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Algorithmic Foundations of Robotics V - Jean-Daniel Boissonnat 2003-09-11

Selected contributions to the Workshop WAFR 2002, held December 15-17, 2002, Nice, France. This fifth biannual Workshop on Algorithmic Foundations of Robotics focuses on algorithmic issues related to robotics and automation. The design and analysis of robot algorithms raises fundamental questions in computer science, computational geometry, mechanical modeling, operations research, control theory, and associated fields. The highly selective program highlights significant new results such as algorithmic models and complexity bounds. The validation of algorithms, design concepts, or techniques is the common thread running through this focused collection.

Intelligent Autonomous Systems 13 - Emanuele Menegatti 2015-09-03

This book describes the latest research accomplishments, innovations, and visions in the field of robotics as presented at the 13th International Conference on Intelligent Autonomous Systems (IAS), held in Padua in July 2014, by leading researchers, engineers, and practitioners from across the world. The contents amply confirm that robots, machines, and systems are rapidly achieving intelligence and autonomy, mastering more and more capabilities such as mobility and manipulation, sensing and perception, reasoning, and decision making. A wide range of research results and applications are covered, and particular attention is paid to the emerging role of autonomous robots and intelligent systems in industrial production, which reflects their maturity and robustness. The contributions have been selected through a rigorous peer-review process and contain many exciting and visionary ideas that will further galvanize the research community, spurring novel research directions. The series of biennial IAS conferences commenced in 1986 and represents a premiere event in robotics.

Creating Precision Robots - Francis Nickols 2018-08-12
Creating Precision Robots: A Project-Based Approach to the Study of Mechatronics and Robotics shows how to use a new "Cardboard Engineering" technique for the handmade construction of three precision microcomputer controlled robots that hit, throw and shoot. Throughout the book, the authors ensure that mathematical concepts and physical principles are not only rigorously described, but also go hand-in-hand with the design and constructional techniques of the working robot. Detailed theory, building plans and instructions, electric circuits and software algorithms are also included, along with the importance of tolerancing and the correct

use of numbers in programming. The book is designed for students and educators who need a detailed description, mathematical analysis, design solutions, engineering drawings, electric circuits and software coding for the design and construction of real bench-top working robots. Provides detailed instructions for the building and construction of specialized robots using line drawings Teaches students how to make real working robots with direct meaning in the engineering academic world Describes and explains the math and physics theory related to hitting, throwing and shooting robots
Programming Robots with ROS - Morgan Quigley 2015-11-16
Chapter 3. Topics; Publishing to a Topic; Checking That Everything Works as Expected; Subscribing to a Topic; Checking That Everything Works as Expected; Latched Topics; Defining Your Own Message Types; Defining a New Message; Using Your New Message; When Should You Make a New Message Type?; Mixing Publishers and Subscribers; Summary; Chapter 4. Services; Defining a Service; Implementing a Service; Checking That Everything Works as Expected; Other Ways of Returning Values from a Service; Using a Service; Checking That Everything Works as Expected; Other Ways to Call Services; Summary.
Introduction to Autonomous Mobile Robots, second edition - Roland Siegwart 2011-02-18

The second edition of a comprehensive introduction to all aspects of mobile robotics, from algorithms to mechanisms. Mobile robots range from the Mars Pathfinder mission's teleoperated Sojourner to the cleaning robots in the Paris Metro. This text offers students and other interested readers an introduction to the fundamentals of mobile robotics, spanning the mechanical, motor, sensory, perceptual, and cognitive layers the field comprises. The text focuses on mobility itself, offering an overview of the mechanisms that allow a mobile robot to move through a real world environment to perform its tasks, including locomotion, sensing, localization, and motion planning. It synthesizes material from such fields as kinematics, control theory, signal analysis, computer vision, information theory, artificial intelligence, and probability theory. The book presents the techniques and technology that enable mobility in a series of interacting modules. Each chapter treats a different aspect of mobility, as the book moves from low-level to high-level details. It covers all aspects of mobile robotics, including software and hardware design considerations, related technologies, and algorithmic techniques. This second edition has been revised and updated throughout, with 130 pages of new material on such topics as locomotion, perception, localization, and planning and navigation. Problem sets

have been added at the end of each chapter. Bringing together all aspects of mobile robotics into one volume, Introduction to Autonomous Mobile Robots can serve as a textbook or a working tool for beginning practitioners. Curriculum developed by Dr. Robert King, Colorado School of Mines, and Dr. James Conrad, University of North Carolina-Charlotte, to accompany the National Instruments LabVIEW Robotics Starter Kit, are available. Included are 13 (6 by Dr. King and 7 by Dr. Conrad) laboratory exercises for using the LabVIEW Robotics Starter Kit to teach mobile robotics concepts.

