Geometric Algebra Applications Vol. II Written for senior level or first year graduate level robotics courses, this text includes material from traditional mechanical engineering, control theoretical material and computer science. It includes coverage of rigid-body transformations and forward and inverse positional kinematics.

Reliability Models of Complex Systems for Robots and Automation Human Modelling for Bio-inspired Robotics: Mechanical Engineering in Assistive Technologies presents the most cutting-edge research outcomes in the area of mechanical and control aspects of human functions for macro-scale (human size) applications. Intended to provide researchers both in academia and industry with key content on which to base their developments, this book is organized and written by senior experts in their fields. Human Modeling for Bio-Inspired Robotics: Mechanical Engineering in Assistive Technologies offers a system-level investigation into human mechanisms that inspire the development of assistive technologies and humanoid robotics, including topics in modelling of anatomical, musculoskeletal, neural and cognitive systems, as well as motor skills, adaptation and integration. Each chapter is written by a subject expert and discusses its background, research challenges, key outcomes, application, and future trends. This book will be especially useful for academic and industry researchers in this exciting field, as well as graduate-level students to bring them up to speed with the latest technology in mechanical design and control aspects of the area. Previous knowledge of the fundamentals of kinematics, dynamics, control, and signal processing is assumed. Presents the most recent research outcomes in the area of mechanical and control aspects of human functions for macro-scale (human size) applications Covers background information and fundamental concepts of human modelling Includes modelling of
anatomical, musculoskeletal, neural and cognitive systems, as well as motor skills, adaptation, integration, and safety issues. Assumes previous knowledge of the fundamentals of kinematics, dynamics, control, and signal processing.

Springer Handbook of Robotics A multiplicity of techniques and angles of attack are incorporated in 18 contributions describing recent developments in the structure, architecture, programming, control, and implementation of industrial robots capable of performing intelligent action and decision making. Annotation copyright Book Robotics Nonlinear Control of Vehicles and Robots develops a unified approach to the dynamic modeling of robots in terrestrial, aerial and marine environments. The main classes of nonlinear systems and stability methods are summarized and basic nonlinear control methods, useful in manipulator and vehicle control, are presented. Formation control of ground robots and ships is discussed. The book also deals with the modeling and control of robotic systems in the presence of non-smooth nonlinearities. Robust adaptive tracking control of robotic systems with unknown payload and friction in the presence of uncertainties is treated. Theoretical and practical aspects of the control algorithms under discussion are detailed. Examples are included throughout the book allowing the reader to apply the control and modeling techniques in their own research and development work. Some of these examples demonstrate state estimation based on the use of advanced sensors as part of the control system.

Fundamentals in Modeling and Control of Mobile Manipulators The author has maintained two open-source MATLAB Toolboxes for more than 10 years: one for robotics and one for vision. The key strength of the Toolboxes provide a set of tools that allow the user to work with real problems, not trivial examples. For the student the book makes the algorithms accessible, the Toolbox code can be read to gain understanding, and the examples illustrate how it can be used — instant gratification in just a couple of lines of MATLAB code. The code can also be the starting point for new work, for researchers or students, by writing programs based on Toolbox functions, or modifying the Toolbox code itself. The purpose of this book is to expand on the tutorial material provided with the toolboxes, add many more examples, and to weave this into a narrative that covers robotics and computer vision separately and together. The author shows how complex problems can be decomposed and solved using just a few simple lines of code, and hopefully to inspire up and coming researchers. The topics covered are guided by the real problems observed over many years as a practitioner of both robotics and computer vision. It is written in a light but informative style, it is easy to read and absorb, and includes a lot of Matlab examples and figures. The book is a real walk through the fundamentals of robot kinematics, dynamics and joint level control, then camera models, image processing, feature extraction and epipolar geometry, and bring it all together in a visual servo system. Additional material is provided at http://www.petercorke.com/RVC

