In Exterior Differential Systems, the authors present the results of their ongoing development of a theory of the geometry of differential equations, focusing especially on Lagrangians and Poincaré-Cartan forms. They also cover certain aspects of the theory of exterior differential systems, which provides the language and techniques for the entire study. Because it plays a central role in uncovering geometric properties of differential equations, the method of equivalence is particularly emphasized. In addition, the authors discuss conformally invariant systems at length, including results on the classification and application of symmetries and conservation laws. The book also covers the Second Variation, Euler-Lagrange PDE systems, and higher-order conservation laws. This timely synthesis of partial differential equations and differential geometry will be of fundamental importance to both students and experienced researchers working in geometric analysis. This book constitutes the refereed proceedings of the 13th International Symposium on Neural Networks, ISNN 2016, held in St. Petersburg, Russia in July 2016. The 84 revised full papers presented in this volume were carefully reviewed and selected from 104 submissions. The papers cover many topics of neural network-related research including signal and image processing; dynamical behaviors of recurrent neural networks; intelligent control; clustering, classification, modeling, and forecasting; evolutionary computation; and cognition computation and spiking neural networks. The essence of this work is the control of electromechanical systems, such as manipulators, electric machines, and power converters. The common thread that links together the results presented here is the passivity property, which is at present in numerous electrical and mechanical systems, and which has great relevance in control engineering at this time. Amongst other topics, the authors cover: Euler-Lagrange Systems, Mechanical Systems, Generalised AC Motors, Induction Motor Control, Robots with AC Drives, and Perspectives and Open Problems. The authors have extensive experience of research and application in the field of control of electromechanical systems, which they have summarised here in this self-contained volume. While written in a strictly mathematical way, it is also elementary, and will be accessible to a wide-ranging audience, including graduate students as well as practitioners and researchers in this field. A self-contained comprehensive introduction to the mathematical theory of dynamical systems for students and researchers in mathematics, science and engineering. A concise treatment of variational techniques, focussing on Lagrangian and Hamiltonian systems, ideal for physics, engineering and mathematics students. Introduction to Dynamical Systems and Geometric Mechanics provides a comprehensive tour of two fields that are intimately entwined: dynamical systems is the study of the behavior of physical systems that may be described by a set of nonlinear first-order ordinary differential equations in Euclidean space, whereas geometric mechanics explore similar systems that instead evolve on differentiable manifolds. The first part discusses the linearization and stability of trajectories and fixed points, invariant manifold theory, periodic orbits, Poincaré maps, Floquet theory, the Poincaré-Bendixson theorem, bifurcations, and chaos. The second part of the book begins with a self-contained chapter on differential geometry that introduces notions of manifolds, mappings, vector fields, the Jacobi-Lie bracket, and differential forms. The area of analysis and control of mechanical systems using differential geometry is flourishing. This book collects many results over the last decade and provides a comprehensive introduction to the area.