Principles of Robot Motion : Theory, Algorithms and Implementation - Howie M...[et al] Choset 2005

1. Introduction -- 2. Bug algorithms -- 3. Configuration space -- 4. Potential functions -- 5. Roadmaps -- 6. Cell decompositions -- 7. Sampling-based algorithms -- 8. Kalman filtering -- 9. Bayesian methods -- 10. Robot dynamics -- 11. Trajectory planning -- 12. Nonholonomic and underactuated systems -- A. Mathematical notation -- B. Basic set definitions -- C. Topology and metric spaces -- D. Curve tracing -- E. Representations of orientation -- F. Polyhedral robots in polyhedral worlds -- G. Analysis of algorithms and complexity classes -- H. Graph representation and basic search -- I. Statistics primer -- J. Linear systems and control

The Complexity of Robot Motion Planning - John Canny 1988

The Complexity of Robot Motion Planning makes original contributions both to robotics and to the analysis of algorithms. In this groundbreaking monograph John Canny resolves long-standing problems concerning the complexity of motion planning and, for the central problem of finding a collision free path for a jointed robot in the presence of obstacles, obtains exponential speedups over existing algorithms by applying high-powered new mathematical techniques. Canny's new algorithm for this "generalized movers' problem," the most-studied and basic robot motion planning problem, has a single exponential running time, and is polynomial for any given robot. The algorithm has an optimal running time exponent and is based on the notion of roadmaps - one-dimensional subsets of the robot's configuration space. In deriving the single exponential bound, Canny introduces and reveals the power of two tools that have not been previously used in geometrical algorithms: the generalized (multivariable) resultant for a system of polynomials and Whitney's notion of stratified sets. He has also developed a novel representation of object orientation based on unnormalized quaternions which reduces the complexity of the algorithms and enhances their practical applicability. After dealing with the movers' problem, the book next attacks and derives several lower bounds on extensions of the problem: finding the shortest path among polyhedral obstacles, planning with velocity limits, and compliant motion planning with uncertainty. It introduces a clever technique, "path encoding," that allows a proof of NP-hardness for the first two problems and then shows that the general form of compliant motion planning, a problem that is the focus of a great deal of recent work in robotics, is non-deterministic exponential time hard. Canny proves this result using a highly original construction. John Canny received his doctorate from MIT and is an assistant professor in the Computer Science Division at the University of California, Berkeley. The Complexity of Robot Motion Planning is the winner of the 1987 ACM Doctoral Dissertation Award.

Planning Algorithms - Steven M. LaValle 2006-05-29

Planning algorithms are impacting technical disciplines and industries around the world, including robotics, computer-aided design, manufacturing, computer graphics, aerospace applications, drug design, and protein folding. This coherent and comprehensive book unifies material from several sources, including robotics, control theory, artificial intelligence, and algorithms.

The treatment is centered on robot motion planning, but integrates material on planning in discrete spaces. A major part of the book is devoted to planning under uncertainty, including decision theory, Markov decision processes, and information spaces, which are the 'configuration spaces' of all sensor-based planning problems. The last part of the book delves into planning under differential constraints that arise when automating the motions of virtually any mechanical system. This text and reference is intended for students, engineers, and researchers in robotics, artificial intelligence, and control theory as well as computer graphics, algorithms, and computational biology.

Principles of Robot Motion - Howie Choset 2005-05-20

A text that makes the mathematical underpinnings of robot motion accessible and relates low-level details of implementation to high-level algorithmic concepts. Robot motion planning has become a major focus of robotics. Research findings can be applied not only to robotics but to planning routes on circuit boards, directing digital actors in computer graphics, robot-assisted surgery and medicine, and in novel areas such as drug design and protein folding. This text reflects the great advances that have taken place in the last ten years, including sensor-based planning, probabilistic planning, localization and mapping, and motion planning for dynamic and nonholonomic systems. Its presentation makes the mathematical underpinnings of robot motion accessible to students of computer science and engineering, relating low-level implementation details to high-level algorithmic concepts.

