

Zhijun Li · Chenguang Yang · Liping Fan

# Advanced Control of Wheeled Inverted Pendulum Systems

 Springer

# Advanced Control Of Wheeled Inverted Pendulum Systems

**Mohammad Osman Tokhi, Noah J  
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Virk, Roger D Eastman**



## **Advanced Control Of Wheeled Inverted Pendulum Systems:**

Advanced Control of Wheeled Inverted Pendulum Systems Zhijun Li,Chenguang Yang,Liping Fan,2012-07-13 Advanced Control of Wheeled Inverted Pendulum Systems is an orderly presentation of recent ideas for overcoming the complications inherent in the control of wheeled inverted pendulum WIP systems in the presence of uncertain dynamics nonholonomic kinematic constraints as well as underactuated configurations The text leads the reader in a theoretical exploration of problems in kinematics dynamics modeling advanced control design techniques and trajectory generation for WIPs An important concern is how to deal with various uncertainties associated with the nominal model WIPs being characterized by unstable balance and unmodelled dynamics and being subject to time varying external disturbances for which accurate models are hard to come by The book is self contained supplying the reader with everything from mathematical preliminaries and the basic Lagrange Euler based derivation of dynamics equations to various advanced motion control and force control approaches as well as trajectory generation method Although primarily intended for researchers in robotic control Advanced Control of Wheeled Inverted Pendulum Systems will also be useful reading for graduate students studying nonlinear systems more generally

## **Fractional Order Control and Synchronization of Chaotic Systems**

Ahmad Taher Azar,Sundarapandian Vaidyanathan,Adel Ouannas,2017-02-27 The book reports on the latest advances in and applications of fractional order control and synchronization of chaotic systems explaining the concepts involved in a clear matter of fact style It consists of 30 original contributions written by eminent scientists and active researchers in the field that address theories methods and applications in a number of research areas related to fractional order control and synchronization of chaotic systems such as fractional chaotic systems hyperchaotic systems complex systems fractional order discrete chaotic systems chaos control chaos synchronization jerk circuits fractional chaotic systems with hidden attractors neural network fuzzy logic controllers behavioral modeling robust and adaptive control sliding mode control different types of synchronization circuit realization of chaotic systems etc In addition to providing readers extensive information on chaos fundamentals fractional calculus fractional differential equations fractional control and stability the book also discusses key applications of fractional order chaotic systems as well as multidisciplinary solutions developed via control modeling As such it offers the perfect reference guide for graduate students researchers and practitioners in the areas of fractional order control systems and fractional order chaotic systems

## Information Systems Design and Intelligent Applications

Vikrant Bhateja,Bao Le Nguyen,Nhu Gia Nguyen,Suresh Chandra Satapathy,Dac-Nhuong Le,2018-03-01 The book is a collection of high quality peer reviewed research papers presented at International Conference on Information System Design and Intelligent Applications INDIA 2017 held at Duy Tan University Da Nang Vietnam during 15 17 June 2017 The book covers a wide range of topics of computer science and information technology discipline ranging from image processing database application data mining grid and cloud computing bioinformatics and many others The various intelligent tools like swarm intelligence artificial

intelligence evolutionary algorithms bio inspired algorithms have been well applied in different domains for solving various challenging problems      *Advanced Control Design with Application to Electromechanical Systems* Magdi S.

Mahmoud,2018-04-12 *Advanced Control Design with Application to Electromechanical Systems* represents the continuing effort in the pursuit of analytic theory and rigorous design for robust control methods The book provides an overview of the feedback control systems and their associated definitions with discussions on finite dimension vector spaces mappings and convex analysis In addition a comprehensive treatment of continuous control system design is presented along with an introduction to control design topics pertaining to discrete time systems Other sections introduces linear H1 and H2 theory dissipativity analysis and synthesis and a wide spectrum of models pertaining to electromechanical systems Finally the book examines the theory and mathematical analysis of multiagent systems Researchers on robust control theory and electromechanical systems and graduate students working on robust control will benefit greatly from this book Introduces a coherent and unified framework for studying robust control theory Provides the control theoretic background required to read and contribute to the research literature Presents the main ideas and demonstrations of the major results of robust control theory Includes MATLAB codes to implement during research      *Trends in Advanced Intelligent Control,*

