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Adaptive Control of
**Underactuated
Mechanical
Systems**



World Scientific

Adaptive Control Of Underactuated Mechanical Systems

**Jundong Wu, Pan Zhang, Qingxin
Meng, Yawu Wang**



Adaptive Control Of Underactuated Mechanical Systems:

Adaptive Control Of Underactuated Mechanical Systems An-chyau Huang, Yung-feng Chen, Chen-yu Kai, 2015-01-29
In this book we collected recent results on the control of underactuated mechanical systems subject to internal uncertainties and external disturbances. The strategy developed is so universal that it is not restricted to a specific system but a large class of underactuated systems. Several benchmark systems are studied in this book including detailed literature review, system dynamics derivation, control problem formulation, and simulation verification. The control strategy developed in chapter 4 is able to stabilize all these benchmark systems with satisfactory performance regardless of the underactuated dynamics and various uncertainties. The book is written as a text suitable for graduate students in the advanced course for the control of underactuated systems. It also provides valuable tools for researchers and practicing engineers working on the control of underactuated mechanical systems. *Adaptive and Fault-Tolerant Control of Underactuated Nonlinear Systems* Jiangshuai Huang, Yong-Duan Song, 2017-12-22
The purpose of the book is to provide an exposition of recently developed adaptive and fault tolerant control of underactuated nonlinear systems. Underactuated systems are abundant in real life ranging from landing vehicles to surface ships and underwater vehicles to spacecrafts. For the tracking and stabilization control of underactuated mechanical systems, many methodologies have been proposed. However, a number of important issues deserve further investigation. In response to these issues, four important problems are solved in this book including control of underactuated nonlinear systems with input saturation, output feedback control in the presence of parametric uncertainties, fault tolerant control of underactuated ships with or without actuator redundancy, and adaptive control of multiple underactuated nonlinear systems including formation control and flocking control of multiple underactuated systems.

Motion Control of Underactuated Mechanical Systems Javier Moreno-Valenzuela, Carlos Aguilar-Avelar, 2017-07-11
This volume is the first to present a unified perspective on the control of underactuated mechanical systems. Based on real time implementation of parameter identification, this book provides a variety of algorithms for the Furuta pendulum and the inertia wheel pendulum, which are two degrees of freedom mechanical systems. Specifically, this work addresses and solves the problem of motion control via trajectory tracking in one joint coordinate while another joint is regulated. Besides discussions on extensions to higher degrees of freedom systems, are given. The book aimed at control engineers as well as graduate students ranges from the problem of parameter identification of the studied systems to the practical implementation of sophisticated motion control algorithms. Offering real world solutions to manage the control of underactuated systems, this book provides a concise tutorial on recent breakthroughs in the field, original procedures to achieve bounding of the error trajectories, convergence and gain tuning guidelines. **Control of Underactuated Mechanical Systems** Afef Hfaiedh, Ahmed Chemori, 2025-04-01
Control of Underactuated Mechanical Systems: Stabilization and Limit Cycle Generation clearly explains stabilization and limit cycle generation in underactuated mechanical systems.

UMS addressing control design challenges and demonstrating concepts through real time experiments The book begins with advancements in UMS introducing key concepts such as stabilization and limitcycle generation supported by literature examples It then focuses on the inertia wheel invertedpendulum presenting a detailed discussion The second part tackles stabilization offering variouscontrol solutions validated through numerical simulations and real time experiments The finalpart addresses stable limit cycle generation detailing three proposed control solutions and theirvalidation through different case studies This book is a valuable resource for PhD and Master students engineers researchers and educators It provides guidance in robotics and automatic control utilizing a simplified methodology forcontrolling underactuated mechanical systems Addresses stabilization and stable limit cycle generation in underactuated mechanical systemsamid perturbations Explores the design development and validation of robust control solutions Illustrates concepts through case studies Validates control solutions with numerical simulations and real time experiments

Analysis and Control of Underactuated Mechanical Systems Amal Choukchou-Braham, Brahim Cherki, Mohamed Djemaï, Krishna Busawon, 2013-11-18 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