Robot Ecology - Magnus Egerstedt 2021-12-28

A revolutionary new framework that draws on insights from ecology for the design and analysis of long-duration robots. Robots are increasingly leaving the confines of laboratories, warehouses, and manufacturing facilities, venturing into agriculture and other settings where they must operate in uncertain conditions over long timescales. This multidisciplinary book draws on the principles of ecology to show how robots can take full advantage of the environments they inhabit, including as sources of energy. Magnus Egerstedt introduces a revolutionary new design paradigm—robot ecology—that makes it possible to achieve long-duration autonomy while avoiding catastrophic failures. Central to ecology is the idea that the richness of an organism's behavior is a function of the environmental constraints imposed by its habitat. Moving beyond traditional strategies that focus on optimal policies for making robots achieve targeted tasks, Egerstedt explores how to use survivability constraints to produce both effective and provably safe robot behaviors. He blends discussions of ecological principles with the development of control barrier functions as a formal approach to constraint-based control design, and provides an in-depth look at the design of the SlothBot, a slow and energy-efficient robot used for environmental monitoring and conservation. Visionary in scope, Robot Ecology presents a comprehensive and unified methodology for designing robots that can function over long durations in diverse natural environments.

Nonholonomic Motion Planning - Zexiang Li 1993

Nonholonomic Motion Planning grew out of the workshop that took place at the 1991 IEEE International Conference on Robotics and Automation. It consists of contributed chapters representing new developments in this area. Contributors to the book include robotics engineers, nonlinear control experts, differential geometers and applied mathematicians. Nonholonomic Motion Planning is arranged into three chapter groups: Controllability: one of the key mathematical tools needed to study nonholonomic motion. Motion Planning for Mobile Robots: in this section the papers are focused on problems with nonholonomic velocity constraints as well

as constraints on the generalized coordinates. Falling Cats, Space Robots and Gauge Theory: there are numerous connections to be made between symplectic geometry techniques for the study of holonomies in mechanics, gauge theory and control. In this section these connections are discussed using the backdrop of examples drawn from space robots and falling cats reorienting themselves. Nonholonomic Motion Planning can be used either as a reference for researchers working in the areas of robotics, nonlinear control and differential geometry, or as a textbook for a graduate level robotics or nonlinear control course.

Motion Planning for Humanoid Robots - Kensuke Harada 2010-08-12

Research on humanoid robots has been mostly with the aim of developing robots that can replace humans in the performance of certain tasks. Motion planning for these robots can be quite difficult, due to their complex kinematics, dynamics and environment. It is consequently one of the key research topics in humanoid robotics research and the last few years have witnessed considerable progress in the field. Motion Planning for Humanoid Robots surveys the remarkable recent advancement in both the theoretical and the practical aspects of humanoid motion planning. Various motion planning frameworks are presented in Motion Planning for Humanoid Robots, including one for skill coordination and learning, and one for manipulating and grasping tasks. The problem of planning sequences of contacts that support acyclic motion in a highly constrained environment is addressed and a motion planner that enables a humanoid robot to push an object to a desired location on a cluttered table is described. The main areas of interest include: • whole body motion planning, • task planning, • biped gait planning, and • sensor feedback for motion planning. Torque-level control of multi-contact behavior, autonomous manipulation of moving obstacles, and movement control and planning architecture are also covered. Motion Planning for Humanoid Robots will help readers to understand the current research on humanoid motion planning. It is written for industrial engineers, advanced undergraduate and postgraduate students.

Probabilistic Robotics - Sebastian Thrun 2005-08-19

An introduction to the techniques and algorithms of the newest field in robotics. Probabilistic robotics is a new and growing area in robotics, concerned with perception and control in the face of uncertainty. Building on the field of mathematical statistics, probabilistic robotics endows robots with a new level of robustness in real-world situations. This book introduces the reader to a wealth of techniques and algorithms in the field. All algorithms are based on a single overarching mathematical foundation. Each chapter provides example implementations in pseudo code, detailed mathematical derivations, discussions from a practitioner's perspective, and extensive lists of exercises and class projects. The book's Web site, www.probablistic-robotics.org, has additional material. The book is relevant for anyone involved in robotic software development and scientific research. It will also be of interest to applied statisticians and engineers dealing with real-world sensor data.