*Optimization and Automation* Wojciech Mitkowski,Janusz Kacprzyk,Krzysztof Oprzędkiewicz,Paweł Skruch,2017-06-06 This volume contains the proceedings of the KKA 2017 the 19th Polish Control Conference organized by the Department of Automatics and Biomedical Engineering AGH University of Science and Technology in Krak w Poland on June 18 21 2017 under the auspices of the Committee on Automatic Control and Robotics of the Polish Academy of Sciences and the Commission for Engineering Sciences of the Polish Academy of Arts and Sciences Part 1 deals with general issues of modeling and control notably flow modeling and control sliding mode predictive dual etc control In turn Part 2 focuses on optimization estimation and prediction for control Part 3 is concerned with autonomous vehicles while Part 4 addresses applications Part 5 discusses computer methods in control and Part 6 examines fractional order calculus in the modeling and control of dynamic systems Part 7 focuses on modern robotics Part 8 deals with modeling and identification while Part 9 deals with problems related to security fault detection and diagnostics Part 10 explores intelligent systems in automatic control and Part 11 discusses the use of control tools and techniques in biomedical engineering Lastly Part 12 considers engineering education and teaching with regard to automatic control and robotics      *Foundations and Applications of*

*Intelligent Systems* Fuchun Sun,Tianrui Li,Hongbo Li,2013-11-22 These proceedings present technical papers selected from the 2012 International Conference on Intelligent Systems and Knowledge Engineering ISKE 2012 held on December 15 17 in Beijing The aim of this conference is to bring together experts from different fields of expertise to discuss the state of the art in Intelligent Systems and Knowledge Engineering and to present new findings and perspectives on future developments The proceedings introduce current scientific and technical advances in the fields of artificial intelligence machine learning

pattern recognition data mining knowledge engineering information retrieval information theory knowledge based systems knowledge representation and reasoning multi agent systems and natural language processing etc Furthermore they include papers on new intelligent computing paradigms which combine new computing methodologies e g cloud computing service computing and pervasive computing with traditional intelligent methods By presenting new methodologies and practices the proceedings will benefit both researchers and practitioners who want to utilize intelligent methods in their specific fields Dr Fuchun Sun is a professor at the Department of Computer Science Technology Tsinghua University China Dr Tianrui Li is a professor at the School of Information Science Technology Southwest Jiaotong University Chengdu China Dr Hongbo Li also works at the Department of Computer Science Technology Tsinghua University China

**Developments in Advanced Control and Intelligent Automation for Complex Systems** Min Wu, Witold Pedrycz, Luefeng Chen, 2021-03-26 This book discusses the developments in the advanced control and intelligent automation for complex systems completed over the last two decades including the progress in advanced control theory and method intelligent control and decision making of complex metallurgical processes intelligent systems and machine learning intelligent robot systems design and control and prediction and control technology for renewable energy With the depth and breadth of coverage of this book it serves as a useful reference for engineers in the field of automation and complex process control and graduate students interested in advanced control theory and computational intelligence as well as their applications to the complex industrial processes This book offers an up to date overview of this active research area It provides readers with the state of the art methods for advanced control and intelligent automation for complex systems

**Fuzzy Systems: Concepts, Methodologies, Tools, and Applications** Management Association, Information Resources, 2017-02-22 There are a myriad of mathematical problems that cannot be solved using traditional methods The development of fuzzy expert systems has provided new opportunities for problem solving amidst uncertainties Fuzzy Systems Concepts Methodologies Tools and Applications is a comprehensive reference source on the latest scholarly research and developments in fuzzy rule based methods and examines both theoretical foundations and real world utilization of these logic sets Featuring a range of extensive coverage across innovative topics such as fuzzy logic rule based systems and fuzzy analysis this is an essential publication for scientists doctors engineers physicians and researchers interested in emerging perspectives and uses of fuzzy systems in various sectors

