Dynamics Of Underactuated Multibody Systems Modeling Control And Optimal Design

The ECCOMAS Thematic Conference "Multibody Dynamics 2009" was held in Warsaw, representing the fourth edition of a series which began in Lisbon (2003), and was then continued in Madrid (2005) and Milan (2007), held under the auspices of the European Community on Computational Methods in Applied Sciences (ECCOMAS). The conference provided a forum for exchanging ideas and results of several topics related to computational methods and applications in multibody dynamics, through the participation of 219 scientists from 27 countries, mostly from Europe but also from America and Asia. This book contains the revised and extended versions of invited conference papers, reporting on the state-of-the-art in the advances of computational multibody models, from the theoretical developments to practical engineering applications. By providing a helpful overview of the most active areas and the recent efforts of many prominent research groups in the field of multibody dynamics, this book can be highly valuable for both experienced researches who want to keep updated with the latest developments in this field and researches approaching the field for the first time. This book presents proceedings of the third international conference in this field, continuing the success of the previous events. The peer-reviewed and the selected papers are arranged to make the proposed book the

most recent and complete overview on the State-of-the-Art in Cable-Driven Parallel Robots! The conference took place 2017 in Quebec, QC, Canada,

Motion and vibration control is a fundamental technology for the development of advanced mechanical systems such as mechatronics, vehicle systems, robots, spacecraft, and rotating machinery. Often the implementation of high performance, low power consumption designs is only possible with the use of this technology. It is also vital to the mitigation of natural hazards for large structures such as high-rise buildings and tall bridges, and to the application of flexible structures such as space stations and satellites. Recent innovations in relevant hardware, sensors, actuators, and software have facilitated new research in this area. This book deals with the interdisciplinary aspects of emerging technologies of motion and vibration control for mechanical, civil and aerospace systems. It covers a broad range of applications (e.g. vehicle dynamics, actuators, rotor dynamics, biologically inspired mechanics, humanoid robot dynamics and control, etc.) and also provides advances in the field of fundamental research e.g. control of fluid/structure integration, nonlinear control theory, etc. Each of the contributors is a recognised specialist in his field, and this gives the book relevance and authority in a wide range of areas.

In this book, the author deals with the mathematical modelling, nonlinear control and performance evaluation of a conceptual anti-aircraft gun based mobile air defence system engaging an attacking three-dimensional aerial target. This book is of interest to academic faculty,

graduate students and industry professionals working in the fields of mathematical modelling and control, ground vehicles, mobile air defence systems and other related topics.

Motion and Vibration Control
of Underactuated Multibody Systems
Proceedings of the 22nd CISM IFToMM Symposium, June 25-28, 2018, Rennes, France
IUTAM Symposium on Intelligent Multibody Systems – Dynamics, Control, Simulation
Computational Methods and Applications
Mathematical Modelling, Nonlinear Control and Performance Evaluation of a Ground Based Mobile Air Defence System

Security for Multihop Wireless Networks provides broad coverage of the security issues facing multihop wireless networks. Presenting the work of a different group of expert contributors in each chapter, it explores security in mobile ad hoc networks, wireless sensor networks, wireless mesh networks, and personal area networks. Detailing technologies and processes that can help you secure your wireless networks, the book covers cryptographic coprocessors, encryption, authentication, key management, attacks and countermeasures, secure routing, secure medium access control, intrusion detection, epidemics, security performance analysis, and security issues in

applications. It identifies vulnerabilities in the physical, MAC, network, transport, and application layers and details proven methods for strengthening security mechanisms in each layer. The text explains how to deal with black hole attacks in mobile ad hoc networks and describes how to detect misbehaving nodes in vehicular ad hoc networks. It identifies a pragmatic and energy efficient security layer for wireless sensor networks and covers the taxonomy of security protocols for wireless sensor communications. Exploring recent trends in the research and development of multihop network security, the book outlines possible defenses against packet-dropping attacks in wireless multihop ad hoc networks.Complete with expectations for the future in related areas, this is an ideal reference for researchers, industry professionals, and academics. Its comprehensive coverage also makes it suitable for use as a textbook in graduate-level electrical engineering programs.