Principles of Robot Motion - Howie Choset 2005-05-20

A text that makes the mathematical underpinnings of robot motion accessible and relates low-level details of implementation to high-level algorithmic concepts. Robot motion planning has become a major focus of robotics. Research findings can be applied not only to robotics but to planning routes on circuit boards, directing digital actors in computer graphics, robot-assisted surgery and medicine, and in novel areas such as drug design and protein folding. This text reflects the great advances that have taken place in the last ten years, including sensor-based planning, probabalistic planning,

localization and mapping, and motion planning for dynamic and nonholonomic systems. Its presentation makes the mathematical underpinnings of robot motion accessible to students of computer science and engineering, relating low-level implementation details to high-level algorithmic concepts.

Mobile Robotics - Alonzo Kelly 2013-11-11

Introduction -- Math fundamentals -- Numerical methods -- Dynamics -- Optimal estimation -- State estimation -- Control -- Perception -- Localization and mapping -- Motion planning

Motion Planning in Dynamic Environments - Kikuo Fujimura 2011-12-14

Computer Science Workbench is a monograph series which will provide you with an in-depth working knowledge of current developments in computer technology. Every volume in this series will deal with a topic of importance in computer science and elaborate on how you yourself can build systems related to the main theme. You will be able to develop a variety of systems, including computer software tools, computer graphics, computer animation, database management systems, and computer-aided design and manufacturing systems. Computer Science Workbench represents an important new contribution in the field of practical computer technology. TOSIYASU L. KUNII To my parents Kenjiro and Nori Fujimura Preface Motion planning is an area in robotics that has received much attention recently. Much of the past research focuses on static environments - various methods have been developed and their characteristics have been well investigated. Although it is essential for autonomous intelligent robots to be able to navigate within dynamic worlds, the problem of motion planning in dynamic domains is relatively little understood compared with static problems.

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/>
Grid and Distributed Computing - Tai-hoon Kim 2011-11-29
This book constitutes the refereed proceedings of the International Conference, GDC 2011, held as Part of the Future Generation Information Technology Conference, FGIT 2011, Jeju Island, Korea, in December 2011. The papers presented were carefully reviewed and selected from numerous submissions and focus on the various aspects of grid and distributed computing.

Algorithmic Foundations of Robotics - Ken Goldberg 1995-05-10

Algorithms, the heart of robotics, form the connection between data collected by sensors and the robot's activities. They also serve as a medium to describe the foundations and principles of robotics. Paper Topics Include: Motion Planning * Navigation * Manipulation * Grasping * Assembly * Controllability * Recognizability * Learning and Distributed Control * Task-Specific Manipulator Design * Simulation of Linkages and Collisions * Completeness and Complexity Measures * Computational Algebra and Geometry

The Robotics Primer - Maja J. Mataric 2007-08-17

A broadly accessible introduction to robotics that spans the most basic concepts and the most novel applications; for students, teachers, and hobbyists. The Robotics Primer offers a broadly accessible introduction to robotics for students at pre-university and university levels, robot hobbyists, and anyone interested in this burgeoning field. The text takes the reader from the most basic concepts (including perception and movement) to the most novel and sophisticated applications and topics (humanoids, shape-shifting robots, space robotics), with an emphasis on what it takes to create autonomous intelligent robot behavior. The core concepts of robotics are carried through from fundamental definitions to more complex explanations, all presented in an engaging, conversational style that will appeal to readers of different backgrounds. The Robotics Primer covers such topics as the definition of robotics, the history of robotics ("Where do Robots Come From?"), robot components, locomotion, manipulation, sensors, control, control architectures, representation, behavior ("Making Your Robot Behave"), navigation, group robotics, learning, and the future of robotics (and its ethical implications). To encourage further engagement, experimentation, and course and lesson design, The Robotics Primer is accompanied by a free robot programming exercise workbook that implements many of the ideas on the book on iRobot platforms. The Robotics Primer is unique as a principled, pedagogical treatment of the topic that is accessible to a broad audience; the only prerequisites are curiosity and attention. It can be used effectively in an educational setting or more informally for self-instruction. The Robotics Primer is a springboard for readers of all backgrounds—including students taking robotics as an elective outside the major, graduate students preparing to specialize in robotics, and K-12 teachers who bring robotics into their classrooms.

