Chapter 2 Robot Kinematics And Dynamics Modeling

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Formation Control of Multi-Agent Systems - Marcio de Queiroz 2018-12-31
Formation Control of Multi-Agent Systems: A Graph Rigidity Approach Marcio de Queiroz, Louisiana State University, USA Xiaoyu Cai, FARO Technologies, USA Matthew Feemster, U.S. Naval Academy, USA A comprehensive guide to formation control of multi-agent systems using rigid graph theory This book is the first to provide a comprehensive and unified treatment of the subject of graph rigidity-based formation control of multi-agent systems. Such systems are relevant to a variety of emerging engineering applications, including unmanned robotic vehicles and mobile sensor networks. Graph theory, and rigid graphs in particular, provides a natural tool for describing the multi-agent formation shape as well as the inter-agent sensing, communication, and control topology. Beginning with an introduction to rigid graph theory, the contents of the book are organized by the agent dynamic model (single integrator, double integrator, and mechanical dynamics) and by the type of formation problem (formation acquisition, formation manoeuvring, and target interception). The book presents the material in ascending level of difficulty and in a self-contained manner; thus, facilitating reader understanding. Key features: Uses the concept of graph rigidity as the basis for describing the multi-agent formation geometry and solving formation control problems. Considers different agent models and formation control problems. Control designs throughout the book progressively build upon each other. Provides a primer on rigid graph theory. Combines theory, computer simulations, and experimental results. Formation Control of Multi-Agent Systems: A Graph Rigidity Approach is targeted at researchers and graduate students in the areas of control systems and robotics. Prerequisite knowledge includes linear algebra, matrix theory, control systems, and nonlinear systems.
Visual Servoing in Robotics - Jorge Pomares 2021-08-31
Visual servoing is a well-known approach to guide robots using visual information. Image processing, robotics, and control theory are combined in order to control the motion of a robot depending on the visual information extracted from the images captured by one or several cameras. With respect to vision issues, a number of issues are currently being addressed by ongoing research, such as the use of different types of image features (or different types of cameras such as RGBD cameras), image processing at high velocity, and convergence properties. As shown in this book, the use of new control schemes allows the system to behave more robustly, efficiently, or compliantly, with fewer delays. Related issues such as optimal and robust approaches, direct control, path tracking, or sensor fusion are also addressed. Additionally, we can currently find visual servoing systems being applied in a number of different domains. This book considers various aspects of visual servoing systems, such as the design of new strategies for their application to parallel robots, mobile manipulators, teleoperation, and the application of this type of control system in new areas.
Dynamics of Robots with Contact Tasks - M. Vukobratovic 2013-04-17
As robots are becoming more and more sophisticated the interest in robot dynamics is increasing. Within this field, contact problems are among the most interesting, since contacts are present in almost any robot task and introduce serious complexity to system dynamics, strongly influencing robot behavior. The book formulates dynamic models of robot interaction with different kinds of environment, from pure geometrical constraints to complex dynamic environments. It provides a number of examples. Dynamic modeling is the primary interest of the book but control issues are treated as well. Because dynamics and contact control tasks are strongly related the authors also provide a brief description of relevant control issues. The book will be of interest to engineers working in research and development in robotics and automation and to both graduate and postgraduate students. The work will also be valuable to readers involved in manufacturing, robotics, automation, computer and control engineering.
Modern Robotics - Kevin M. Lynch 2017-05-25
A modern and unified treatment of the mechanics, planning, and control of robots, suitable for a first course in robotics.
Mobile Intelligent Autonomous Systems - Jitendra R. Raol 2016-04-19
Going beyond the traditional field of robotics to include other mobile vehicles, this reference and "recipe book" describes important theoretical concepts, techniques, and applications that can be used to build truly mobile intelligent autonomous systems (MIAS). With the infusion of neural networks, fuzzy logic, and genetic algorithm paradigms for MIAS, it blends modeling, sensors, control, estimation, optimization, signal processing, and heuristic methods in MIAS and robotics, and includes examples and applications throughout. Offering a comprehensive view of important topics, it helps readers understand the subject from a system-theoretic and practical point of view.
Soft Computing for Hybrid Intelligent Systems - Oscar Castillo 2008-09-10
We describe in this book, new methods and applications of hybrid intelligent systems using soft computing techniques. Soft Computing (SC) consists of several intelligent computing paradigms, including fuzzy logic, neural networks, and evolutionary al- rithms, which can be used to produce powerful hybrid intelligent systems. The book is organized in five main parts, which contain a group of papers around a similar subject. The first part consists of papers with the main theme of intelligent control, which are basically papers that use hybrid systems to solve particular problems of control. The second part contains papers with the main theme of pattern recognition, which are basically papers using soft computing techniques for achieving pattern recognition in different applications. The third part contains papers with the themes of intelligent agents and social systems, which are papers that apply the ideas of agents and social behavior to solve real-world problems. The fourth part contains papers that deal with the hardware implementation of intelligent systems for solving particular problems. The fifth part contains papers that deal with modeling, simulation and optimization for real-world applications.
Mobile Robots in Rough Terrain - Karl Iagnemma 2004-07-08
This monograph discusses issues related to estimation, control, and motion planning for mobile robots operating in rough terrain, with particular attention to planetary exploration rovers. Rough terrain robotics is becoming increasingly important in space exploration, and industrial applications. However, most current motion planning and control algorithms are not well suited to rough terrain mobility, since they do not consider the physical characteristics of the rover and its environment. Specific addressed topics are: wheel terrain interaction modeling, including terrain parameter estimation and wheel terrain contact angle estimation; rough terrain motion planning; articulated suspension control; and traction control. Simulation