*Advanced Production and Industrial Engineering* Pavan Kumar Kankar, 2022-12-15 Things change rapidly in the field of engineering and awareness of innovation in production techniques is essential for those working in the field if they are to utilise the best and most appropriate solutions available This book presents the proceedings of ICAPIE 22 the 7th International Conference on Advanced Production and Industrial Engineering held on 11 and 12 June 2022 in Delhi India The aim of the conference was to explore new windows for discoveries in design materials and manufacturing which have an important role in all fields of scientific growth and to provide an arena for the showcasing of advancements and research

endeavours from around the world The 102 peer reviewed and revised papers in this book include a large number of technical papers with rich content describing ground breaking research from various institutes Covering a wide range of topics and promoting the contribution of production and industrial engineering and technology for a sustainable future the book will be of interest to all those working in production and industrial engineering *Mobile Robot: Motion Control and Path Planning* Ahmad Taher Azar,Ibraheem Kasim Ibraheem,Amjad Jaleel Humaidi,2023-06-30 This book presents the recent research advances in linear and nonlinear control techniques From both a theoretical and practical standpoint motion planning and related control challenges are key parts of robotics Indeed the literature on the planning of geometric paths and the generation of time based trajectories while accounting for the compatibility of such paths and trajectories with the kinematic and dynamic constraints of a manipulator or a mobile vehicle is extensive and rich in historical references Path planning is vital and critical for many different types of robotics including autonomous vehicles multiple robots and robot arms In the case of multiple robot route planning it is critical to produce a safe path that avoids colliding with objects or other robots When designing a safe path for an aerial or underwater robot the 3D environment must be considered As the number of degrees of freedom on a robot arm increases so does the difficulty of path planning As a result safe pathways for high dimensional systems must be developed in a timely manner Nonetheless modern robotic applications particularly those requiring one or more robots to operate in a dynamic environment e g human robot collaboration and physical interaction surveillance or exploration of unknown spaces with mobile agents etc pose new and exciting challenges to researchers and practitioners For instance planning a robot s motion in a dynamic environment necessitates the real time and online execution of difficult computational operations The development of efficient solutions for such real time computations which could be offered by specially designed computational architectures optimized algorithms and other unique contributions is thus a critical step in the advancement of present and future oriented robotics **13th Chaotic Modeling and Simulation**

**International Conference** Christos H. Skiadas,Yiannis Dimotikalis,2021-12-14 Gathering the proceedings of the 13th CHAOS2020 International Conference this book highlights recent developments in nonlinear dynamical and complex systems The conference was intended to provide an essential forum for Scientists and Engineers to exchange ideas methods and techniques in the field of Nonlinear Dynamics Chaos Fractals and their applications in General Science and the Engineering Sciences The respective chapters address key methods empirical data and computer techniques as well as major theoretical advances in the applied nonlinear field Beyond showcasing the state of the art the book will help academic and industrial researchers alike apply chaotic theory in their studies International Advanced Researches & Engineering Congress 2017 Proceeding Book Recep HALICIOGLU,Hediye KIRLI AKIN,Yusuf FEDAI,2017-12-29 INTERNATIONAL WORKSHOPS at IAREC 17 This book includes English main and Turkish languages International Workshop on Mechanical Engineering International Workshop on Mechatronics Engineering International Workshop on Energy Systems Engineering International

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**Trends, Paradigms, and Advances in Mechatronics Engineering** Mellal, Mohamed Arezki, 2022-11-18 Most modern systems involve various engineering disciplines Mechatronic systems are designed to be dependable and efficient however mechatronics engineering faces multiple challenges at the design and exploitation stages It is essential for engineers to be aware of these challenges and remain up to date with the emerging research in the mechatronics engineering field Trends Paradigms and Advances in Mechatronics Engineering presents the latest advances and applications of mechatronics It highlights the recent challenges in the field and facilitates understanding of the subject Covering topics such as the construction industry design optimization and low cost fabrication this premier reference source is a crucial resource for engineers computer scientists construction managers students and educators of higher education librarians researchers and academicians