Learning ROS for Robotics Programming - Enrique Fernández 2015-08-18

Your one-stop guide to the Robot Operating System About This Book Model your robot on a virtual world and learn how to simulate it Create, visualize, and process Point Cloud information Easy-to-follow, practical tutorials to program your own robots Who This Book Is For If you are a robotic enthusiast who wants to learn how to build and program your own robots in an easy-to-develop, maintainable, and shareable way, this book is for you. In order to make the most of the book, you should have a C++ programming background, knowledge of GNU/Linux systems, and general skill in computer science. No previous background on ROS is required, as this book takes you from the ground up. It is also advisable to

have some knowledge of version control systems, such as svn or git, which are often used by the community to share code. What You Will Learn Install a complete ROS Hydro system Create ROS packages and metapackages, using and debugging them in real time Build, handle, and debug ROS nodes Design your 3D robot model and simulate it in a virtual environment within Gazebo Give your robots the power of sight using cameras and calibrate and perform computer vision tasks with them Generate and adapt the navigation stack to work with your robot Integrate different sensors like Range Laser, Arduino, and Kinect with your robot Visualize and process Point Cloud information from different sensors Control and plan motion of robotic arms with multiple joints using MoveIt! In Detail If you have ever tried building a robot, then you know how cumbersome programming everything from scratch can be. This is where ROS comes into the picture. It is a collection of tools, libraries, and conventions that simplifies the robot building process. What's more, ROS encourages collaborative robotics software development, allowing you to connect with experts in various fields to collaborate and build upon each other's work. Packed full of examples, this book will help you understand the ROS framework to help you build your own robot applications in a simulated environment and share your knowledge with the large community supporting ROS. Starting at an introductory level, this book is a comprehensive guide to the fascinating world of robotics, covering sensor integration, modeling, simulation, computer vision, navigation algorithms, and more. You will then go on to explore concepts like topics, messages, and nodes. Next, you will learn how to make your robot see with HD cameras, or navigate obstacles with range sensors. Furthermore, thanks to the contributions of the vast ROS community, your robot will be able to navigate autonomously, and even recognize and interact with you in a matter of minutes. What's new in this updated edition? First and foremost, we are going to work with ROS Hydro this time around. You will learn how to create, visualize, and process Point Cloud information from different sensors. This edition will also show you how to control and plan motion of robotic arms with multiple joints using MoveIt! By the end of this book, you will have all the background you need to build your own robot and get started with ROS. Style and approach This book is an easy-to-follow guide that will help you find your way through the ROS framework. This book is packed with hands-on examples that will help you program your robot and give you complete solutions using ROS open source libraries and tools.

Robot Motion Planning - Jean-Claude Latombe 2012-12-06

One of the ultimate goals in Robotics is to create autonomous robots. Such robots will accept high-level descriptions of tasks and will execute them without further human intervention. The input descriptions will specify what the user wants done rather than how to do it. The robots will be any kind of versatile mechanical device equipped with actuators and sensors under the control of a computing system. Making progress toward autonomous robots is of major practical interest in a wide variety of application domains including manufacturing, construction, waste management, space exploration, undersea work, assistance for the disabled, and medical surgery. It is also of great technical interest, especially for Computer Science, because it raises challenging and rich computational issues from which new concepts of broad usefulness are likely to emerge. Developing the technologies necessary for autonomous robots is a formidable undertaking with deep interweaved ramifications in automated reasoning, perception and control. It raises many important problems. One of them - motion planning - is the central theme of this book. It can be loosely stated as follows: How can a robot decide what motions to perform in order

to achieve goal arrangements of physical objects? This capability is eminently necessary since, by definition, a robot accomplishes tasks by moving in the real world. The minimum one would expect from an autonomous robot is the ability to plan its own motions.

Algorithmic Foundations of Robotics IX - David Hsu
2010-11-18

Robotics is at the cusp of dramatic transformation. Increasingly complex robots with unprecedented autonomy are finding new applications, from medical surgery, to construction, to home services. Against this background, the algorithmic foundations of robotics are becoming more crucial than ever, in order to build robots that are fast, safe, reliable, and adaptive. Algorithms enable robots to perceive, plan, control, and learn. The design and analysis of robot algorithms raise new fundamental questions that span computer science, electrical engineering, mechanical engineering, and mathematics. These algorithms are also finding applications beyond robotics, for example, in modeling molecular motion and creating digital characters for video games and architectural simulation. The Workshop on Algorithmic Foundations of Robotics (WAFR) is a highly selective meeting of leading researchers in the field of robot algorithms. Since its creation in 1994, it has published some of the field's most important and lasting contributions. This book contains the proceedings of the 9th WAFR, held on December 13-15, 2010 at the National University of Singapore. The 24 papers included in this book span a wide variety of topics from new theoretical insights to novel applications.