Tethered Space Robot It is at least two decades since the conventional robotic manipulators have become a common manufacturing tool for different industries, from automotive to pharmaceutical. The proven benefits of utilizing robotic manipulators for manufacturing in different industries motivated scientists and researchers to try to extend the applications of robots to many other areas by inventing several new types of robots other than conventional manipulators. The new types of robots can be categorized in two groups; redundant (and hyper-redundant) manipulators, and mobile (ground, marine, and aerial) robots. These groups of robots, known as advanced robots, have more freedom for their mobility, which allows them to do tasks that the conventional
manipulators cannot do. Engineers have taken advantage of the extra mobility of the advanced robots to make them work in constrained environments, ranging from limited joint motions for redundant (or hyper-redundant) manipulators to obstacles in the way of mobile (ground, marine, and aerial) robots. Since these constraints usually depend on the work environment, they are variable. Engineers have had to invent methods to allow the robots to deal with a variety of constraints automatically. A robot that is equipped with those methods is called an Autonomous Robot. Autonomous Robots: Kinematics, Path Planning, and Control covers the kinematics and dynamic modeling/analysis of Autonomous Robots, as well as the methods suitable for their control. The text is suitable for mechanical and electrical engineers who want to familiarize themselves with methods of modeling/analysis/control that have been proven efficient through research.

Multi-View Geometry Based Visual Perception and Control of Robotic Systems 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.

Human Modeling for Bio-Inspired Robotics Nonlinear Control of Robots and Unmanned Aerial Vehicles: An Integrated Approach presents control and regulation methods that rely upon feedback linearization techniques. Both robot manipulators and UAVs employ operating regimes with large magnitudes of state and control variables, making such an approach vital for their control systems design. Numerous application examples are included to facilitate the art of nonlinear control system design, for both robotic systems and UAVs, in a single unified framework. MATLAB® and Simulink® are integrated to demonstrate the importance of computational methods and systems simulation in this process.

Data-Driven Science and Engineering Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems covers 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.

Robotics, Vision and Control This beginning graduate textbook teaches data science and machine learning methods for modeling, prediction, and control of complex systems.

Nonlinear Control of Vehicles and Robots A Mathematical Introduction to Robotic Manipulation presents a mathematical formulation of the kinematics, dynamics, and control of robot manipulators. It uses an elegant set of mathematical tools that emphasizes the geometry of robot motion and allows a large class of robotic manipulation problems to be analyzed within a unified framework. The foundation of the book is a derivation of robot kinematics using the product of the exponentials formula. The authors explore the kinematics of open-chain manipulators and multifingered robot hands, present an analysis of the dynamics and control of robot systems, discuss the specification and control of internal forces and internal motions, and address the implications of the nonholonomic nature of rolling contact are addressed, as well. The wealth of information, numerous examples, and exercises make A Mathematical Introduction to Robotic Manipulation valuable as both a reference for robotics researchers and a text for students in advanced robotics courses.

Introduction to Mobile Robot Control Robot Manipulator Control offers a complete survey of control systems for serial-link robot arms and acknowledges how robotic device performance hinges upon a well-developed control system. Containing over 750 essential equations, this thoroughly up-to-date Second Edition, the book explicates theoretical and mathematical requisites for controls design and summarizes current techniques in computer simulation and implementation of controllers. It also addresses procedures and issues in computed-torque, robust, adaptive, neural network, and force control. New chapters relay practical information on commercial robot manipulators and devices and cutting-edge methods in neural network control.

Legged Robots that Balance Bipedal locomotion is among the most difficult challenges in control engineering. Most books treat the subject from a quasi-static perspective, overlooking the hybrid nature of bipedal mechanics. Feedback Control of Dynamic Bipedal Robot Locomotion is the first book to present a comprehensive and mathematically sound treatment of feedback design for achieving stable, agile, and efficient locomotion in bipedal robots. In this unique and groundbreaking treatise, expert authors lead you systematically through every step of the process, including: Mathematical modeling of walking and running gaits in planar robots Analysis of periodic orbits in hybrid systems Design and analysis of feedback systems for achieving stable periodic motions Algorithms for synthesizing feedback controllers Detailed simulation examples Experimental implementations on two bipedal test beds The elegance of the authors' approach is evident in the marriage of control theory and mechanics, uniting control-based presentation and mathematical custom with a mechanics-based approach to the problem and computational rendering. Concrete examples and numerous illustrations complement and clarify the mathematical discussion. A supporting Web site offers links to videos of several experiments along with MATLAB® code for several of the models. This one-of-a-kind book builds a solid understanding of the theoretical and practical aspects of truly dynamic locomotion in planar bipedal robots.