and experimental results are presented that show that the desribed algorithms lead to improved mobility for robotic systems in rough terrain.

Snake Robots - Pål Liljebäck 2012-06-13

Snake Robots is a novel treatment of theoretical and practical topics related to snake robots: robotic mechanisms designed to move like biological snakes and able to operate in challenging environments in which human presence is either undesirable or impossible. Future applications of such robots include search and rescue, inspection and maintenance, and subsea operations. Locomotion in unstructured environments is a focus for this book. The text targets the disparate muddle of approaches to modelling, development and control of snake robots in current literature, giving a unified presentation of recent research results on snake robot locomotion to increase the reader’s basic understanding of these mechanisms and their motion dynamics and clarify the state of the art in the field. The book is a complete treatment of snake robotics, with topics ranging from mathematical modelling techniques, through mechatronic design and implementation, to control design strategies. The development of two snake robots is described and both are used to provide experimental validation of many of the theoretical results. Snake Robots is written in a clear and easily understandable manner which makes the material accessible by specialists in the field and non-experts alike. Numerous illustrative figures and images help readers to visualize the material. The book is particularly useful to new researchers taking on a topic related to snake robots because it provides an extensive overview of the snake robot literature and also represents a suitable starting point for research in this area.

Control and Dynamic Systems V40: Advances in Robotic Systems Part 2 of 2 - C.T. Leonides 2012-12-02

Advances in Robotic Systems, Part 2 is the second of a companion set of two volumes on advances in robotic systems dynamics and control. This book comprises nine chapters, with the first focusing on kinesthetic feedback techniques in teleoperated systems. The succeeding chapters then delve into topics such as parallel algorithms and fault-tolerant reconfigurable architecture for robot kinematics and dynamics computations; trajectory planning for robot control; and a control systems perspective. Other chapters cover simplified techniques for adaptive control of robotic systems; theory and applications of configuration control for redundant manipulators; nonlinear feedback for force control of robot manipulators; systolic architectures for dynamic control of manipulators; inverse dynamics; and forward dynamics. This book will be of interest to practitioners in the fields of computer science, systems science, and mathematics.

Local Stability and Ultimate Boundedness in the Control of Robot Manipulators - Marco A. Arteaga 2021-11-08

This book offers a unique compendium of the authors´ own research on the use of theoretical stability analysis, showing how to take advantage of local stability design and ultimate boundedness for practical robot control. It addresses researchers and postgraduate students dealing with control theory, particularly with nonlinear systems. Thanks to the numerous worked examples, it could also be used as a textbook in postgraduate courses.

Intelligent Robotics and Applications - Xin-Jun Liu 2021-10-19

The 4-volume set LNAI 13013 – 13016 constitutes the proceedings of the 14th International Conference on Intelligent Robotics and Applications, ICIRA 2021, which took place in Yantai, China, during October 22-25, 2021. The 299 papers included in these proceedings were carefully reviewed and selected from 386 submissions. They were organized in topical sections as follows: Robotics dexterous manipulation; sensors, actuators, and controllers for soft and hybrid robots; cable-driven parallel robot; human-centered wearable robotics; hybrid system modeling and human-machine interface; robot manipulation skills learning; micro_nano materials, devices, and systems for biomedical applications; actuating, sensing, control, and instrumentation for ultra-precision engineering; human-robot collaboration; robotic machining; medical robot; machine intelligence for human motion analytics; human-robot interaction for service robots; novel mechanisms, robots and applications; space robot and on-orbit service; neural learning enhanced motion planning and control for human robot interaction; medical engineering.