Underactuated multibody systems are intriguing mechatronic systems, as they posses fewer control inputs than degrees of freedom. Some examples are modern light-weight flexible robots and articulated

manipulators with passive joints. This book investigates such underactuated multibody systems from an integrated perspective. This includes all major steps from the modeling of rigid and flexible multibody systems, through nonlinear control theory, to optimal system design. The underlying theories and techniques from these different fields are presented using a self-contained and unified approach and notation system. Subsequently, the book focuses on applications to large multibody systems with multiple degrees of freedom, which require a combination of symbolical and numerical procedures. Finally, an integrated, optimization-based design procedure is proposed, whereby both structural and control design are considered concurrently. Each chapter is supplemented by illustrated examples. This book describes the development of an integrated approach for generating the path and gait of realistic hexapod robotic systems. It discusses in detail locomation with straight-ahead, crab and turning motion capabilities in varying terrains, like sloping surfaces, staircases, and various user-defined rough terrains. It also presents computer simulations and validation using Virtual Prototyping (VP)

tools and real-world experiments. The book also explores improving solutions by applying the developed nonlinear, constrained inverse dynamics model of the system formulated as a coupled dynamical problem based on the Newton–Euler (NE) approach and taking into account realistic environmental conditions. The approach is developed on the basis of rigid multi-body modelling and the concept that there is no change in the configuration of the system in the short time span of collisions. The present work deals with the inverse dynamics simulation of underactuated multibody systems. In particular, the study focuses on solving trajectory tracking control problems of differentially flat underactuated systems. The use of servo constraints provides an approach to formulate trajectory tracking control problems of underacutated systems, which are also called underactuated servo constraint problems. This work was published by Saint Philip Street Press pursuant to a Creative Commons license permitting commercial use. All rights not granted by the work's license are retained by the author or authors.

Fundamentals of Multibody Dynamics

Nonlinear Control of Multibody Systems with Symmetries Via Shape Change

Mechatronics: Ideas for Industrial Applications

Structural Nonlinear Dynamics and Diagnosis

Proceedings of the ... American Control Conference

Proceedings of the IUTAM Symposium on Dynamics Modeling and Interaction Control in Virtual and Real Environments, held in Budapest, Hungary, June 7-11, 2010

This volume encompasses prototypical, innovative and emerging examples and benchmarks of Differential-Algebraic Equations (DAEs) and their applications, such as electrical networks, chemical reactors, multibody systems, and multiphysics models, to name but a few. Each article begins with an exposition of modelling, explaining whether the model is prototypical and for which applications it is used. This is followed by a mathematical analysis, and if appropriate, a discussion of the numerical aspects including simulation. Additionally, benchmark examples are included throughout the text. Mathematicians, engineers, and other scientists, working in both academia and industry either on differential-algebraic equations and systems or on problems where the tools and insight provided by differential-algebraic equations could be useful, would find this book resourceful.

Applied Dynamics is an important branch of engineering mechanics widely applied to mechanical and automotive engineering, aerospace and

biomechanics as well as control engineering and mechatronics. The computational methods presented are based on common fundamentals. For this purpose analytical mechanics turns out to be very useful where D'Alembert's principle in the Lagrangian formulation proves to be most efficient. The method of multibody systems, finite element systems and continuous systems are treated consistently. Thus, students get a much better understanding of dynamical phenomena, and engineers in design and development departments using computer codes may check the results more easily by choosing models of different complexity for vibration and stress analysis.

Covers both holonomic and non-holonomic constraints in a study of the mechanics of the constrained rigid body. Covers all types of general constraints applicable to the solid rigid Performs calculations in matrix form Provides algorithms for the numerical calculations for each type of constraint Includes solved numerical examples Accompanied by a website hosting programs

This textbook – a result of the author's many years of research and teaching – brings together diverse concepts of the versatile tool of multibody dynamics, combining the efforts of many researchers in the field of mechanics.