Soft Robotics: Trends, Applications and Challenges A modern and unified treatment of
the mechanics, planning, and control of robots, suitable for a first course in robotics.

Intelligent Robotic Systems Micro/nano-scale engineering—especially the design and implementation of ultra-fast and ultra-scale energy devices, sensors, and cellular and molecular systems—remains a daunting challenge. Modeling and control has played an essential role in many technological breakthroughs throughout the course of history. Therefore, the need for a practical guide to modeling and control for micro/nano-scale devices and systems has emerged. The first edited volume to address this rapidly growing field, Modeling and Control for Micro/Nano Devices and Systems gives control engineers, lab managers, high-tech researchers, and graduate students easy access to the expert contributors’ cutting-edge knowledge of micro/nanotechnology, energy, and bio-systems. The editors offer an integrated view from theory to practice, covering diverse topics ranging from micro/nano-scale sensors to energy devices and control of biology systems in cellular and molecular levels. The book also features numerous case studies for modeling of micro/nano devices and systems, and explains how the models can be used for control and optimization purposes. Readers benefit from learning the latest modeling techniques for micro/nano-scale devices and systems, and then applying those techniques to their own research and development efforts.

Autonomous Robots 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

Theory of Robot Control Written by two of Europe’s leading robotics experts, this book provides the tools for a unified approach to the modelling of robotic manipulators, whatever their mechanical structure. No other publication covers the three fundamental issues of robotics: modelling, identification and control. It covers the development of various mathematical models required for the control and simulation of robots. · World class authority · Unique range of coverage not available in any other book · Provides a complete course on robotic control at an undergraduate and graduate level

Human and Robot Hands Mobile manipulators combine the advantages of mobile platforms and robotic arms, extending their operational range and functionality to large spaces and remote, demanding, and/or dangerous environments. They also bring complexity and difficulty in dynamic modeling and control system design. However, advances in nonlinear system analysis and control system design offer powerful tools and concepts for the control of mobile manipulator systems. Fundamentals in Modeling and
Control of Mobile Manipulators presents a thorough theoretical treatment of several fundamental problems for mobile robotic manipulators. The book integrates fresh concepts and state-of-the-art results to systematically examine kinematics and dynamics, motion generation, feedback control, coordination, and cooperation. From this treatment, the authors form a basic theoretical framework for a mobile robotic manipulator that extends the theory of nonlinear control and applies to more realistic problems. Drawing on their research over the past ten years, the authors propose novel control theory concepts and techniques to tackle key problems. Topics covered include kinematic and dynamic modeling, control of nonholonomic systems, path planning that considers motion and manipulation, hybrid motion/force control and hybrid position/force control where the mobile manipulator is required to interact with environments, and coordination and cooperation strategies for multiple mobile manipulators. The book also includes practical examples of applications in engineering systems. This timely book investigates important scientific and engineering issues for researchers and engineers working with either single or multiple mobile manipulators for larger operational space, better cooperation, and improved productivity.

Nonlinear Control of Robots and Unmanned Aerial Vehicles Tethered Space Robot: Dynamics, Measurement, and Control discusses a novel tethered space robot (TSR) system that contains the space platform, flexible tether and gripper. TSR can capture and remove non-cooperative targets such as space debris. It is the first time the concept has been described in a book, which describes the system and mission design of TSR and then introduces the latest research on pose measurement, dynamics and control. The book covers the TSR system, from principle to applications, including a complete implementing scheme. A useful reference for researchers, engineers and students interested in space robots, OOS and debris removal. Provides for the first time comprehensive coverage of various aspects of tethered space robots (TSR) Presents both fundamental principles and application technologies including pose measurement, dynamics and control Describes some new control techniques, including a coordinated control method for tracking optimal trajectory, coordinated coupling control and coordinated approaching control using mobile tether attachment points

Robotics and Automation Handbook 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.