Applications of Mobile Robots - 2019-03-20

This book includes a selection of research work in the mobile robotics area, where several interesting topics are presented. In this way we find a review of multi-agents, different techniques applied to the navigation systems, artificial intelligence algorithms, which include deep learning applications, systems where a Kalman filter estimator is extended for visual odometry, and finally the design of an on-chip system for the execution of cognitive agents. Additionally, the development of different ideas in mobile robot applications are included and hopefully will be useful and enriching for readers.

Actuation-Aware Simplified Dynamic Models for Robotic Legged Locomotion - Romeo Orsolino 2019-02-14

In the recent years, we witnessed an ever increasing number of successful hardware implementations of motion planners for legged robots. If one common property is to be identified among these real-world applications, that is the ability of performing online (re)planning. Online planning is forgiving, in the sense that it allows to relentlessly compensate for external disturbances of whatever form they might be, ranging from unmodeled dynamics to external pushes or unexpected obstacles and, at the same time, follow user commands. Initially replanning was restricted only to heuristic-based planners that exploit the low computational effort of simplified dynamic models. Such models deliberately only capture the main dynamics of the system, thus leaving to the controllers the issue of anchoring the desired trajectory to the whole body model of the robot. In recent years, however, a number of novel Model Predictive Control (MPC) approaches have been presented that attempt to increase the accuracy of the obtained solutions by employing more complex dynamic formulations, this without trading-off the computational efficiency of simplified models. In this dissertation, as an example of successful hardware implementation of heuristics and simplified model-based locomotion, I first describe the control framework that I developed for the generation of an omni-directional bounding gait for the HyQ quadruped robot. By analyzing the stable limit cycles for the sagittal dynamics and the Center of Pressure (CoP) for the lateral stabilization, the described locomotion framework is able to achieve a stable bounding gait while adapting the footsteps to terrains of mild roughness and to sudden changes of the user desired linear and angular velocities. The next topic reported and second contribution of this dissertation is my effort to formulate more descriptive simplified dynamic models, without compromising their computational efficiency, in order to extend the navigation capabilities of legged robots to complex geometry environments. With this in mind, I investigated the possibility of incorporating feasibility constraints in these template models and, in particular, I focused on the joint-torque limits, which are usually neglected at the planning stage. Along the same direction, the third contribution discussed in this thesis is the formulation of the so called actuation wrench polytope (AWP), defined as the set of feasible wrenches that an articulated robot can perform given its actuation limits. Interesected with the contact wrench cone (CWC), this yields a new 6D polytope that we name feasible wrench polytope (FWP), defined as the set of all wrenches that a legged robot can realize given its actuation capabilities and the friction constraints. Results are reported where, thanks to efficient computational geometry algorithms and to appropriate approximations, the FWP is employed for a one-step receding horizon optimization of center of mass trajectory and phase durations given a predefined step sequence on rough terrains. In order to augment the robot’s reachable workspace, I then decided to trade off the generality of the FWP formulation for a suboptimal scenario in which a quasi-static motion is assumed. This led to the definition of a new concept that I refer to under the name of feasible region. This can be seen as a different variant of 2D linear subspaces orthogonal to gravity where the robot is guaranteed to place its own center of mass (CoM) while being able to carry its own body weight given its actuation capabilities. The feasible region provides an intuitive tool for the visualization in 2D of the actuation capabilities of legged robots. The low dimensionality of the feasible region also enables the concurrent online optimization of actuation consistent CoM trajectories and target foothold locations on rough terrains, which can hardly be achieved with other state-of-the-art approaches.