Algorithmic Foundations of Robotics VIII - Gregory S. Chirikjian 2010-02-04

This book contains selected contributions to WAFR, the highly-competitive meeting on the algorithmic foundations of robotics. They address the unique combination of questions that the design and analysis of robot algorithms inspires.

Elements of Robotics - Mordechai Ben-Ari 2017-10-25

This open access book bridges the gap between playing with robots in school and studying robotics at the upper undergraduate and graduate levels to prepare for careers in industry and research. Robotic algorithms are presented formally, but using only mathematics known by high-school and first-year college students, such as calculus, matrices and probability. Concepts and algorithms are explained through detailed diagrams and calculations. *Elements of Robotics* presents an overview of different types of robots and the components used to build robots, but focuses on robotic algorithms: simple algorithms like odometry and feedback control, as well as algorithms for advanced topics like localization, mapping, image processing, machine learning and swarm robotics. These algorithms are demonstrated in simplified contexts that enable detailed computations to be performed and feasible activities to be posed. Students who study these simplified demonstrations will be well prepared for advanced study of robotics. The algorithms are presented at a relatively abstract level, not tied to any specific robot. Instead a generic robot is defined that uses elements common to most educational robots: differential drive with two motors, proximity sensors and some method of displaying output to the user. The theory is supplemented with over 100 activities, most of which can be successfully implemented using inexpensive educational robots. Activities that require more computation can be programmed on a computer. Archives are available with suggested implementations for the Thymio robot and standalone programs in Python.

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.

Rehabilitation Robotics - Roberto Colombo 2018-03-08

Rehabilitation Robotics gives an introduction and overview of all areas of rehabilitation robotics, perfect for anyone new to the field. It also summarizes available robot technologies and their application to different pathologies for skilled researchers and clinicians. The editors have been involved in the development and application of robotic devices for neurorehabilitation for more than 15 years. This experience using several commercial devices for robotic rehabilitation has enabled them to develop the know-how and expertise necessary to guide those seeking comprehensive understanding of this topic. Each chapter is written by an expert in the respective field, pulling in perspectives from both engineers and clinicians to present a multi-disciplinary view. The book targets the implementation of efficient robot strategies to facilitate the re-acquisition of motor skills. This technology incorporates the outcomes of behavioral studies on motor learning and its neural correlates into the design, implementation and validation of robot agents that behave as 'optimal' trainers, efficiently exploiting the structure and plasticity of the human sensorimotor systems. In this context, human-robot interaction plays a paramount role, at both the physical and cognitive level, toward achieving a symbiotic interaction where the human body and the robot can benefit from each other's dynamics. Provides a comprehensive review of recent developments in the area of rehabilitation robotics. Includes information on both therapeutic and assistive robots. Focuses on the state-of-the-art and representative advancements in the design, control, analysis, implementation and validation of rehabilitation robotic systems.

Computational Principles of Mobile Robotics - Gregory Dudek 2010-07-26

This textbook for advanced undergraduates and graduate students emphasizes algorithms for a range of strategies for locomotion, sensing, and reasoning. It concentrates on wheeled and legged mobile robots but discusses a variety of other propulsion systems. This edition includes advances in robotics and intelligent machines over the ten years prior to publication, including significant coverage of SLAM (simultaneous localization and mapping) and multi-robot systems. It includes additional mathematical background and an extensive list of sample problems. Various mathematical techniques that were assumed in the first edition are now briefly introduced in appendices at the end of the text to make the book more self-contained. Researchers as well as students in the field of mobile robotics will appreciate this comprehensive treatment of state-of-the-art methods and key technologies.

Advanced Concepts for Intelligent Vision Systems - Sebastiano Battiato 2015-10-07

This book constitutes the thoroughly refereed proceedings of the 16th International Conference on Advanced Concepts for Intelligent Vision Systems, ACIVS 2015, held Catania, Italy, in October 2015. The 76 revised full papers were carefully selected from 129 submissions. AcivS 2015 is a conference focusing on techniques for building adaptive, intelligent, safe and secure imaging systems. The focus of the conference is on following topic: low-level Image processing, video processing and camera networks, motion and tracking, security, forensics and biometrics, depth and 3D, image quality improvement and assessment, classification and recognition, multidimensional signal processing, multimedia compression, retrieval, and navigation.