Modeling and Control for Micro/Nano Devices and Systems This book describes visual perception and control methods for robotic systems that need to interact with the environment. Multiple view geometry is utilized to extract low-dimensional geometric information from abundant and high-dimensional image information, making it convenient to develop general solutions for robot perception and control tasks. In this book, multiple view geometry is used for geometric modeling and scaled pose estimation. Then Lyapunov methods are applied to design stabilizing control laws in the presence of model uncertainties and multiple constraints.

Intelligent Control of Robotic Systems 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.

Probabilistic Robotics Comprehension of complex systems comes from an understanding of not only the behavior of constituent elements but how they act together to form the behavior of the whole. However, given the multidisciplinary nature of complex systems, the scattering of information across different areas creates a chaotic situation for those trying to understand possible solutions and applications. Modeling and Control of Complex Systems brings together a number of research experts to present some of their latest approaches and future research directions in a language accessible to system theorists. Contributors discuss complex systems such as networks for modeling and control of civil structures, vehicles, robots, biomedical systems, fluid flow systems, and home automation systems. Each chapter provides theoretical and methodological descriptions of a specific application in the control of complex systems, including congestion control in computer networks, autonomous multi-robot docking systems, modeling and control in cancer genomics, and backstepping controllers for stabilization of turbulent flow PDEs. With this unique reference, you will discover how complexity is dealt with in different disciplines and learn about the latest methodologies, which are applicable to your own specialty. The balanced mix of theory and simulation presented by Modeling and Control of Complex Systems supplies a strong vehicle for enlarging your knowledge base a fueling future advances and incredible breakthroughs.

Introduction to Robotics This book presents a unified mathematical treatment of diverse problems in the general domain of robotics and associated fields using Clifford or geometric algebra. By addressing a wide spectrum of problems in a common language, it offers both fresh insights and new solutions that are useful to scientists and engineers working in areas related with robotics. It introduces non-specialists to Clifford and geometric algebra, and provides examples to help readers learn how to compute using geometric entities and geometric formulations. It also includes an in-depth study of applications of Lie group theory, Lie algebra, spinors and versors and the algebra of incidence using the universal geometric algebra generated by reciprocal null cones. Featuring a detailed study of kinematics, differential kinematics and dynamics using geometric algebra, the book also develops Euler Lagrange and Hamiltonian equations for dynamics using conformal geometric algebra, and the recursive Newton-Euler using screw theory in the motor algebra framework. Further, it comprehensively explores robot
modeling and nonlinear controllers, and discusses several applications in computer vision, graphics, neurocomputing, quantum computing, robotics and control engineering using the geometric algebra framework. The book also includes over 200 exercises and tips for the development of future computer software packages for extensive calculations in geometric algebra, and a entire section focusing on how to write the subroutines in C++, Matlab and Maple to carry out efficient geometric computations in the geometric algebra framework. Lastly, it shows how program code can be optimized for real-time computations. An essential resource for applied physicists, computer scientists, AI researchers, roboticists and mechanical and electrical engineers, the book clarifies and demonstrates the importance of geometric computing for building autonomous systems to advance cognitive systems research.

Bipedal Robots A study of the latest research results in the theory of robot control, structured so as to echo the gradual development of robot control over the last fifteen years. In three major parts, the editors deal with the modelling and control of rigid and flexible robot manipulators and mobile robots. Most of the results on rigid robot manipulators in part I are now well established, while for flexible manipulators in part II, some problems still remain unresolved. Part III deals with the control of mobile robots, a challenging area for future research. The whole is rounded off with an appendix reviewing basic definitions and the mathematical background for control theory. The particular combination of topics makes this an invaluable source of information for both graduate students and researchers.

