

## An Introduction To Robotics And Java Programming

This book provides a general introduction to robot technology with an emphasis on robot mechanisms and kinematics. It is conceived as a reference book for students in the field of robotics.

The relationship between technological and pedagogical innovation has recently created a new field of research at the crossroads between Psychology, Educational Sciences and Artificial Intelligence: Educational Robotics (ER). Through analysis of the achievable educational goals based on the technological status and specific learning modes of different types of robots, it is possible to define three pedagogical paradigms: learning robotics, learning with robotics, and learning by robotics. In this book we address these three paradigms through three themes: human representations of robots, the acceptance and trust shown when interacting with a humanoid, and learning favored by the development and programming of robots in an educational context. These themes allow the authors to fully explore, define and delimit this novel field of research for future application in educational and social contexts. Finally, the book discusses contributions and limitations which have emerged from different methodologies of research, potential educational applications, and concepts of human–robot interaction for the development of the above paradigms.

Written from a manufacturing perspective, this book takes readers step-by-step through the theory and application techniques of designing and building a robot-driven automated work cell—from selection of hardware through programming of the devices to economic justification of the project. All-inclusive in approach, it covers not only robot automation, but all the other technology needed in the automated work cell to integrate the robot with the work environment and with the enterprise data base. Robot and other required automation hardware and software are introduced in the order in which they would be selected in an actual industrial automation design. Includes system troubleshooting guides, case studies problems, and worked example problems. Robot Classification. Automated Work Cells and CIM Systems. End-of-Arm Tooling. Automation Sensors. Work-Cell Support Systems. Robot and System Integration. Work-Cell Programming. Justification and Applications of Work Cells. Safety. Human Interface: Operator Training, Acceptance, and Problems. For those interested in Robotics and Manufacturing Automation or Production Design.

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>

Learning Robotics, with Robotics, by Robotics

An Introduction to Robotics Analysis, Systems, Applications  
Supercompilers for Parallel and Vector Computers  
An Introduction

Niku offers comprehensive, yet concise coverage of robotics that will appeal to engineers. Robotic applications are drawn from a wide variety of fields. Emphasis is placed on design along with analysis and modeling. Kinematics and dynamics are covered extensively in an accessible style. Vision systems are discussed in detail, which is a cutting-edge area in robotics. Engineers will also find a running design project that reinforces the concepts by having them apply what they 've learned.

This book is focused on geometrical models of robot mechanisms. Rotation and orientation of an object are described by Rodrigues's formula, rotation matrix and quaternions. Pose and displacement of an object are mathematically dealt with homogenous transformation matrices. The geometrical robot model is based on Denavit Hartenberg parameters. Direct and inverse model of six degrees of freedom anthropomorphic industrial robots are also presented.

Introduction to RoboticsMechanics and ControlPearson Educación

A comprehensive survey of artificial intelligence algorithms and programming organization for robot systems, combining theoretical rigor and practical applications. This textbook offers a comprehensive survey of artificial intelligence (AI) algorithms and programming organization for robot systems. Readers who master the topics covered will be able to design and evaluate an artificially intelligent robot for applications involving sensing, acting, planning, and learning. A background in AI is not required; the book introduces key AI topics from all AI subdisciplines throughout the book and explains how they contribute to autonomous capabilities. This second edition is a major expansion and reorganization of the first edition, reflecting the dramatic advances made in AI over the past fifteen years. An introductory overview provides a framework for thinking about AI for robotics, distinguishing between the fundamentally different design paradigms of automation and autonomy. The book then discusses the reactive functionality of sensing and acting in AI robotics; introduces the deliberative functions most often associated with intelligence and the capability of autonomous initiative; surveys multi-robot systems and (in a new chapter) human-robot interaction; and offers a "metaview" of how to design and evaluate autonomous systems and the ethical considerations in doing so. New material covers locomotion, simultaneous localization and mapping, human-robot interaction, machine learning, and ethics. Each chapter includes exercises, and many chapters provide case studies. Endnotes point to additional reading, highlight advanced topics, and offer robot trivia.