Analysis and Control of Underactuated Mechanical Systems

Multibody Dynamics 2019

Advances in Mechanism and Machine Science

Romansy 19 - Robot Design, Dynamics and Control
Modeling, Control and Optimal Design
Applications of Differential-Algebraic Equations: Examples and Benchmarks

The book is a collection of contributions devoted to analytical, numerical and experimental techniques of dynamical systems, presented at the International Conference on Dynamical Systems: Theory and Applications, held in ?ód?, Poland on December 2-5, 2013. The studies give deep insight into both the theory and applications of non-linear dynamical systems, emphasizing directions for future research. Topics covered include: constrained motion of mechanical systems and tracking control; diversities in the inverse dynamics; singularly perturbed ODEs with periodic coefficients; asymptotic solutions to the problem of vortex structure around a cylinder; investigation of the regular and chaotic dynamics; rare phenomena and chaos in power converters; non-holonomic constraints in wheeled robots; exotic bifurcations in non-smooth systems; micro-chaos; energy exchange of coupled oscillators; HIV dynamics; homogenous transformations with applications to off-shore slender structures; novel approaches to a qualitative study of a dissipative system; chaos of postural sway in humans; oscillators with fractional derivatives; controlling chaos via bifurcation diagrams; theories relating to optical choppers with rotating wheels; dynamics in expert systems; shooting methods for non-standard boundary value problems; automatic sleep

scoring governed by delay differential equations; isochronous oscillations; the aerodynamics pendulum and its limit cycles; constrained N-body problems; nano-fractal oscillators and dynamically-coupled dry friction. This book, which presents the peer-reviewed post-proceedings of CSNDD 2012 and CSNDD 2014, addresses the important role that relevant concepts and tools from nonlinear and complex dynamics could play in present and future engineering applications. It includes 22 chapters contributed by outstanding researchers and covering various aspects of applications, including: structural health monitoring, diagnosis and damage detection, experimental methodologies, active vibration control and smart structures, passive control of structures using nonlinear energy sinks, vibro-impact dynamic MEMS/NEMS/AFM, energy-harvesting materials and structures, and time-delayed feedback control, as well as aspects of deterministic versus stochastic dynamics and control of nonlinear phenomena in physics. Researchers and engineers interested in the challenges posed and opportunities offered by nonlinearities in the development of passive and active control strategies, energy harvesting, novel design criteria, modeling and characterization will find the book to be an outstanding introduction.

This volume, which brings together research presented at the IUTAM Symposium Intelligent Multibody Systems – Dynamics, Control, Simulation, held at Sozopol, Bulgaria, September 11-15, 2017, focuses on preliminary virtual

simulation of the dynamics of motion, and analysis of loading of the devices and of their behaviour caused by the working conditions and natural phenomena. This requires up-to-date methods for dynamics analysis and simulation, novel methods for numerical solution of ODE and DAE, real-time simulation, passive, semi-passive and active control algorithms. Applied examples are mechatronic (intelligent) multibody systems, autonomous vehicles, space structures, structures exposed to external and seismic excitations, large flexible structures and wind generators, robots and bio-robots. The book covers the following subjects: -Novel methods in multibody system dynamics; -Real-time dynamics; -Dynamic models of passive and active mechatronic devices; -Vehicle dynamics and control; -Structural dynamics; -Deflection and vibration suppression; -Numerical integration of ODE and DAE for large scale and stiff multibody systems; -Model reduction of large-scale flexible systems. The book will be of interest for scientists and academicians, PhD students and engineers at universities and scientific institutes.

This proceedings volume contains papers that have been selected after review for oral presentation at ROMANSY 2016, the 21th CISM-IFToMM Symposium on Theory and Practice of Robots and Manipulators. These papers cover advances on several aspects of the wide field of Robotics as concerning Theory and Practice of Robots and Manipulators. ROMANSY 2016 is the 21st event in a series that started in 1973 as one of the first conference

activities in the world on Robotics. The first event was held at CISM (International Centre for Mechanical Science) in Udine, Italy on 5-8 September 1973. It was also the first topic conference of IFToMM (International Federation for the Promotion of Mechanism and Machine Science) and it was directed not only to the IFToMM community.