Adaptive Control Dianwei Qian, 2018-03 Adaptive control is the control method used by a controller which must adapt to a controlled system with parameters which vary or are initially uncertain An adaptive control system utilizes on line identification of which either system parameter or controller parameter which does not need a priori information about the bounds on these uncertain or time varying parameters These approaches consider their control design in the sense of Lyapunov Besides there are still some branches by combining adaptive control and other control methods i e nonlinear control methods intelligent control methods and predict control methods to name but a few Addresses some original contributions reporting the latest advances in adaptive control It aims to gather the latest research on state of the art methods applications and research for the adaptive control theory and recent new findings obtained by the technique of adaptive control Apparently the book cannot include all research topics Different aspects of adaptive control are explored

Chapters includes some new tendencies and developments in research on a adaptive formation controller for multi robot systems L1 adaptive control design of the the longitudinal dynamics of a hypersonic vehicle model adaptive high gain control of biologically inspired receptor systems adaptive residual vibration suppression of sigid flexible coupled systems neuro hierarchical sliding mode control for under actuated mechanical systems neural network adaptive PID control design based on PLC for a water level system and fuzzy based design of networked control systems with random time delays and packet dropout in the forward communication channel

Non-linear Control for Underactuated Mechanical Systems Isabelle Fantoni,Rogelio Lozano,2012-12-06 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

Hierarchical Sliding Mode Control for Under-actuated Cranes Dianwei Qian,Jianqiang Yi,2015-10-15 This book reports on the latest developments in sliding mode overhead crane control presenting novel research ideas and findings on sliding mode control SMC hierarchical SMC and compensator design based hierarchical sliding mode The results which were previously scattered across various journals and conference proceedings are now presented in a systematic and unified form The book will be of interest to researchers engineers and graduate students in control engineering and mechanical engineering who want to learn the methods and applications of SMC

Advances and Applications in Nonlinear Control Systems Sundarapandian Vaidyanathan,Christos Volos,2016-03-17 The book reports on the latest advances and applications of nonlinear control systems It consists of 30 contributed chapters by subject experts who are specialized in the various topics addressed in this book The special chapters have been brought out in the broad areas of nonlinear control systems such as robotics nonlinear circuits power systems memristors underwater vehicles chemical processes observer design output regulation backstepping control sliding mode control time delayed control variables structure control robust adaptive control fuzzy logic control chaos hyperchaos jerk systems hyperjerk systems chaos control chaos synchronization etc Special importance was given to chapters offering practical solutions modeling and novel control methods for the recent research problems in nonlinear control systems This book will serve as a reference book for graduate students and researchers with a basic knowledge of electrical and control systems engineering The resulting design procedures on the nonlinear control systems are emphasized using MATLAB software

Control of Underactuated Manipulators Jundong Wu,Pan Zhang,Qingxin Meng,Yawu Wang,2023-05-13 This book investigates in detail cutting edge technologies of underactuated manipulator control which is a frontier topic in robotics that possesses great significance in energy conservation as well as fault tolerance for industrial applications It is also the crucial technology associated with systems in special environments including underwater or aerospace environments So far the topic of underactuated manipulator control has attracted engineers and scientists from various disciplines such as applied physics material automation and robotics Pursuing a holistic

approach the book establishes a fundamental framework for this topic while emphasizing the importance of design and optimization in the control of underactuated manipulators. Chapters of the book cover a wide variety of manipulator systems including vertical underactuated manipulator, planar underactuated manipulator with first order nonholonomic constraint, planar underactuated manipulator with second order nonholonomic constraint, and flexible underactuated manipulator. The book is intended for undergraduate and graduate students that are interested in underactuated manipulators, researchers that investigate the design and optimization for controllers of underactuated manipulators, and engineers working with underactuated systems.

Discover tales of courage and bravery in Crafted by is empowering ebook, **Adaptive Control Of Underactuated Mechanical Systems** . In a downloadable PDF format (*), this collection inspires and motivates. Download now to witness the indomitable spirit of those who dared to be brave.

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