Foundations of Robotics

Behavior Trees in Robotics and AI

An Introduction to Robotics

An Introduction to Industrial Robots, Teleoperators and Robot Vehicles

Introduction To Robotics: Analysis,Control,Applications, 2nd Edition

***This book provides an introductory text for students coming new to the field of robotics, and a survey of the state of the art for professional practitioners. Some of the outstanding features of this book include: . A unique approach which ties the multi-disciplinary components of robotics into a unified text. . Broad and in-depth coverage of all the major topics from the mechanics of movement to modelling and programming. . Rigorous mathematical treatment of mature topics combined with an algorithmic approach to newer areas of research. . Practical examples taken from a wide range of fields including computer science electronic engineering, mechanical engineering and production engineering. . Step-by-step development of problems and many worked examples.***

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*Robotic applications are drawn from a wide variety of fields. Emphasis is placed on design along with analysis and modeling. Kinematics and dynamics are covered extensively in an accessible style. Vision systems are discussed in detail, which is a cutting-edge area in robotics. Engineers will also find a running design project that reinforces the concepts by having them apply what they've learned.*

*Robotics is a key technology in the modern world. Robots are a well-established part of manufacturing and warehouse automation, assembling cars or washing machines, and, for example, moving goods to and from storage racks for Internet mail order. More recently robots have taken their first steps into homes and hospitals, and seen spectacular success in planetary exploration. Yet, despite these successes, robots have failed to live up to the predictions of the 1950s and 60s, when it was widely thought - by scientists and engineers as well as the public - that by turn of the 21st century we would have intelligent robots as butlers, companions, or co-workers. This Very Short Introduction explains how it is that robotics can be both a success story and a disappointment, how robots can be both ordinary and remarkable, and looks at their important developments in science and their applications to everyday life. ABOUT THE SERIES: The Very Short Introductions series from Oxford University Press contains hundreds of titles in almost every subject area. These pocket-sized books are the perfect way to get ahead in a new subject quickly. Our expert authors combine facts, analysis, perspective, new ideas, and enthusiasm to make interesting and challenging topics highly readable.*

*Based on the author's wide-ranging experience as a robot user, supplier and consultant, Implementation of Robot Systems will enable you to approach the use of robots in your plant or facility armed with the right knowledge base and awareness of critical factors to take into account. This book starts with the basics of typical applications and robot capabilities before covering all stages of successful robot integration. Potential problems and pitfalls are flagged and worked through so that you can learn from others' mistakes and plan proactively with possible issues in mind. Taking in content from the author's graduate level teaching of automation and robotics for engineering in business and his consultancy as part of a UK Government program to help companies advance their technologies and practices in the area, Implementation of Robot Systems blends technical information with critical financial and business considerations to help you stay ahead of the competition. Includes case studies of typical robot capabilities and use across a range of industries, with real-world installation examples and problems encountered Provides step-by-step coverage of the various stages required to achieve successful implementation, including system design, financial justification, working with suppliers and project management Offers no-nonsense advice on the pitfalls and issues to anticipate, along with guidance on how to avoid or resolve them for cost and time-effective solutions*

*A Layman's Introduction to Robotics*

*Fundamental Algorithms in MATLAB*

*Educational Robotics*

*Robotics: A Very Short Introduction*

*Analysis, Control, Applications*

Must-read play looks to a future in which all workers are automatons. They revolt when they acquire souls (i.e., when they gain the ability to hate) and the resulting catastrophe make for a powerful theatrical experience.

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.