Humanoid Robots This book, by a leading authority on legged locomotion, presents exciting engineering and science, along with fascinating implications for theories of human motor control. It lays fundamental groundwork in legged locomotion, one of the least developed areas of robotics, addressing the possibility of building useful legged robots that run and balance. The book describes the study of physical machines that run and balance on just one leg, including analysis, computer simulation, and laboratory experiments. Contrary to expectations, it reveals that control of such machines is not particularly difficult. It describes how the principles of locomotion discovered with one leg can be extended to systems with several legs and reports preliminary experiments with a quadruped machine that runs using these principles. Raibert's work is unique in its emphasis on dynamics and active balance, aspects of the problem that have played a minor role in most previous work. His studies focus on the central issues of balance and dynamic control, while avoiding several problems that have dominated previous research on legged machines. Marc Raibert is Associate Professor of Computer Science and Robotics at Carnegie-Mellon University and on the editorial board of The MIT Press journal, Robotics Research. Legged Robots That Balance is fifteenth in the Artificial Intelligence Series, edited by Patrick Winston and Michael Brady.

Modeling, Identification and Control of Robots This book offers a comprehensive, timely snapshot of current research, technologies and applications of soft robotics. The different chapters, written by international experts across multiple fields of soft robotics, cover innovative systems and technologies for soft robot legged locomotion, soft robot manipulation, underwater soft robotics, biomimetic soft robotic platforms, plant-inspired soft robots, flying soft robots, soft robotics in surgery, as well as methods for their modeling and control. Based on the results of the second edition of the Soft Robotics Week, held on April 25 – 30, 2016, in Livorno, Italy, the book reports on the major research lines and novel technologies presented and discussed during the event.
Dynamic Analysis of Robot Manipulators This book provides a new approach to the control of food transformation processes, emphasizing the advantage of considering the system as a multivariable one, and taking a holistic approach to the decision-making process in the plant, considering not only the technical but also the economic implications of these decisions. In addition, it presents a hierarchical structure for the global control of the plant, and includes appropriate techniques for each of the control layers. The book addresses the challenges of modeling food transformation processes, using both traditional system-identification techniques and, where these prove impractical, models based on expert knowledge and using fuzzy systems. The construction of optimal controllers for each of these types of models is also discussed, as a means to close a feedback loop on the higher-level outputs of the process. Finally, the problem of production planning is covered from two standpoints: the traditional batch-sizing problem, and the planning of production throughout the season. Systematic season-wide production planning is built upon the models constructed for the control of the plant, and incorporates market- and business-specific information. Examples based on the processing of various foodstuffs help to illustrate the text throughout, while the book’s closing chapter presents a case study on advances in the processing of olive oil. Given its scope, the book will primarily be of interest to two groups of readers: food engineering practitioners and students, who are familiar with the characteristics of food processes but have little or no background in control engineering; and control engineering researchers, students and practitioners, whose situation is just the opposite, and who wish to learn more about food engineering and its specific challenges for control. Advances in Industrial Control reports and encourages the transfer of technology in control engineering. The rapid development of control technology has an impact on all areas of the control discipline. The series offers an opportunity for researchers to present an extended exposition of new work in all aspects of industrial control.

Robot Analysis and Control The second edition of this handbook provides a state-of-the-art cover view 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
A Mathematical Introduction to Robotic Manipulation Microcomputer technology and micromechanical design have contributed to recent rapid advances in Robotics. Particular advances have been made in sensor technology that allow robotic systems to gather data and react "intelligently" in flexible manufacturing systems. The analysis and recording of the data are vital to controlling the robot. In order to solve problems in control and planning for a Robotic system it is necessary to meet the growing need for the integration of sensors in to the system. Control in Robotics and Automation addresses this need. This book covers integration planning and control based on prior knowledge and real-time sensory information. A new task-oriented approach to sensing, planning and control introduces an event-based method for system design together with task planning and three dimensional modeling in the execution of remote operations. Typical remote systems are teleoperated and provide work efficiencies that are on the order of ten times slower than what is directly achievable by humans. Consequently, the effective integration of automation into teleoperated remote systems offers potential to improve remote system work efficiency. The authors introduce visually guided control systems and study the role of computer vision in autonomously guiding a robot system. Sensor-Based Planning and Control in an Event-Based Approach Visually Guided Sensing and Control Multiple Sensor Fusion in Planning and Control System Integration and Implementation Practical Applications

Wheeled Mobile Robotics Introduces the basic concepts of robot manipulation—the fundamental kinematic and dynamic analysis of manipulator arms, and the key techniques for trajectory control and compliant motion control. Material is supported with abundant examples adapted from successful industrial practice or advanced research topics. Includes carefully devised conceptual diagrams, discussion of current research topics with references to the latest publications, and end-of-book problem sets. Appendixes. Bibliography.

