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Passivity-Based Control and Estimation in Networked Robotics



Springer

Passivity Based Control And Estimation In Networked Robotics Communications And Control Engineering

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Passivity Based Control And Estimation In Networked Robotics Communications And Control Engineering:

Passivity-Based Control and Estimation in Networked Robotics Takeshi Hatanaka, Nikhil Chopra, Masayuki Fujita, Mark W. Spong, 2015-04-10 Highlighting the control of networked robotic systems this book synthesizes a unified passivity based approach to an emerging cross disciplinary subject Thanks to this unified approach readers can access various state of the art research fields by studying only the background foundations associated with passivity In addition to the theoretical results and techniques the authors provide experimental case studies on testbeds of robotic systems including networked haptic devices visual robotic systems robotic network systems and visual sensor network systems The text begins with an introduction to passivity and passivity based control together with the other foundations needed in this book The main body of the book consists of three parts The first examines how passivity can be utilized for bilateral teleoperation and demonstrates the inherent robustness of the passivity based controller against communication delays The second part emphasizes passivity s usefulness for visual feedback control and estimation Convergence is rigorously proved even when other passive components are interconnected The passivity approach is also differentiated from other methodologies The third part presents the unified passivity based control design methodology for multi agent systems This scheme is shown to be either immediately applicable or easily extendable to the solution of various motion coordination problems including 3 D attitude pose synchronization flocking control and cooperative motion estimation Academic researchers and practitioners working in systems and control and or robotics will appreciate the potential of the elegant and novel approach to the control of networked robots presented here The limited background required and the case study work described also make the text appropriate for and it is hoped inspiring to students

Network Optimization Methods in Passivity-Based Cooperative Control

Miel Sharf, 2021-05-24 This book establishes an important mathematical connection between cooperative control problems and network optimization problems It shows that many cooperative control problems can in fact be understood under certain passivity assumptions using a pair of static network optimization problems Merging notions from passivity theory and network optimization it describes a novel network optimization approach that can be applied to the synthesis of controllers for diffusively coupled networks of passive or passivity short dynamical systems It also introduces a data based model free approach for the synthesis of network controllers for multi agent systems with passivity short agents Further the book describes a method for monitoring link faults in multi agent systems using passivity theory and graph connectivity It reports on some practical case studies describing the effectivity of the developed approaches in vehicle networks All in all this book offers an extensive source of information and novel methods in the emerging field of multi agent cooperative control paving the way to future developments of autonomous systems for various application domains

Dissipative Systems Analysis and Control

Bernard Brogliato, Rogelio Lozano, Bernhard Maschke, Olav Egeland, 2019-07-03 The third edition of the now standard Dissipative Systems Analysis and Control presents a revised and expanded treatment of

dissipative systems theory constituting a self contained advanced introduction for graduate students researchers and practising engineers It examines linear nonlinear and nonsmooth systems with many examples in each chapter occasional infinite dimensional examples are also included Throughout emphasis is placed on the use of the dissipative properties of a system for the design of stable and robust feedback control laws or state observers The theory is substantiated by experimental results and by reference to its application in illustrative physical cases Lagrangian systems passivity based and adaptive controllers are covered thoroughly The third edition is substantially updated to accommodate new material within the existing chapter structure The additions include the introduction of negative imaginary transfer functions the design of stable state observers that use passivity as a tool for their stability analysis a new section on robust set valued control of uncertain Lagrangian systems extended section on discrete time systems especially the preservation of dissipativity after discretization a thorough treatment of nonsmooth set valued Lur e systems well posedness and stability an extended chapter on the Kalman Yakubovich Popov Lemma and over 1000 references

Analysis and Design of Networked Control

Systems under Attacks Yuan Yuan, Hongjiu Yang, Lei Guo, Fuchun Sun, 2018-09-21 This book adopts a systematic view of the control systems in cyber physical systems including the security control of the optimal control system security control of the non cooperative game system quantify the impact of the Denial of Service attacks on the optimal control system and the adaptive security control of the networked control systems Because the cyber physical system is a hybrid system it adopts cross layer approach to handle the security control of the CPS It presents a number of attack models according to the attack scenario and defense facilities and a number of cross layer co design methodologies to secure the control of CPS