This book is one of four books that teach the fundamentals of embedded systems as applied to the Texas Instruments MSP432 microcontroller. An embedded system is a system that performs a specific task and has a computer embedded inside. A system is comprised of components and interfaces connected together for a common purpose. This book teaches the fundamentals of microcontroller interfacing and real-time programming in the context of robotics. There is a chapter on assembly language to expose important concepts of the microcontroller architecture. However, most of the software development occurs in C. This book can be used with Texas Instruments Robot Systems Learning Kit (TI-RSLK). This book provides an introduction to robots that could be used at the college level with little or no prerequisites. Specific topics include microcontrollers, fixed-point numbers, the design of software in C, elementary data structures, programming input/output including interrupts, analog to digital conversion, digital to analog conversion, power, sensor interfacing, motor interfacing, an introduction to digital signal processing, control systems, and communication systems. The book shows how you deploy both Bluetooth Low Energy, and wifi onto the robot, creating an internet of things. This book employs a bottom-up approach to learning. It will not include an exhaustive recapitulation of the information in data sheets. First, it begins with basic fundamentals, which allows the reader to solve new problems with new technology. Second, the book presents many detailed design examples. These examples illustrate the process of design. There are multiple structural components that assist learning. Checkpoints, with answers in the back, are short easy to answer questions providing immediate feedback while reading. The book includes an index and a glossary so that information can be searched. The most important learning experiences in a class like this are of course the laboratories. Specifically for this volume, look at the lab assignments for TI-RSLK curriculum. There is a web site accompanying this book: <http://users.ece.utexas.edu/~valvano/arm/robotics.ht>

The revised text to the analysis, control, and applications of robotics The revised and updated third edition of Introduction to Robotics: Analysis, Control, Applications, offers a guide to the fundamentals of robotics, robot components and subsystems and applications. The author—a noted expert on the topic—covers the mechanics and kinematics of serial and parallel robots, both with the Denavit-Hartenberg approach as well as screw-based mechanics. In addition, the text contains information on microprocessor applications, control systems, vision systems, sensors, and actuators. Introduction to Robotics gives engineering students and practicing engineers the information needed to design a robot, to integrate a robot in appropriate applications, or to analyze a robot. The

updated third edition contains many new subjects and the content has been streamlined throughout the text. The new edition includes two completely new chapters on screw-based mechanics and parallel robots. The book is filled with many new illustrative examples and includes homework problems designed to enhance learning. This important text: Offers a revised and updated guide to the fundamental of robotics Contains information on robot components, robot characteristics, robot languages, and robotic applications Covers the kinematics of serial robots with Denavit-Hartenberg methodology and screw-based mechanics Includes the fundamentals of control engineering, including analysis and design tools Discusses kinematics of parallel robots Written for students of engineering as well as practicing engineers, Introduction to Robotics, Third Edition reviews the basics of robotics, robot components and subsystems, applications, and has been revised to include the most recent developments in the field.

Analysis and Control

Modern Robotics

Introduction to AI Robotics, second edition

Introduction to Autonomous Robots

An Introduction to High-Tech Social Agents, Intelligent Tutors, and Curricular Tools

Software -- Programming Languages.

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.

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.

This books serves as an introduction to robotics analysis, the systems and sub-systems that constitute robots and robotic systems, and robotics applications. All of the fundamentals of

robotics are covered—robotics analysis; including kinematics, kinetics and force control, and trajectory planning of robots; its sub-systems such as actuators, sensors, and vision systems; as well as robotics applications. Introduction to Robotics also includes many subjects related to mechatronics, microprocessor actuator control, integration of sensors, vision systems, and fuzzy logic. For practicing mechanical engineers, electronic and electric engineers, computer engineers, and engineering technologists who would like to learn about robotics.

Introduction to Humanoid Robotics

Introduction to Robotics, Global Edition

Robots in Education

Elements of Robotics

Embedded Systems

*This book is for researchers, engineers, and students who are willing to understand how humanoid robots move and be controlled. The book starts with an overview of the humanoid robotics research history and state of the art. Then it explains the required mathematics and physics such as kinematics of multi-body system, Zero-Moment Point (ZMP) and its relationship with body motion. Biped walking control is discussed in depth, since it is one of the main interests of humanoid robotics. Various topics of the whole body motion generation are also discussed. Finally multi-body dynamics is presented to simulate the complete dynamic behavior of a humanoid robot. Throughout the book, Matlab codes are shown to test the algorithms and to help the reader's understanding.*

*A thorough introduction to all aspects of robotics emphasizing its potential in industry. Provides coverage of industrial robots, remotely controlled arms, and mobile robots. Begins with a preliminary discussion of basic concepts and terms, and goes on to cover various applications. Summarizes the uses and engineering of telechiric manipulators and mobile robots.*