CAD/CAM, Robotics and Factories of the Future - Dipak Kumar Mandal 2016-01-05

This volume is based on the proceedings of the 28th International Conference on CAD/CAM, Robotics and Factories of the Future. This book specially focuses on the positive changes made in the field of robotics, CAD/CAM and future outlook for emerging manufacturing units. Some of the important topics discussed in the conference are product development and sustainability, modeling and simulation, automation, robotics and handling systems, supply chain management and logistics, advanced manufacturing processes, human aspects in engineering activities, emerging scenarios in engineering education and training. The contents

of this set of proceedings will prove useful to both researchers and practitioners.
Soft Computing: Theories and Applications - Millie Pant 2017-11-23
This book focuses on soft computing and its applications to solve real-life problems occurring in different domains ranging from medical and health care, supply chain management and image processing to cryptanalysis. It presents the proceedings of International Conference on Soft Computing: Theories and Applications (SoCTA 2016), offering significant insights into soft computing for teachers and researchers and inspiring more and more researchers to work in the field of soft computing. >The term soft computing represents an umbrella term for computational techniques like fuzzy logic, neural networks, and nature inspired algorithms. In the past few decades, there has been an exponential rise in the application of soft computing techniques for solving complex and intricate problems arising in different spheres of life. The versatility of these techniques has made them a favorite among scientists and researchers working in diverse areas. SoCTA is the first international conference being organized at Amity University Rajasthan (AUR), Jaipur. The objective of SoCTA 2016 is to provide a common platform to researchers, academicians, scientists, and industrialists working in the area of soft computing to share and exchange their views and ideas on the theory and application of soft computing techniques in multi-disciplinary areas. The aim of the conference is to bring together young and experienced researchers, academicians, scientists, and industrialists for the exchange of knowledge. SoCTA especially encourages the young researchers at the beginning of their career to participate in this conference and present their work on this platform.
Frontiers in Advanced Control Systems - Ginalber Luiz Serra 2012-07-25
This book pretends to bring the state-of-art research results on advanced control from both the theoretical and practical perspectives. The fundamental and advanced research results as well as the contributions in terms of the technical evolution of control theory are of particular interest. This book can serve as a bridge between people who are working on the theoretical and practical research on control theory, and facilitate the proposal of development of new control techniques and its applications. In addition, this book presents educational importance to help students and researchers to know the frontiers of the control technology.
Mathematical Concepts and Applications in Mechanical Engineering and Mechatronics - Ram, Mangey 2016-10-25
The application of mathematical concepts has proven to be beneficial within a number of different industries. In particular, these concepts have created significant developments in the engineering field. Mathematical Concepts and Applications in Mechanical Engineering and Mechatronics is an authoritative reference source for the latest scholarly research on the use of applied mathematics to enhance the current trends and productivity in mechanical engineering. Highlighting theoretical foundations, real-world cases, and future directions, this book is ideally designed for researchers, practitioners, professionals, and students of mechatronics and mechanical engineering.
Robot Modeling and Control - Mark W. Spong 2020-03-30
A New Edition Featuring Case Studies and Examples of the Fundamentals of Robot Kinematics, Dynamics, and Control In the 2nd Edition of Robot Modeling and Control, students will cover the theoretical fundamentals and the latest technological advances in robot kinematics. With so much advancement in technology, from robotics to motion planning, society can implement more powerful and dynamic algorithms than ever before. This in-depth reference guide educates readers in four distinct parts; the first two serve as a guide to the fundamentals of robotics and motion control, while the last two dive more in-depth into control theory and nonlinear system analysis. With the new edition, readers gain access to new case studies and thoroughly researched information covering topics such as: ● Motion-planning, collision avoidance, trajectory optimization, and control of robots ● Popular topics within the robotics industry and how they apply to various technologies ● An expanded set of examples, simulations, problems, and case studies ● Open-ended suggestions for students to apply the knowledge to real-life situations A four-part reference essential for both undergraduate and graduate students, Robot Modeling and Control serves as a foundation for a solid education in robotics and motion planning.