Advances in Neural Networks - ISNN 2005

Numerical Methods for the Inverse Dynamics Simulation of Underactuated Mechanical Systems

Applied Dynamics

Selected Papers from MOVIC 2008

ROMANSY 22 – Robot Design, Dynamics and Control

Inverse Dynamics and Trajectory Tracking

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

The three volume set LNCS 3496/3497/3498 constitutes the refereed proceedings of the Second International Symposium on Neural Networks, ISNN 2005, held in Chongqing, China in May/June 2005. The 483 revised papers presented were carefully reviewed and selected from 1.425 submissions. The papers are organized in topical

sections on theoretical analysis, model design, learning methods, optimization methods, kernel methods, component analysis, pattern analysis, systems modeling, signal processing, image processing, financial analysis, control systems, robotic systems, telecommunication networks, incidence detection, fault diagnosis, power systems, biomedical applications, industrial applications, and other applications.

This book presents recent advances and developments in control, automation, robotics, and measuring techniques. It presents contributions of top experts in the fields, focused on both theory and industrial practice. The particular chapters present a deep analysis of a specific technical problem which is in general followed by a numerical analysis and simulation, and results of an implementation for the solution of a real world problem. The presented theoretical results, practical solutions and guidelines will be useful for both researchers working in the area of engineering sciences and for practitioners solving industrial

problems.

Inverse dynamics problems arise in several mechanical systems. The aim is to calculate the inputs of a system in order that the outputs are identical to predefined or measured target signals. The motivation for inverse methods is related to practical applications in robotics, cranes or test rigs in the automotive and agricultural industry. The book considers four mathematical methods regarding to inverse problems in underactuated multibody systems. The first method under consideration is called virtual iteration. The algorithm is suitable for large multibody systems and finite element models, which are nearly linear. The second approach formulates the equations of motion as differential-algebraic equations and introduces so called control or servo constraints. The inverse problem can also be formulated as an optimal control problem. The basis is a cost functional, which includes the system outputs and the targets. The fourth method is a flatness-based trajectory tracking control. The considered methods are applied to academic and

industrial examples.
Dynamics and Control of Underactuated Multibody Spacecraft
Humanoid Robots
Modeling and Control
ROMANSY 21 - Robot Design, Dynamics and Control
Applications
Proceedings of the 9th ECCOMAS Thematic Conference on Multibody Dynamics
This book includes selected papers from the ECCOMAS Thematic Conference on Multibody Dynamics, that took place in Barcelona, Spain, from June 29 to July 2, 2015. By having its origin in analytical and continuum mechanics, as well as in computer science and applied mathematics, multibody dynamics provides a basis for analysis and virtual prototyping of innovative applications in many fields of contemporary engineering. With the utilization of computational models and algorithms that classically belonged to different fields of applied science, multibody dynamics delivers reliable simulation platforms for diverse highly-developed industrial products such as vehicle and railway systems, aeronautical and space

vehicles, robotic manipulators, smart structures, biomechanical systems, and nanotechnologies.
Parallel robots modeling and analysis.- Parallel robots design, calibration and control.- Robot design.- Robot control.- Mobile robots design, modeling and control.- Humans and humanoids.- Perception. The papers in this volume provide a vision of the evolution of the robotics disciplines and indicate new directions in which these disciplines are foreseen to develop. Paper topics include, but are not limited to, novel robot design and robot modules/components, service, rehabilitation, mobile robots, humanoid robots, challenges in control, modeling, kinematical and dynamical analysis of robotic systems, innovations in sensor systems for robots and perception, and recent advances in robotics. In particular, many contributions on parallel robotics from leading researchers in this domain are included. This book contains an edited versIOn of lectures presented at the NATO ADVANCED STUDY INSTITUTE on VIRTUAL NONLINEAR MUL TIBODY SYSTEMS which

was held in Prague, Czech Republic, from 23 June to 3 July 2002. It was organized by the Department of Mechanics, Faculty of Mechanical Engineering, Czech Technical University in Prague, in cooperation with the Institute B of Mechanics, University of Stuttgart, Germany. The ADVANCED STUDY INSTITUTE addressed the state of the art in multibody dynamics placing special emphasis on nonlinear systems, virtual reality, and control design as required in mechatronics and its corresponding applications. Eighty-six participants from twenty-two countries representing academia, industry, government and research institutions attended the meeting. The high qualification of the participants contributed greatly to the success of the ADVANCED STUDY INSTITUTE in that it promoted the exchange of experience between leading scientists and young scholars, and encouraged discussions to generate new ideas and to define directions of research and future developments. The full program of the ADVANCED STUDY INSTITUTE included also contributed presentations made by participants

where different topics were explored, among them: Such topics include: nonholonomic systems; flexible multibody systems; contact, impact and collision; numerical methods of differential-algebraical equations; simulation approaches; virtual modelling; mechatronic design; control; biomechanics; space structures and vehicle dynamics. These presentations have been reviewed and a selection will be published in this volume, and in special issues of the journals Multibody System Dynamics and Mechanics of Structures and Machines.