*A comprehensive survey of the growing field of self-reconfigurable robots that discusses the history of the field, design considerations, and control strategies. Self-reconfigurable robots are constructed of robotic modules that can be connected in many different ways. These modules move in relationship to each other, which allows the robot as a whole to change shape. This shapeshifting makes it possible for the robots to adapt and optimize their shapes for different tasks. Thus, a self-reconfigurable robot can first assume the shape of a rolling track to cover distance quickly, then the shape of a snake to explore a narrow space, and finally the shape of a hexapod to carry an artifact back to the starting point. The field of self-reconfigurable robots has seen significant progress over the last twenty years, and this book collects and synthesizes existing research previously only available in widely scattered individual papers, offering an accessible guide to the latest information on self-reconfigurable robots for researchers and*

*students interested in the field. Self-Reconfigurable Robots focuses on conveying the intuition behind the design and control of self-reconfigurable robots rather than technical details. Suggestions for further reading refer readers to the underlying sources of technical information. The book includes descriptions of existing robots and a brief history of the field; discussion of module design considerations, including module geometry, connector design, and computing and communication infrastructure; an in-depth presentation of strategies for controlling self-reconfiguration and locomotion; and exploration of future research challenges.*

*This open access book introduces the reader to the foundations of AI and ethics. It discusses issues of trust, responsibility, liability, privacy and risk. It focuses on the interaction between people and the AI systems and Robotics they use. Designed to be accessible for a broad audience, reading this book does not require prerequisite technical, legal or philosophical expertise. Throughout, the authors use examples to illustrate the issues at hand and conclude the book with a discussion on the application areas of AI and Robotics, in particular autonomous vehicles, automatic weapon systems and biased algorithms. A list of questions and further readings is also included for students willing to explore the topic further.*

*Self-reconfigurable Robots*

*Mechanics and Control*

*Introduction to Autonomous Mobile Robots, second edition*

*An Introduction to Robotics and Robot's Vision*

*Fundamentals of Robot Technology*

Behavior Trees (BTs) provide a way to structure the behavior of an artificial agent such as a robot or a non-player character in a computer game. Traditional design methods, such as finite state machines, are known to produce brittle behaviors when complexity increases, making it very hard to add features without breaking existing functionality. BTs were created to address this very problem, and enables the creation of systems that are both modular and reactive. Behavior Trees in Robotics and AI: An Introduction provides a broad introduction as well as an in-depth exploration of the topic, and is the first comprehensive book on the use of BTs. This book introduces the subject of BTs from simple topics, such as semantics and design principles, to complex topics, such as learning and task planning. For each topic, the authors provide a set of examples, ranging from simple illustrations to realistic complex behaviors, to enable the reader to successfully combine theory with practice. Starting with an introduction to BTs, the book then describes how BTs relate to, and in many cases, generalize earlier switching structures, or control architectures. These ideas are then used as a

foundation for a set of efficient and easy to use design principles. The book then presents a set of important extensions and provides a set of tools for formally analyzing these extensions using a state space formulation of BTs. With the new analysis tools, the book then formalizes the descriptions of how BTs generalize earlier approaches and shows how BTs can be automatically generated using planning and learning. The final part of the book provides an extended set of tools to capture the behavior of Stochastic BTs, where the outcomes of actions are described by probabilities. These tools enable the computation of both success probabilities and time to completion. This book targets a broad audience, including both students and professionals interested in modeling complex behaviors for robots, game characters, or other AI agents. Readers can choose at which depth and pace they want to learn the subject, depending on their needs and background.

Briefly traces the history of robots, discusses industrial and educational robots, robot software, and careers in robotics, and predicts how robots will affect our future

Addressing the use of robots for flexible automation from a manufacturing systems viewpoint, that is how robots interface with all the manufacturing hardware and software, this text discusses industrial applications and weaves a major case study throughout, allowing students to follow and join an automation design team as they work through each stage of the design process. An accompanying disk and video provide project data. This third edition expands the number of well-documented manufacturing cases and applications, and adds a chapter on-work-cell design based on computer-integrated manufacturing (CIM) principles.