Serial and Parallel Robot Manipulators - Serdar Küçük 2012-03-30
The robotics is an important part of modern engineering and is related to a group of branches such as electric
Design, Modeling and Control of Aerial Robots for Physical Interaction and Manipulation - Burak Yüksel 2017-06-10
Aerial robots, meaning robots with flying capabilities, are essentially robotic platforms, which are autonomously controlled via some sophisticated control engineering tools. Similar to aerial vehichles, they can overcome the gravitational forces thanks to their design and/or actuation type. What makes them different from the conventional aerial vehicles, is the level of their autonomy. Reducing the complexity for piloting of such robots/vehicles provide the human operator more freedom and comfort. With their increasing autonomy, they can perform many complicated tasks by their own (such as surveillance, monitoring, or inspection), leaving the human operator the most high-level decisions to be made, if necessary. In this way they can be operated in hazardous and challenging environments, which might posses high risks to the human health. Thanks to their wide range of usage, the ongoing researches on aerial robots is expected to have an increasing impact on the human life. Aerial Physical Interaction (APhI) is a case, in which the aerial robot exerts meaningful forces and torques (wrench) to its environment while preserving its stable flight. In this case, the robot does not try avoiding every obstacle in its environment, but prepare itself for embracing the effect of a physical interaction, furthermore turn this interaction into some meaningful robotic tasks. Aerial manipulation can be considered as a subset of APhI, where the flying robot is designed and controlled in purpose of manipulating its environment. A clear motivation of using aerial robots for physical interaction, is to benefit their great workspace and agility. Moreover, developing robots that can perform not only APhI but also aerial manipulation can bring the great workspace of the flying robots together with the vast dexterity of the manipulating arms. This thesis work is addressing the design, modeling and control problem of these aerial robots for the purpose of physical interaction and manipulation. Using the nonlinear mathematical models of the robots at hand, in this thesis several different control methods (IDA-PBC, Exact Linearization, Differential Flatness Based Control) for APhI and aerial manipulation tasks have been developed and proposed. Furthermore, novel design tools (e.g. new rigid/elastic manipulating arms, hardware, software) to be used together with miniature aerial robots are presented within this thesis, which contributes to the robotics society not only in terms of concrete theory but also practical implementation and experimental robotics.
Design, Analysis and Control of Cable-Suspended Parallel Robots and Its Applications - Bin Zi 2017-02-18
This book provides an essential overview of the authors' work in the field of cable-suspended parallel robots, focusing on innovative design, mechanics, control, development and applications. It presents and analyzes several typical mechanical architectures of cable-suspended parallel robots in practical applications, including the feed cable-suspended structure for super antennae, hybrid-driven-based cable-suspended parallel robots, and cooperative cable parallel manipulators for multiple mobile cranes. It also addresses the fundamental mechanics of cable-suspended parallel robots on the basis of their typical applications, including the kinematics, dynamics and trajectory tracking control of the feed cable-suspended structure for super antennae. In addition it proposes a novel hybrid-driven-based cable-suspended parallel robot that uses integrated mechanism design methods to improve the performance of traditional cable-suspended parallel robots. A comparative study on error and performance indices of hybrid-driven based and traditional cable-suspended parallel robots rounds out the coverage. This book addresses the needs of researchers, engineers and post-graduates in the field of cable-suspended parallel robots and related areas.
Robot Dynamics And Control - Mark W Spong 2008-08-04
This self-contained introduction to practical robot kinematics and dynamics includes a comprehensive treatment of robot control. It provides background material on terminology and linear transformations, followed by coverage of kinematics and inverse kinematics, dynamics, manipulator control, robust control, force control, use of feedback in nonlinear systems, and adaptive control. Each topic is supported by examples of specific applications. Derivations and proofs are included in many cases. The book includes many worked examples, examples illustrating all aspects of the theory, and problems.
Advances in Industrial Machines and Mechanisms - Y. V. D. Rao 2021-07-20
This book presents the select proceedings of the 1st International 13th National Conference on Industrial