Modern Robotics The purpose of this monograph is to present computationally efficient algorithms for solving basic problems in robot manipulator dynamics. In particular, the following problems of rigid-link open-chain manipulator dynamics are considered: i) computation of inverse dynamics, ii) computation of forward dynamics, and iii) generation of linearized dynamic models. Computationally efficient solutions of these problems are prerequisites for real time robot applications and simulations. Cartesian tensor analysis is the mathematical foundation on which the above mentioned computational algorithms are based. In particular, it is shown in this monograph that by exploiting the relationships between second order Cartesian tensors and their vector invariants, a number of new tensor vector identities can be obtained. These identities enrich the theory of Cartesian tensors and allow us to manipulate complex Cartesian tensor equations effectively. Moreover, based on these identities the classical vector description for the Newton-Euler equations of rigid body motion are rewritten in an equivalent tensor formulation which is shown to have computational advantages over the classical vector formulation. Thus, based on Cartesian tensor analysis, a conceptually simple, easy to implement and computationally efficient tensor methodology is presented in this monograph for studying classical rigid body dynamics. XII Application of this tensor methodology to the dynamic analysis of rigid-link open-chain robot manipulators is simple and leads to an efficient formulation of the dynamic equations of motion.
Modelling and Control of Robot Manipulators

Based on the successful Modelling and Control of Robot Manipulators by Sciavicco and Siciliano (Springer, 2000), Robotics provides the basic know-how on the foundations of robotics: modelling, planning and control. It has been expanded to include coverage of mobile robots, visual control and motion planning. A variety of problems is raised throughout, and the proper tools to find engineering-oriented solutions are introduced and explained. The text includes coverage of fundamental topics like kinematics, and trajectory planning and related technological aspects including actuators and sensors. To impart practical skill, examples and case studies are carefully worked out and interwoven through the text, with frequent resort to simulation. In addition, end-of-chapter exercises are proposed, and the book is accompanied by an electronic solutions manual containing the MATLAB® code for computer problems; this is available free of charge to those adopting this volume as a textbook for courses.

Robot Dynamics And Control

In the last ten years, a true explosion of investigations into fuzzy modeling and its applications in control, diagnostics, decision making, optimization, pattern recognition, robotics, etc. has been observed. The attraction of fuzzy modeling results from its intelligibility and the high effectiveness of the models obtained. Owing to this the modeling can be applied for the solution of problems which could not be solved till now with any known conventional methods. The book provides the reader with an advanced introduction to the problems of fuzzy modeling and to one of its most important applications: fuzzy control. It is based on the latest and most significant knowledge of the subject and can be used not only by control specialists but also by specialists working in any field requiring plant modeling, process modeling, and systems modeling, e.g. economics, business, medicine, agriculture, and meteorology.

Robot Manipulator Control

This book illustrates basic principles, along with the development of the advanced algorithms, to realize smart robotic systems. It speaks to strategies by which a robot (manipulators, mobile robot, quadrotor) can learn its own kinematics and dynamics from data. In this context, two major issues have been dealt with; namely, stability of the systems and experimental validations. Learning algorithms and techniques as covered in this book easily extend to other robotic systems as well. The book contains MATLAB-based examples and c-codes under robot operating systems (ROS) for experimental validation so that readers can replicate these algorithms in robotics platforms.