This introduction to robotics offers a distinct and unified perspective of the mechanics, planning and control of robots. Ideal for self-learning, or for courses, as it assumes only freshman-level physics, ordinary differential equations, linear algebra and a little bit of computing background. Modern Robotics presents the state-of-the-art, screw-theoretic techniques capturing the most salient physical features of a robot in an intuitive geometrical way. With numerous exercises at the end of each chapter, accompanying software written to reinforce the concepts in the book and video lectures aimed at changing the classroom experience, this is the go-to textbook for learning about this fascinating subject.

An introduction to robotics, automation, and successful systems integration in manufacturing

Mechanics, Planning, and Control

Implementation of Robot Systems

R.U.R.



### A Mathematical Introduction to Robotic Manipulation

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.

Robots in Education is an accessible introduction to the use of robotics in formal learning, encompassing pedagogical and psychological theories as well as implementation in curricula. Today, a variety of communities across education are increasingly using robots as general classroom tutors, tools in STEM projects, and subjects of study. This volume explores how the unique physical and social-interactive capabilities of educational robots can generate bonds with students while freeing instructors to focus on their individualized approaches to teaching and learning. Authored by a uniquely interdisciplinary team of scholars, the book covers the basics of robotics and their supporting technologies; attitudes toward and ethical implications of robots in learning; research methods relevant to extending our knowledge of the field; and more. 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.

For senior-year undergraduate and first-year graduate courses in robotics. An intuitive introduction to robotic theory and application Since its original publication in 1986, Craig's Introduction to Robotics: Mechanics and Control has been the leading textbook for teaching robotics at the university level. Blending traditional mechanical engineering material with computer science and control theoretical concepts, the text covers a range of topics, including rigid-body transformations, forward and inverse positional kinematics, velocities and

Jacobians of linkages, dynamics, linear and non-linear control, force control methodologies, mechanical design aspects, and robotic programming. The 4th Edition features a balance of application and theory, introducing the science and engineering of mechanical manipulation—establishing and building on foundational understanding of mechanics, control theory, and computer science. With an emphasis on the computational aspects of problems, the text aims to present material in a simple, intuitive manner.

Introduction to Robotics in CIM Systems

Robotics, Vision and Control

Introduction to Robotics

An Introduction to Ethics in Robotics and AI

The Robotics Primer

**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.

Foundations of Robotics presents the fundamental concepts and methodologies for the analysis, design, and control of robot manipulators. It explains the physical meaning of the concepts and equations used, and it provides, in an intuitively clear way, the necessary background in kinetics, linear algebra, and control theory. Illustrative examples appear throughout. The author begins by discussing typical robot manipulator mechanisms and their controllers. He then devotes three chapters to the analysis of robot manipulator mechanisms. He covers the kinematics of robot manipulators, describing the motion of manipulator links and objects related to manipulation. A chapter on dynamics includes the derivation of the dynamic equations of motion, their use for control and simulation and the identification of inertial parameters. The final chapter develops the concept of manipulability. The second half focuses on the control of robot manipulators. Various position-control algorithms that guide the manipulator's end effector along a desired trajectory are described. Two typical methods used to control the contact force between the end effector and its environments are detailed. For manipulators with redundant degrees of freedom, a technique to develop control algorithms for active utilization of the redundancy is described. Appendixes give compact reviews of the function  $\text{atan2}$ , pseudo inverses, singular-value decomposition, and Lyapunov stability theory. Tsuneo Yoshikawa teaches in the Division of Applied Systems Science in Kyoto University's Faculty of Engineering. This is an introduction for the amateur to the ideas and concepts, both theoretical and practical, of robotics. It is divided into two sections. The first covers how and why robots work and how they are controlled. The second discusses how to make a simple two-legged humanoid robot that can be programmed to walk. There are no complicated formulae or equations to grapple with or complicated circuit diagrams to decipher, and you do not have to be a machinist or a programmer. The robot can be built quickly

**on a workbench or even a kitchen table, with a minimum number of handtools, and all the parts are easily available.**

**Kinematics, Perception, Localization and Planning**