Problems on Machines and Mechanism (IPRoMM 2020) and examines issues in the design, manufacture, and performance of mechanical and mechatronic elements and systems that are employed in modern machines and devices. The topics covered include robotics, industrial CAD/CAM systems, mechatronics, machinery associated with conventional and unconventional manufacturing systems, material handling and automated assembly, mechanical and electro-mechanical systems of modern machinery and equipment, micro-devices, compliant mechanisms, hybrid electric vehicle and electric vehicle mechanisms, acoustic and noise control. This book also discusses the recent advances in the integration of IoT and Industry 4.0 in mechanism and machines. The book will be a valuable reference for academicians, researchers, and professionals interested in the design and development of industrial machines.

Parallel PnP Robots - Guanglei Wu 2020-08-08

This book discusses the parametric modeling, performance evaluation, design optimization and comparative study of the high-speed, parallel pick-and-place robots. It collects the modeling methodology, evaluation criteria and design guidelines for parallel PnP robots to provide a systematic analysis method for robotic developers. Furthermore, it gathers the research results previously scattered in many prestigious international journals and conference proceedings and methodically edits them and presents them in a unified form. The book is of interest to researchers, R&D engineers and graduate students in industrial parallel robotics who wish to learn the core principles, methods, algorithms, and applications.

Advanced Technologies in Modern Robotic Applications - Chenguang Yang 2016-05-18

This book presents in a systematic manner the advanced technologies used for various modern robot applications. By bringing fresh ideas, new concepts, novel methods and tools into robot control, robot vision, human robot interaction, teleoperation of robot and multiple robots system, we are to provide a state-of-the-art and comprehensive treatment of the advanced technologies for a wide range of robotic applications. Particularly, we focus on the topics of advanced control and obstacle avoidance techniques for robot to deal with unknown perturbations, of visual servoing techniques which enable robot to autonomously operate in a dynamic environment, and of advanced techniques involved in human robot interaction. The book is primarily intended for researchers and engineers in the robotic and control community. It can also serve as complementary reading for robotics at the both graduate and undergraduate levels.

Applied mechanics reviews - 1948

Intelligent Robotics and Applications - Xianmin Zhang 2014-11-15

This two volume set LNAI 8917 and 8918 constitutes the refereed proceedings of the 7th International Conference on Intelligent Robotics and Applications, ICIRA 2014, held in Guangzhou, China, in December 2014. The 109 revised full papers presented were carefully reviewed and selected from 159 submissions. The papers aim at enhancing the sharing of individual experiences and expertise in intelligent robotics with particular emphasis on technical challenges associated with varied applications such as biomedical applications, industrial automations, surveillance, and sustainable mobility.

Modular Robots: Theory and Practice - Guilin Yang 2021-08-30

This book introduces the latest advances in modular robotics, and presents a unified geometric framework for modeling, analysis, and design of modular robots, including kinematics, dynamics, calibration, and configuration optimization. Supplementing the main content with a wealth of illustrations, the book offers a valuable guide for researchers, engineers and graduate students in the fields of mechatronics, robotics, and automation who wish to learn about the theory and practice of modular robots.

Multi-body Dynamic Modeling of Multi-legged Robots - Abhijit Mahapatra 2020-02-27

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.

Wearable Robots - José L. Pons 2008-04-15

A wearable robot is a mechatronic system that is designed around the shape and function of the human body, with segments and joints corresponding to those of the person it is externally coupled with. Teleoperation and power amplification were the first applications, but after recent technological advances the range of application fields has widened. Increasing recognition from the scientific community means that this technology is now employed in telemanipulation, man-amplification, neuromotor control research and rehabilitation, and to assist with impaired human motor control. Logical in structure and original in its global orientation, this volume gives a full overview of wearable robotics, providing the reader with a complete understanding of the key applications and technologies suitable for its development. The main topics are demonstrated through two detailed case studies; one on a lower limb active orthosis for a human leg, and one on a wearable robot that suppresses upper limb tremor. These examples highlight the difficulties and potentialities in this area of technology, illustrating how design decisions should be made based on these. As well as discussing the cognitive interaction between human and robot, this comprehensive text also covers: the mechanics of the wearable robot and it’s biomechanical interaction with the user, including state-of-the-art technologies that enable sensory and motor interaction between human (biological) and wearable artificial (mechatronic) systems; the basis for bioinspiration and biomimetism, general rules for the development of biologically-inspired designs, and how these could serve recursively as biological models to explain biological systems; the study on the development of networks for wearable robotics. Wearable Robotics: Biomechatronic Exoskeletons will appeal to lecturers, senior undergraduate students, postgraduates and other researchers of medical, electrical and bio engineering who are interested in the area of assistive robotics. Active system developers in this sector of the engineering industry will also find it an informative and welcome resource.

Force Control Theory and Method of Human Load Carrying Exoskeleton Suit - Zhiyong Yang 2017-04-06

This book reports on the latest advances in concepts and further development of principal component analysis (PCA), discussing in detail a number of open problems related to dimensional reduction techniques and their extensions. It brings together research findings, previously scattered throughout many scientific journal papers worldwide, and presents them in a methodologically unified form. Offering vital insights into the subject matter in self-contained chapters that balance the theory and concrete applications, and focusing on open problems, it is essential reading for all researchers and practitioners with an interest in PCA