In this work, outstanding, recent developments in various disciplines, such as structural dynamics, multiphysic mechanics, computational mathematics, control theory, biomechanics, and computer science, are merged together in order to provide academicians and professionals with methods and tools for the virtual prototyping of complex mechanical systems. Each chapter of the work represents an important contribution to multibody dynamics, a discipline that plays a central role in the modelling, analysis, simulation and

optimization of mechanical systems in a variety of fields and for a wide range of applications.

Analysis and Algorithms

Dynamics and Control of Multibody Systems in Central Gravity

Theory and Applications

IUTAM Symposium on Dynamics Modeling and Interaction Control in Virtual and Real Environments

Multibody Dynamics

Inverse Dynamics and Trajectory Tracking of Underactuated Multibody Systems

This book gathers the proceedings of the 15th IFToMM World Congress, which was held in Krakow, Poland, from June 30 to July 4, 2019. Having been organized every four years since 1965, the Congress represents the world's largest scientific event on mechanism and machine science (MMS). The contributions cover an extremely diverse range of topics, including biomechanical engineering, computational kinematics, design methodologies, dynamics of machinery, multibody dynamics, gearing and transmissions, history of MMS, linkage

and mechanical controls, robotics and mechatronics, micro-mechanisms, reliability of machines and mechanisms, rotor dynamics, standardization of terminology, sustainable energy systems, transportation machinery, tribology and vibration. Selected by means of a rigorous international peer-review process, they highlight numerous exciting advances and ideas that will spur novel research directions and foster new multidisciplinary collaborations.

This volume provides the international multibody dynamics community with an up-to-date view on the state of the art in this rapidly growing field of research which now plays a central role in the modeling, analysis, simulation and optimization of mechanical systems in a variety of fields and for a wide range of industrial applications. This book contains selected contributions delivered at the ECCOMAS Thematic Conference on Multibody Dynamics, which was held in Brussels, Belgium and organized by the Université catholique de Louvain, from 4th to 7th July 2011. Each paper reflects the State-of-Art in

the application of Multibody Dynamics to different areas of engineering. They are enlarged and revised versions of the communications, which were enhanced in terms of self-containment and tutorial quality by the authors. The result is a comprehensive text that constitutes a valuable reference for researchers and design engineers which helps to appraise the potential for the application of multibody dynamics methodologies to a wide range of areas of scientific and engineering relevance.

This proceedings volume contains papers that have been selected after review for oral presentation at ROMANSY 2018, the 22nd CISM-IFToMM Symposium on Theory and Practice of Robots and Manipulators. These papers cover advances on several aspects of the wide field of Robotics as concerning Theory and Practice of Robots and Manipulators. ROMANSY 2018 is the 22nd event in a series that started in 1973 as one of the first conference activities in the world on Robotics. The first event was held at CISM (International Centre for Mechanical

Science) in Udine, Italy on 5-8 September 1973. It was also the first topic conference of IFToMM (International Federation for the Promotion of Mechanism and Machine Science) and it was directed not only to the IFToMM community.
This volume contains the invited papers presented at the IUTAM Symposium on Multibody Dynamics and Interaction Control in Virtual and Real Environments held in Budapest, Hungary, June 7?11 2010. The symposium aimed to bring together specialists in the fields of multibody system modeling, contact/collision mechanics and control of mechanical systems. The offered topics included modeling aspects, mechanical and mathematical models, the question of neglections and simplifications, reduction of large systems, interaction with environment like air, water and obstacles, contact of all types, control concepts, control stability and optimization. Discussions between experts in these fields made it possible to exchange ideas about the recent advances in multibody system modeling and interaction control, as

well as about the possible future trends. The presentations of recent scientific results may facilitate the interaction between scientific areas like system/control engineering and mechanical engineering. Papers on dynamics modeling and interaction control were selected to cover the main areas: mathematical modeling, dynamic analysis, friction modeling, solid and thermomechanical aspects, and applications. A significant outcome of the meeting was the opening towards applications that are of key importance to the future of nonlinear dynamics.
Numerical methods for the inverse dynamics simulation of underactuated mechanical systems
Solid Mechanics: a Variational Approach