Learning for Adaptive and Reactive Robot Control - Aude Billard 2022-02-08

Methods by which robots can learn control laws that enable real-time reactivity using dynamical systems; with applications and exercises. This book presents a wealth of machine learning techniques to make the

control of robots more flexible and safe when interacting with humans. It introduces a set of control laws that enable reactivity using dynamical systems, a widely used method for solving motion-planning problems in robotics. These control approaches can replan in milliseconds to adapt to new environmental constraints and offer safe and compliant control of forces in contact. The techniques offer theoretical advantages, including convergence to a goal, non-penetration of obstacles, and passivity. The coverage of learning begins with low-level control parameters and progresses to higher-level competencies composed of combinations of skills. Learning for Adaptive and Reactive Robot Control is designed for graduate-level courses in robotics, with chapters that proceed from fundamentals to more advanced content. Techniques covered include learning from demonstration, optimization, and reinforcement learning, and using dynamical systems in learning control laws, trajectory planning, and methods for compliant and force control. Features for teaching in each chapter:

- applications, which range from arm manipulators to whole-body control of humanoid robots;
- pencil-and-paper and programming exercises;
- lecture videos, slides, and MATLAB code examples available on the author's website.
- an eTextbook platform website offering protected material[EPS2] for instructors including solutions.

Introduction to Autonomous Robots - Nikolaus Correll
2016-04-25

This book introduces concepts in mobile, autonomous robotics to 3rd-4th year students in Computer Science or a related discipline. The book covers principles of robot motion, forward and inverse kinematics of robotic arms and simple wheeled platforms, perception, error propagation, localization and simultaneous localization and mapping. The cover picture shows a wind-up toy that is smart enough to not fall off a table just using intelligent mechanism design and illustrate the importance of the mechanism in designing intelligent, autonomous systems. This book is open source, open to contributions, and released under a creative common license.

Principles of Robot Motion - Howie Choset 2005

A text that makes the mathematical underpinnings of robot motion accessible and relates low-level details of implementation to high-level algorithmic concepts.

Algorithmic Foundations of Robotics X - Emilio Frazzoli
2013-02-14

Algorithms are a fundamental component of robotic systems. Robot algorithms process inputs from sensors that provide noisy and partial data, build geometric and physical models of the world, plan high-and low-level actions at different time horizons, and execute these actions on actuators with limited precision. The design and analysis of robot algorithms raise a unique combination of questions from many elds, including control theory, computational geometry and topology, geometrical and physical modeling, reasoning under uncertainty, probabilistic algorithms, game theory, and theoretical computer science. The Workshop on Algorithmic Foundations of Robotics (WAFR) is a single-track meeting of leading researchers in the eld of robot algorithms. Since its inception in 1994, WAFR has been held every other year, and has provided one of the premiere venues for the publication of some of the eld's most important and lasting contributions. This books contains the proceedings of the tenth WAFR, held on June 13{15 2012 at the Massachusetts Institute of Technology. The 37 papers included in this book cover a broad range of topics, from fundamental theoretical issues in robot motion planning, control, and perception, to novel applications.

A Mathematical Introduction to Robotic Manipulation - Richard M. Murray 2017-12-14

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.

Principles Of Robot Motion: Theory Algorithms And Implementations - Choset Et Al. 2005

Mechanics of Robotic Manipulation - Matthew T. Mason
2001-06-08

The science and engineering of robotic manipulation. "Manipulation" refers to a variety of physical changes made to the world around us. Mechanics of Robotic Manipulation addresses one form of robotic manipulation, moving objects, and the various processes involved—grasping, carrying, pushing, dropping, throwing, and so on. Unlike most books on the subject, it focuses on manipulation rather than manipulators. This attention to processes rather than devices allows a more fundamental approach, leading to results that apply to a broad range of devices, not just robotic arms. The book draws both on classical mechanics and on classical planning, which introduces the element of imperfect information. The book does not propose a specific solution to the problem of manipulation, but rather outlines a path of inquiry.

Embedded Robotics - Thomas Bräunl 2008-09-20

This book presents a unique examination of mobile robots and embedded systems, from introductory to intermediate level. It is structured in three parts, dealing with Embedded Systems (hardware and software design, actuators, sensors, PID control, multitasking), Mobile Robot Design (driving, balancing, walking, and flying robots), and Mobile Robot Applications (mapping, robot soccer, genetic algorithms, neural networks, behavior-based systems, and simulation). The book is written as a text for courses in computer science, computer engineering, IT, electronic engineering, and mechatronics, as well as a guide for robot hobbyists and researchers.