Springer Handbook of Robotics - Bruno Siciliano 2016-07-27

The second edition of this handbook provides a state-of-the-art overview on the various aspects in the rapidly developing field of robotics. Reaching for the human frontier, robotics is vigorously engaged in the growing challenges of new emerging domains. Interacting, exploring, and working with humans, the new generation of robots will increasingly touch people and their lives. The credible prospect of practical robots among humans is the result of the scientific endeavour of a half a century of robotic developments that established robotics as a modern scientific discipline. The ongoing vibrant expansion and strong growth of the field during the last decade has fueled this second edition of the Springer Handbook of Robotics. The first edition of the handbook soon became a landmark in robotics publishing and won the American Association of Publishers PROSE Award for Excellence in Physical Sciences & Mathematics as well as the organization’s Award for Engineering & Technology. The second edition of the handbook, edited by two internationally renowned scientists with the support of an outstanding team of seven part editors and more than 200 authors, continues to be an authoritative reference for robotics researchers, newcomers to the field, and scholars from related disciplines. The contents have been restructured to achieve four main objectives: the enlargement of foundational topics for robotics, the enlightenment of design of various types of robotic systems, the extension of the treatment on robots moving in the environment, and the enrichment of advanced robotics applications. Further to an extensive update, fifteen new chapters have been introduced on emerging topics, and a new generation of authors have joined the handbook’s team. A novel addition to the second edition is a comprehensive collection of multimedia references to more than 700

videos, which bring valuable insight into the contents. The videos can be viewed directly augmented into the text with a smartphone or tablet using a unique and specially designed app. Springer Handbook of Robotics Multimedia Extension Portal: http://handbookofrobotics.org/

Industrial Robots Programming - J. Norberto Pires 2007-04-03

Industrial Robots Programming focuses on designing and building robotic manufacturing cells, and explores the capabilities of today’s industrial equipment as well as the latest computer and software technologies. Special attention is given to the input devices and systems that create efficient human-machine interfaces, and how they help non-technical personnel perform necessary programming, control, and supervision tasks. Drawing upon years of practical experience and using numerous examples and illustrative applications, J. Norberto Pires covers robotics programming as it applies to: The current industrial robotic equipment including manipulators, control systems, and programming environments. Software interfaces that can be used to develop distributed industrial manufacturing cells and techniques which can be used to build interfaces between robots and computers. Real-world applications with examples designed and implemented recently in the lab. Industrial Robots Programming has been selected for indexing by Scopus. For more information about Industrial Robotics, please find the author's Industrial Robotics collection at the iTunesU University of Coimbra channel.

Wheeled Mobile Robotics - Gregor Klancar 2017-02-02

Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systemscovers the main topics from the wide area of mobile robotics, explaining all applied theory and application. The book gives the reader a good foundation, enabling them to continue to more advanced topics. Several examples are included for better understanding, many of them accompanied by short MATLAB® script code making it easy to reuse in practical work. The book includes several examples of discussed methods and projects for wheeled mobile robots and some advanced methods for their control and localization. It is an ideal resource for those seeking an understanding of robotics, mechanics, and control, and for engineers and researchers in industrial and other specialized research institutions in the field of wheeled mobile robotics. Beginners with basic math knowledge will benefit from the examples, and engineers with an understanding of basic system theory and control will find it easy to follow the more demanding fundamental parts and advanced methods explained. Offers comprehensive coverage of the essentials of the field that are suitable for both academics and practitioners Includes several examples of the application of algorithms in simulations and real laboratory projects Presents foundation in mobile robotics theory before continuing with more advanced topics Self-sufficient to beginner readers, covering all important topics in the mobile robotics field Contains specific topics on modeling, control, sensing, path planning, localization, design architectures, and multi-agent systems

Control and Dynamic Systems V39: Advances in Robotic Systems Part 1 of 2 - C.T. Leonides 2012-12-02

Advances in Robotic Systems, Part 1 shows how the activity in robotic systems has increased significantly over the past decade. Major centers of research and development in robotic systems were established on the international scene, and these became focal points for the brilliant research efforts of many academicians and industrial professionals. The systems aspects of robotics, in general, and of robot control, in particular, are manifested through a number of technical facts. This book comprises 10 chapters, with the first focusing on applications of neural networks to robotics. The following chapters then discuss a unified approach to kinematic modeling, identification and compensation for robot calibration; nonlinear control algorithms in robotic systems; and kinematic and dynamic task space motion planning for robot control. Other chapters cover discrete kinematic modeling techniques in Cartesian space for robotic system; force distribution algorithms for multifingered grippers; frequency analysis for a discrete-time robot system; minimum cost trajectory planning for industrial robots; tactile sensing techniques in robotic systems; and sensor data fusion in robotic systems. This book will be of interest to practitioners in the fields of computer science, systems science, and mathematics.