Machine Learning for Robotics Applications Monica Bianchini, Milan Simic, Ankush Ghosh, Rabindra Nath Shaw, 2021-04-23 Machine learning has become one of the most prevalent topics in recent years The application of machine learning we see today is a tip of the iceberg The machine learning revolution has just started to roll out It is becoming an integral part of all modern electronic devices Applications in automation areas like automotive security and surveillance augmented reality smart home retail automation and healthcare are few of them Robotics is also rising to dominate the automated world The future applications of machine learning in the robotics area are still undiscovered to the common readers We are therefore putting an effort to write this edited book on the future applications of machine learning on robotics where several applications have been included in separate chapters The content of the book is technical It has been tried to cover all possible application areas of Robotics using machine learning This book will provide the future vision on the unexplored areas of applications of Robotics using machine learning The ideas to be presented in this book are backed up by original research results The chapter provided here in depth look with all necessary theory and mathematical calculations It will be perfect for laymen and developers as it will combine both advanced and introductory material to form an argument for what machine learning could achieve in the future It will provide a vision on future areas of application and their approach in detail Therefore this book

will be immensely beneficial for the academicians researchers and industry project managers to develop their new project and thereby beneficial for mankind Original research and review works with model and build Robotics applications using Machine learning are included as chapters in this book *Subject Guide to Books in Print* ,1997 **Data-driven**

Passivity-based Control of Underactuated Robotic Systems Wankun Sirichotiyakul,2022 Classical control strategies for robotic systems are based on the idea that feedback control can be used to override the natural dynamics of the machines Passivity based control Pbc is a branch of nonlinear control theory that follows a similar approach where the natural dynamics is modified based on the overall energy of the system This method involves transforming a nonlinear control system through a suitable control input into another fictitious system that has desirable stability characteristics The majority of Pbc techniques require the discovery of a reasonable storage function which acts as a Lyapunov function candidate that can be used to certify stability There are several challenges in the design of a suitable storage function including 1 what a reasonable choice for the function is for a given control system and 2 the control synthesis requires a closed form solution to a set of nonlinear partial differential equations The latter is in general difficult to overcome especially for systems with high degrees of freedom limiting the applicability of Pbc techniques A machine learning framework that automatically determines the storage function for underactuated robotic systems is introduced in this dissertation This framework combines the expressive power of neural networks with the systematic methods of the Pbc paradigm bridging the gap between controllers derived from learning algorithms and nonlinear control theory A series of experiments demonstrates the efficacy and applicability of this framework for a family of underactuated robots Boise State University ScholarWorks **Handling**

Uncertainty and Networked Structure in Robot Control Lucian Buşoniu,Levente Tamás,2016-02-06 This book focuses on two challenges posed in robot control by the increasing adoption of robots in the everyday human environment uncertainty and networked communication Part I of the book describes learning control to address environmental uncertainty Part II discusses state estimation active sensing and complex scenario perception to tackle sensing uncertainty Part III completes the book with control of networked robots and multi robot teams Each chapter features in depth technical coverage and case studies highlighting the applicability of the techniques with real robots or in simulation Platforms include mobile ground aerial and underwater robots as well as humanoid robots and robot arms Source code and experimental data are available at <http://extras.springer.com> The text gathers contributions from academic and industry experts and offers a valuable resource for researchers or graduate students in robot control and perception It also benefits researchers in related areas such as computer vision nonlinear and learning control and multi agent systems [Dissipativity/passivity Based Control Design for Symmetric and Switched Systems with Application to Medical Robotics](#) Vahideh Ghanbari,2017 *Parameter Estimation and Adaptive Control for Nonlinear Servo Systems* Shubo Wang,Jing Na,Xuemei Ren,2024-01-16 *Parameter Estimation and Adaptive Control for Nonlinear Servo Systems* presents the latest advances in observer based control design focusing on

adaptive control for nonlinear systems such as adaptive neural network control adaptive parameter estimation and system identification This book offers an array of new real world applications in the field Written by eminent scientists in the field of control theory this book covers the latest advances in observer based control design It provides fundamentals algorithms and it discusses key applications in the fields of power systems robotics and mechatronics flight and automotive systems Presents a clear and concise introduction to the latest advances in parameter estimation and adaptive control with several concise applications for servo systems Covers a wide range of applications usually not found in similar books such as power systems robotics mechatronics aeronautics and industrial systems Contains worked examples which make it ideal for advanced courses as well as for researchers starting to work in the field particularly suitable for engineers wishing to enter the field quickly and efficiently