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

**Advanced Knowledge Application in Practice** Igor Fuerstner, 2010-11-02 The integration and interdependency of the world economy leads towards the creation of a global market that offers more opportunities but is also more complex and competitive than ever before Therefore widespread research activity is necessary if one is to remain successful on the market This book is the

result of research and development activities from a number of researchers worldwide covering concrete fields of research

*Coefficient Diagram Method for Control System Design* Shunji Manabe, Young Chol Kim, 2021-04-10 This book describes a new control design technique called Coefficient Diagram Method CDM whereby practical control engineers without deep control theories and mathematics background can design a good controller for their specific plants In addition control experts can solve some complicated design problems Since the CDM was first introduced in 1998 it reveals from the literature that CDM has provided successful controller designs for a variety of practical control problems In the last two decades a great deal of research has been done on CDM while a growing number of researchers want to learn and utilize the method However there has been no textbook to learn it systematically so far This book is motivated by such a need It is also suitable as a textbook or reference book for master programs in control engineering

**Proceedings of the 10th National Technical Seminar on Underwater System Technology 2018** Zainah Md Zain, Hamzah Ahmad, Dwi Pebrianti, Mahfuzah Mustafa, Nor Rul Hasma Abdullah, Rosdiyana Samad, Maziyah Mat Noh, 2019-02-08 This book presents cutting edge research papers in the field of Underwater System Technology in Malaysia and Asia in general The topics covered include intelligent robotics novel sensor technologies control algorithms acoustic signal processing imaging techniques biomimetic robots green energy sources and underwater communication backbones and protocols The book showcases some of the latest technologies and applications developed to facilitate local marine exploration and exploitation It also addresses related topics concerning the Sustainable Development Goals SDG outlined by the United Nations

Adaptive Mobile Robotics Abul K. M. Azad, 2012 This book provides state of the art scientific and engineering research findings and developments in the area of mobile robotics and associated support technologies The book contains peer reviewed articles presented at the CLAWAR 2012 conference Robots are no longer confined to industrial and manufacturing environments A great deal of interest is invested in the use of robots outside the factory environment The CLAWAR conference series established as a high profile international event acts as a platform for dissemination of research and development findings and supports such a trend to address the current interest in mobile robotics to meet the needs of mankind in various sectors of the society These include personal care public health services in the domestic public and industrial environments The editors of the book have extensive research experience and publications in the area of robotics in general and in mobile robotics specifically and their experience is reflected in editing the contents of the book

**Adaptive Mobile Robotics - Proceedings Of The 15th International Conference On Climbing And Walking Robots And The Support Technologies For Mobile Machines** Mohammad Osman Tokhi, Noah J Cowan, Abul K M Azad, Gurminder S Virk, Roger D Eastman, 2012-07-11 This book provides state of the art scientific and engineering research findings and developments in the area of mobile robotics and associated support technologies The book contains peer reviewed articles presented at the CLAWAR 2012 conference Robots are no longer confined to industrial manufacturing environments A great deal of interest is invested in the use of robots outside the

factory environment The CLAWAR conference series established as a high profile international event acts as a platform for dissemination of research and development findings and supports such a trend to address the current interest in mobile robotics to meet the needs of mankind in various sectors of the society These include personal care public health services in the domestic public and industrial environments The editors of the book have extensive research experience and publications in the area of robotics in general and in mobile robotics specifically and their experience is reflected in editing the contents of the book

**Automation 2021: Recent Achievements in Automation, Robotics and Measurement Techniques**

Roman Szewczyk, Cezary Zieliński, Małgorzata Kaliczyńska, 2021-04-29 This book contains 38 papers authored by both scientists and practitioners focused on an interdisciplinary approach to the development of cyber physical systems Recently our civilization has been facing one of the most severe challenges in modern history The COVID 19 pandemic devastated the global economy and significantly disrupted numerous areas of economic activity Only radical increase of efficiency and versatility of industrial production with further limitation of human involvement paralleled by the decrease of environmental burden will enable us to cope with such challenges We hope that the presented book provides input to the solution of at least some problems brought about by this challenge This approach relies on the development of measuring techniques robotic and mechatronic systems industrial automation numerical modeling and simulation as well as application of artificial intelligence techniques required by the transformation leading to Industry 4 0

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