Introduction to Mobile Robot Control - Spyros G Tzafestas 2013-10-03

Introduction to Mobile Robot Control provides a complete and concise study of modeling, control, and navigation methods for wheeled non-holonomic and omnidirectional mobile robots and manipulators. The book begins with a study of mobile robot drives and corresponding kinematic and dynamic models, and discusses the sensors used in mobile robotics. It then examines a variety of model-based, model-free, and vision-based controllers with unified proof of their stabilization and tracking performance, also addressing the problems of path, motion, and task planning, along with localization and mapping topics. The book provides a host of experimental results, a conceptual overview of systemic and software mobile robot control architectures, and a tour of the use of wheeled mobile robots and manipulators in industry and society. Introduction to Mobile Robot Control is an essential reference, and is also a textbook suitable as a supplement for many university robotics courses. It is accessible to all and can be used as a reference for professionals and researchers in the mobile robotics field. Clearly and authoritatively presents mobile robot concepts Richly illustrated throughout with figures and examples Key concepts demonstrated with a host of experimental and simulation examples No prior knowledge of the subject is required; each chapter commences with an introduction and background

Robotic Systems: Concepts, Methodologies, Tools, and Applications - Management Association, Information Resources 2020-01-03

Through expanded intelligence, the use of robotics has fundamentally transformed a variety of fields, including manufacturing, aerospace, medicine, social services, and agriculture. Continued research on robotic design is critical to solving various dynamic obstacles individuals, enterprises, and humanity at large face on a daily basis. Robotic Systems: Concepts, Methodologies, Tools, and Applications is a vital reference source that delves into the current issues, methodologies, and trends relating to advanced robotic technology in the modern world. Highlighting a range of topics such as mechatronics, cybernetics, and human-computer interaction, this multi-volume book is ideally designed for robotics engineers, mechanical engineers, robotics technicians, operators, software engineers, designers, programmers, industry professionals, researchers, students, academicians, and computer practitioners seeking current research on developing innovative ideas for intelligent and autonomous robotics systems.

Modeling and Control of a Tracked Mobile Robot for Pipeline Inspection - Michał Ciszewski 2020-03-18

This book describes the design, mathematical modeling, control system development and experimental validation of a versatile mobile pipe inspection robot. It also discusses a versatile robotic system for pipeline inspection, together with an original, adaptable tracked mobile robot featuring a patented motion unit. Pipeline inspection is a common field of application for mobile robots because the monitoring of inaccessible, long and narrow pipelines is a very difficult task for humans. The main design objective is to minimize the number of robots needed to inspect different types of horizontal and vertical pipelines, with both smooth and rough surfaces. The book includes extensive information on the various design phases, mathematical modeling, simulations and control system development. In closing, the prototype construction process and testing procedures are presented and supplemented with laboratory and field experiments.

Bipedal Robots - Christine Chevallereau 2013-03-01

This book presents various techniques to carry out the gait modeling, the gait patterns synthesis, and the control of biped robots. Some general information on the human walking, a presentation of the current experimental biped robots, and the application of walking bipeds are given. The modeling is based on the decomposition on a walking step into different sub-phases depending on the way each foot stands into contact on the ground. The robot design is dealt with according to the mass repartition and the choice of the actuators. Different ways to generate walking patterns are considered, such as passive walking and gait synthesis performed using optimization technique. Control based on the robot modeling, neural network methods, or intuitive approaches are presented. The unilaterality of contact is dealt with using on-line adaptation of the desired motion.

Advanced Dynamics Modeling, Duality and Control of Robotic Systems - Edward Y.L. Gu 2021-09-24

This book provides detailed fundamental theoretical reviews and preparations necessary for developing advanced dynamics modeling and control strategies for various types of robotic systems. This research book specifically addresses and discusses the uniqueness issue of representing orientation or rotation, and further proposes an innovative isometric embedding approach. The novel approach can not only reduce the dynamic formulation for robotic systems into a compact form, but it also offers a new way to realize the

orientational trajectory-tracking control procedures. In addition, the book gives a comprehensive introduction to fundamentals of mathematics and physics that are required for modeling robot dynamics and developing effective control algorithms. Many computer simulations and realistic 3D animations to verify the new theories and algorithms are included in the book as well. It also presents and discusses the principle of duality involved in robot kinematics, statics, and dynamics. The duality principle can guide the dynamics modeling and analysis into a right direction for a variety of robotic systems in different types from open serial-chain to closed parallel-chain mechanisms. It intends to serve as a diversified research reference to a wide range of audience, including undergraduate juniors and seniors, graduate students, researchers, and engineers interested in the areas of robotics, control and applications.