A Stable and Transparent Framework for Adaptive Shared Control of Robots Ribin

Balachandran,2023-12-28 Robotic research and developments in computing technologies including artificial intelligence have led to significant improvements in autonomous capabilities of robots Yet human supervision is advisable and in many cases necessary when robots interact with real world outside lab environments This is due to the fact that complete autonomy in robots has not yet been achieved When robots encounter challenges beyond their capabilities a viable solution is to include human operators in the loop who can support robots through teleoperation taking complete control or shared control This monograph focuses on a special form of shared control namely mixed initiative where the final command to the robot is a weighted sum of the commands from the operator and the autonomous controller The weights fixed or adaptive called authority allocation AA factors decide who has more control authority over the robot Several research groups use different methods to adapt the AA factors online and the benefits of adaptive mixed initiative shared control have been well established in terms of task completion success and operator usability However stability of the overall shared control framework with communication time delays between the operator and the robot is a field that has not been examined extensively This monograph presents methods to improve performance and stability in shared control so that the possibilities of its applications can be widened Firstly methods to improve the haptic feedback performance of teleoperation are developed Secondly methods to stabilize adaptive shared control systems while still ensuring high teleoperation performance are proposed The methods are validated on multiple robotic systems and they were applied in several projects both in space and terrestrial domains With the aforementioned contributions this monograph provides an overarching framework to improve synergy between humans and robots The flexibility of the framework allows integration of existent teleoperation and shared control approaches which further promotes synergy within the robotics community

High-performance Passivity-based Robotic Force Control Mark Elliott Dohring,2002

Informatics in Control Automation and Robotics Juan Andrade

Cetto,Joaquim Filipe,Jean-Louis Ferrier,2011-03-15 The present book includes a set of selected papers from the fourth International Conference on Informatics in Control Automation and Robotics ICINCO 2009 held in Milan Italy from 2 to 5 July

2009 The conference was organized in three simultaneous tracks Intelligent Control Systems and Optimization Robotics and Automation and Systems Modeling Signal Processing and Control The book is based on the same structure ICINCO received 365 paper submissions not including those of workshops from 55 countries in all continents After a double blind paper review performed by the Program Committee only 34 submissions were accepted as full papers and thus selected for oral presentation leading to a full paper acceptance ratio of 9% Additional papers were accepted as short papers and posters A further refinement was made after the conference based also on the assessment of presentation quality so that this book includes the extended and revised versions of the very best papers of ICINCO 2009 Commitment to high quality standards is a major concern of ICINCO that will be maintained in the next editions of this conference including not only the stringent paper acceptance ratios but also the quality of the program committee keynote lectures workshops and logistics

Passivity Based Control in Software Systems: Example and Case Studies Kashev Dalmia, 2016 *Non-Adaptive and Adaptive Control of Manipulation Robots* M. Vukobratovic, D. Stokic, N. Kircanski, 2013-12-11 The material presented in this monograph is a logical continuation of research results achieved in the control of manipulation robots This is in a way a synthesis of many year research efforts of the associates of Robotics Department Mihailo Pupin Institute in the field of dynamic control of robotic systems As in Vol 2 of this Series all results rely on the mathematical models of dynamics of active spatial mechanisms which offer the possibility for adequate dynamic control of manipulation robots Compared with Vol 2 this monograph has three essential new characteristics and a variety of new tasks arising in the control of robots which have been formulated and solved for the first time One of these novelties is nonadaptive control synthesized for the case of large variations in payload parameters under the condition that the practical stability of the overall system is satisfied Such a case of control synthesis meets the actual today's needs in industrial robot applications The second characteristic of the monograph is the efficient adaptive control algorithm based on decentralized control structure intended for tasks in which parameter variations cannot be specified in advance To be objective this is not the case in industrial robotics today Thus nonadaptive control with and without a particular parameter variation is supplemented by adaptive dynamic control algorithms which will certainly be applicable in the future industrial practice when parametric identification of workpieces will be required