Autonomous Robots - George A. Bekey 2005-05-20

An introduction to the science and practice of autonomous robots that reviews over 300 current systems and examines the underlying technology. Autonomous robots are intelligent machines capable of performing tasks in the world by themselves, without explicit human control. Examples range from autonomous helicopters to Roomba, the robot vacuum cleaner. In this book, George Bekey offers an introduction to the science and practice of autonomous robots that can be used both in the classroom and as a reference for industry professionals. He surveys the hardware implementations of more than 300 current systems, reviews some of their application areas, and examines the underlying technology, including control, architectures, learning, manipulation, grasping, navigation, and mapping. Living systems can be considered the prototypes of autonomous systems, and Bekey explores the biological inspiration that forms the basis of many recent developments in robotics. He also discusses robot control issues and the design of control architectures. After an overview of the field that introduces some of its fundamental concepts, the book

presents background material on hardware, control (from both biological and engineering perspectives), software architecture, and robot intelligence. It then examines a broad range of implementations and applications, including locomotion (wheeled, legged, flying, swimming, and crawling robots), manipulation (both arms and hands), localization, navigation, and mapping. The many case studies and specific applications include robots built for research, industry, and the military, among them underwater robotic vehicles, walking machines with four, six, and eight legs, and the famous humanoid robots Cog, Kismet, ASIMO, and QRIO. The book concludes with reflections on the future of robotics—the potential benefits as well as the possible dangers that may arise from large numbers of increasingly intelligent and autonomous robots.

Practical Robotics in C++ - Lloyd Brombach 2021-01-29

An easy-to-follow guide that will help you build robots

using with ease
KEY FEATURES ● Simplified coverage on fundamentals of building a robot platform. ● Learn to program Raspberry Pi for interacting with hardware. ● Cutting-edge coverage on autonomous motion, mapping, and path planning algorithms for advanced robotics.

DESCRIPTION Practical Robotics in C++ teaches the complete spectrum of Robotics, right from the setting up a computer for a robot controller to putting power to the wheel motors. The book brings you the workshop knowledge of the electronics, hardware, and software for building a mobile robot platform. You will learn how to use sensors to detect obstacles, how to train your robot to build itself a map and plan an obstacle-avoiding path, and how to structure your code for modularity and interchangeability with other robot projects. Throughout the book, you can experience the demonstrations of complete coding of robotics with the use of simple and clear C++ programming. In addition, you will explore how to leverage the Raspberry Pi GPIO hardware interface pins and existing libraries to make an incredibly capable machine on the most affordable computer platform ever. **WHAT YOU WILL LEARN** ● Write code for the motor

drive controller. ● Build a Map from Lidar Data. ● Write and implement your own autonomous path-planning algorithm. ● Write code to send path waypoints to the motor drive controller autonomously. ● Get to know more about robot mapping and navigation. **WHO THIS BOOK IS FOR** This book is most suitable for C++ programmers who have keen interest in robotics and hardware programming. All you need is just a good understanding of C++ programming to get the most out of this book. **TABLE OF CONTENTS** 1. Choose and Set Up a Robot Computer 2. GPIO Hardware Interface Pins Overview and Use 3. The Robot Platform 4. Types of Robot Motors and Motor Control 5. Communication with Sensors and other Devices 6. Additional Helpful Hardware 7. Adding the Computer to Control your Robot 8. Robot Control Strategy 9. Coordinating the Parts 10. Maps for Robot Navigation 11. Robot Tracking and Localization 12. Autonomous Motion 13. Autonomous Path Planning 14. Wheel Encoders for Odometry 15. Ultrasonic Range Detectors 16. IMUs: Accelerometers, Gyroscopes, and Magnetometers 17. GPS and External Beacon Systems 18. LIDAR Devices and Data 19. Real Vision with Cameras 20. Sensor Fusion 21. Building and Programming an Autonomous Robot

Robot Motion Planning and Control - Jean-Paul Laumond 2014-03-12

How can a robot decide what motions to perform in order to achieve tasks in the physical world? Robot motion planning encompasses several different disciplines, most notably robotics, computer science, control theory and mathematics. This volume presents an interdisciplinary account of recent developments in the field. Topics covered include: combining geometric algorithms and control techniques to account for the nonholonomic constraints of most mobile robots; the mathematical machinery necessary for understanding nonholonomic systems; applying optimal techniques to compute optimal paths; feedback control for nonholonomic mobile robots; probabilistic algorithms and new motion planning approaches; and a survey of recent techniques for dealing with collision detection.