Production Planning, Modeling and Control of Food Industry Processes

This book looks at the common problems both human and robotic hands encounter when controlling the large number of joints, actuators and sensors required to efficiently perform motor tasks such as object exploration, manipulation and grasping. The authors adopt an integrated approach to explore the control of the hand based on sensorimotor synergies that can be applied in both neuroscience and robotics. Hand synergies are based on goal-directed, combined muscle and kinematic activation leading to a reduction of the dimensionality of the motor and sensory space, presenting a highly effective solution for the fast and simplified design of artificial systems. Presented in two parts, the first part, Neuroscience, provides the theoretical and experimental foundations to describe the synergistic organization of the human hand. The second part, Robotics, Models and Sensing Tools, exploits the framework of hand synergies to better control and design robotic hands and haptic/sensing systems/tools, using a reduced number of control inputs/sensors, with the goal of pushing their effectiveness close to the natural one. Human and Robot Hands provides a valuable reference for students, researchers and
designers who are interested in the study and design of the artificial hand.

Modeling and Control of Complex Systems As the capability and utility of robots has increased dramatically with new technology, robotic systems can perform tasks that are physically dangerous for humans, repetitive in nature, or require increased accuracy, precision, and sterile conditions to radically minimize human error. The Robotics and Automation Handbook addresses the major aspects of designing, fabricating, and enabling robotic systems and their various applications. It presents kinetic and dynamic methods for analyzing robotic systems, considering factors such as force and torque. From these analyses, the book develops several controls approaches, including servo actuation, hybrid control, and trajectory planning. Design aspects include determining specifications for a robot, determining its configuration, and utilizing sensors and actuators. The featured applications focus on how the specific difficulties are overcome in the development of the robotic system. With the ability to increase human safety and precision in applications ranging from handling hazardous materials and exploring extreme environments to manufacturing and medicine, the uses for robots are growing steadily. The Robotics and Automation Handbook provides a solid foundation for engineers and scientists interested in designing, fabricating, or utilizing robotic systems.

Feedback Control of Dynamic Bipedal Robot Locomotion Probabilistic robotics is a growing area in the subject, concerned with perception and control in the face of uncertainty and giving robots a level of robustness in real-world situations. This book introduces techniques and algorithms in the field.

Control in Robotics and Automation Fundamental and technological topics are blended uniquely and developed clearly in nine chapters with a gradually increasing level of complexity. A wide variety of relevant problems is raised throughout, and the proper tools to find engineering-oriented solutions are introduced and explained, step by step. Fundamental coverage includes: Kinematics; Statics and dynamics of manipulators; Trajectory planning and motion control in free space. Technological aspects include: Actuators; Sensors; Hardware/software control architectures; Industrial robot-control algorithms. Furthermore, established research results involving description of end-effector orientation, closed kinematic chains, kinematic redundancy and singularities, dynamic parameter identification, robust and adaptive control and force/motion control are provided. To provide readers with a homogeneous background, three appendices are included on: Linear algebra; Rigid-body mechanics; Feedback control. To acquire practical skill, more than 50 examples and case studies are carefully worked out and interwoven through the text, with frequent resort to simulation. In addition, more than 80 end-of-chapter exercises are proposed, and the book is accompanied by a solutions manual containing the MATLAB code for computer problems; this is available from the publisher free of charge to those adopting this work as a textbook for courses.

Fuzzy Modeling and Control Availability of a system is a crucial factor for planning and optimization. The concept is more challenging for modern systems such as robots and autonomous systems consisting of a complex configuration of components. As complex systems have become global and essential in today’s society, their reliable design and the determination of their availability have turned into a very important task for managers and engineers. Reliability Models of Complex Systems for Robots and Automation offers different models and approaches for reliability evaluation and optimization of a complex autonomous system. Comprehensive fault tree analysis on the critical components of industrial robots and its integration with the reliability block diagram approach is
designed in order to investigate the robot system reliability. The cost and hazard decision tree are integrated for the first time in an approach to evaluate the reliability of a complex system. Considers a complex production system composing of several autonomous robots Develops binary state reliability evaluation model for a complex system Introduces new concepts of hazard decision tree Proposes fault tree and reliability block diagram for complex robotic systems Develops stochastic process based reliability evaluation and optimization models Today’s competitive world with increasing customer demands for highly reliable products makes reliability engineering a more challenging task. Reliability analysis is one of the main tools to ensure agreed delivery deadlines which in turn maintains certainty in real tangible factors such as customer goodwill and company reputation.

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