Cartesian Impedance Control of Redundant and Flexible-Joint Robots Christian Ott, 2008-09-18 By the dawn of the new millennium robotics has undergone a major transformation in scope and dimensions This expansion has been brought about by the maturity of the field and the advances in its related technologies From a largely dominant industrial focus robotics has been rapidly expanding into the challenges of the human world The new generation of robots is expected to safely and dependably co-habitat with humans in homes workplaces and communities providing support in services entertainment education healthcare manufacturing and assistance Beyond its impact on physical robots the body of knowledge robotics has produced is revealing a much wider range of applications reaching across diverse research areas and

scientific disciplines such as biomechanics haptics neuroscience virtual simulation animation surgery and sensor networks among others In return the challenges of the new emerging areas are proving an abundant source of stimulation and insights for the field of robotics It is indeed at the intersection of disciplines that the most striking advances happen The goal of the series of Springer Tracts in Advanced Robotics STAR is to bring in a timely fashion the latest advances and developments in robotics on the basis of their significance and quality It is our hope that the wider dissemination of research developments will stimulate more exchanges and collaborations among the research community and contribute to further advancement of this rapidly growing field

Secure Coordination Control of Networked Robotic Systems Xiaolei Li, Jiange Wang, Xiaoyuan Luo, Xinping Guan, 2024-03-19 As one of the core equipments and actuators robotic technology has attracted much attention and has made great progress However a single robotic system is often unable to handle complex tasks due to limitations in sensors microprocessors actuators and the ability to handle complex situations With the development of distributed control and microprocessing technology networked robotic systems have greatly expanded their perceptual computational and execution capabilities with high efficiency low cost and strong functionality advantages As a typical distributed cyber physical system DCPS which is an intelligent system that integrates computing communication and control networked robotic systems can perform higher level tasks by sharing information and working together It can provide intelligent control and monitoring of a physical process such as environment observation information collection and search and rescue etc Thus coordination control of networked robotic systems has become the focus of scholars worldwide However the sensing communication and control integration of networked robotic systems make them face unprecedented network security threats in which cyber attacks have become a major hidden danger to the reliable operation of autonomous unmanned systems Although existing control methods can achieve swarm collaborative control of networked robotic systems the protection of which especially the security of control systems is rarely addressed In this book we conduct research on the secure coordination problem of networked robotic systems from a control theory perspective given the limited communication bandwidth and the increasingly prominent network security threats This book showcases several continuous time and event triggered secure control design and analysis methods for networked robotic systems under different types of cyberattacks Additionally several future research directions are provided for networked robotic systems This book will be an important reference for scientists engineers and graduate students from the field of underwater robotic technologies maritime science and control engineering

On Network-based Control and Sensitivity Characterization of Mobile Robot in Intelligent Space Rangsarit Vanijirattikhan, 2008 Keywords networked control system network based control system distributed control delay compensation telerobotics communication network control system path tracking mobile robot unmanned ground vehicle sensitivity analysis

[Passivity-based Control of Transport-reaction Systems](#) Martin G. Ruzskowski, 2003

Knowledge-Based Control with Application to Robots Clarence W. DeSilva, Alistair G.J.

MacFarlane, 2014-03-12 This monograph considers the integration of knowledge based soft control with hard control algorithms As a specific application the development of a knowledge based controller for robotic manipulators is addressed Servo control alone is known to be inadequate for nonlinear and high speed processes including robots Furthermore knowledge based control such as fuzzy control when directly included in the servo loop has produced unsatisfactory performance in research robots These considerations along with the fact that human experts can very effectively perform tuning functions in process controllers form the basis for the control structure proposed in this work The book is suitable for students researchers and practising professionals in the fields of Automatic Control and Robotics The material is presented in simple and clear language with sufficient introductory information Someone with an undergraduate knowledge in dynamics and control should be able to use the book without any difficulty

The Enigmatic Realm of **Passivity Based Control And Estimation In Networked Robotics Communications And Control Engineering**: Unleashing the Language is Inner Magic

In a fast-paced digital era where connections and knowledge intertwine, the enigmatic realm of language reveals its inherent magic. Its capacity to stir emotions, ignite contemplation, and catalyze profound transformations is nothing in short supply of extraordinary. Within the captivating pages of **Passivity Based Control And Estimation In Networked Robotics Communications And Control Engineering** a literary masterpiece penned by way of a renowned author, readers attempt a transformative journey, unlocking the secrets and untapped potential embedded within each word. In this evaluation, we shall explore the book's core themes, assess its distinct writing style, and delve into its lasting affect the hearts and minds of people who partake in its reading experience.

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Passivity Based Control And Estimation In Networked Robotics Communications And Control Engineering Introduction

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