Proceedings of the 15th IFToMM World Congress on Mechanism and Machine Science
Selected papers from CSNDD 2012 and CSNDD 2014
Proceedings of the Third International Conference on Cable-Driven Parallel Robots
Robot and Multibody Dynamics: Analysis and

Algorithms provides a comprehensive and detailed exposition of a new mathematical approach, referred to as the Spatial Operator Algebra (SOA), for studying the dynamics of articulated multibody systems. The approach is useful in a wide range of applications including robotics, aerospace systems, articulated mechanisms, bio-mechanics and molecular dynamics simulation. The book also: treats algorithms for simulation, including an analysis of complexity of the algorithms, describes one universal, robust, and analytically sound approach to formulating the equations that govern the motion of complex multi-body systems, covers a range of more advanced topics including under-actuated systems, flexible systems, linearization, diagonalized dynamics and space manipulators. Robot and Multibody Dynamics: Analysis and Algorithms will be a valuable resource for researchers and engineers looking for new mathematical approaches to finding engineering solutions in robotics and dynamics.

An increasing complexity of models used to predict real-world systems leads to the need for algorithms to replace complex models with far simpler ones, while preserving the accuracy of the predictions. This three-volume handbook covers methods as well as applications. This third volume focuses on applications in engineering, biomedical engineering, computational physics and computer science.

This monograph describes the Reaction Wheel Pendulum, the newest inverted-pendulum-like device for control education and research. We discuss the history and background of the reaction wheel pendulum and other similar experimental devices. We develop mathematical models of the reaction wheel pendulum in depth, including linear and nonlinear models, and models of the sensors and actuators that are used for feedback control. We treat various aspects of the control problem, from linear control of themotor, to stabilization of the pendulum about an equilibrium configuration using linear control, to the nonlinear control problem of swingup control. We also discuss hybrid and switching control, which is useful for switching between the swingup and balance controllers. We also discuss important practical issues such as friction modeling and friction compensation, quantization of sensor signals, and saturation. This monograph can be used as a supplement for courses in feedback control at the undergraduate level, courses in mechatronics, or courses in linear and nonlinear state space control at the graduate level. It can also be used as a laboratory manual and as a reference for research in nonlinear control.

Humanoid Robots: Modeling and Control provides systematic presentation of the models used in the analysis, design and control of humanoid robots. The book starts with a historical overview of the field, a

summary of the current state of the art achievements and an outline of the related fields of research. It moves on to explain the theoretical foundations in terms of kinematic, kineto-static and dynamic relations. Further on, a detailed overview of biped balance control approaches is presented. Models and control algorithms for cooperative object manipulation with a multi-finger hand, a dual-arm and a multi-robot system are also discussed. One of the chapters is devoted to selected topics from the area of motion generation and control and their applications. The final chapter focuses on simulation environments, specifically on the step-by-step design of a simulator using the Matlab® environment and tools. This book will benefit readers with an advanced level of understanding of robotics, mechanics and control such as graduate students, academic and industrial researchers and professional engineers. Researchers in the related fields of multi-legged robots, biomechanics, physical therapy and physics-based computer animation of articulated figures can also benefit from the models and computational algorithms presented in the book. Provides a firm theoretical basis for modelling and control algorithm design Gives a systematic presentation of models and control algorithms Contains numerous implementation examples demonstrated with 43 video clips

The Reaction Wheel Pendulum

Security for Multihop Wireless Networks

Cable-Driven Parallel Robots
Proceedings of the 19th CISM-IFtomm Symposium
Applied Non-Linear Dynamical Systems
Multi-body Dynamic Modeling of Multi-legged Robots