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**Introduction To Robotics: Mechanics And Control, 3/E**

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**Introduction To Robotics: Mechanics And Control, 3/E**

In this comprehensive textbook about robot grasping, readers will discover an integrated look at the major concepts and technical results in robot grasp mechanics. A large body of prior research, including key theories, graphical techniques, and insights on robot hand designs, is organized into a systematic review, using common notation and a common analytical framework. With introductory and advanced chapters that support senior undergraduate and graduate level robotics courses, this book provides a full introduction to robot grasping principles that are needed to model and analyze multi-finger robot grasps, and serves as a valuable reference for robotics students, researchers, and practicing robot engineers. Each chapter contains many worked-out examples, exercises with full solutions, and figures that highlight new concepts and help the reader master the use of the theories and equations presented.

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

Robot Analysis and Control Complete, state-of-the-art coverage of robot analysis This unique book provides the fundamental knowledge needed for understanding the mechanics of both serial and parallel manipulators. Presenting fresh and authoritative material on parallel manipulators that is not available in any other resource, it offers an in-depth treatment of position analysis, Jacobian analysis, statics and stiffness analysis, and dynamical analysis of both types of manipulators, including a discussion of industrial and research applications. It also features: * The homotopy continuation method and dialectic elimination method for solving polynomial systems that apply to robot kinematics * Numerous worked examples and problems to reinforce learning * An extensive bibliography offering many resources for more advanced study Drawing on Dr. Lung-Wen Tsai's vast experience in the field as well as recent research publications, Robot Analysis is a first-rate text for upper-level undergraduate and graduate students in mechanical engineering, electrical engineering, and computer studies, as well as an excellent desktop reference for robotics researchers working in industry or in government.

Robot Optimization for Robot Modelling with MATLAB This book describes the development of an integrated approach for generating the path and gait of realistic hexapod robotic systems. It discusses in detail locomotion with straight-ahead, crab and turning motion capabilities.
Advanced Theory of Constraint and Motion Analysis for Robot Mechanisms The identity and role of writing has evolved in the age of digital media. But how did writing itself make digital media possible in the first place? Lydia H. Liu offers here the first rigorous study of the political history of digital writing and its fateful entanglement with the Freudian unconscious. Liu’s innovative analysis brings the work of theorists and writers back into conversation with one another to document significant meetings of minds and disciplines. She shows how the earlier avant-garde literary experiments with alphabetical writing and the word-association games of psychoanalysis contributed to the mathematical making of digital media. Such intellectual convergence, she argues, completed the transformation of alphabetical writing into the postphonetic, ideographic system of digital media, which not only altered the threshold of sense and nonsense in communication processes but also compelled a new understanding of human-machine interplay at the level of the unconscious. Ranging across information theory, cybernetics, modernism, literary theory, neurotic machines, and psychoanalysis, The Freudian Robot rewrites the history of digital media and the literary theory of the twentieth century.

The Complexity of Robot Motion Planning Safe Robot Navigation Among Moving and Steady Obstacles is the first book to focus on reactive navigation algorithms in unknown dynamic environments with moving and steady obstacles. The first three chapters provide introduction and background on sliding mode control theory, sensor models, and vehicle kinematics. Chapter 4 deals with the problem of optimal navigation in the presence of obstacles. Chapter 5 discusses the problem of reactively navigating. In Chapter 6, border patrolling algorithms are applied to a more general problem of reactively navigating. A method for guidance of a Dubins-like mobile robot is presented in Chapter 7. Chapter 8 introduces and studies a simple biologically-inspired strategy for navigation a Dubins-car. Chapter 9 deals with a hard scenario where the environment of operation is cluttered with obstacles that may undergo arbitrary motions, including rotations and deformations. Chapter 10 presents a novel reactive algorithm for collision free navigation of a nonholonomic robot in unknown complex dynamic environments with moving obstacles. Chapter 11 introduces and examines a novel purely reactive algorithm to navigate a planar mobile robot in densely cluttered environments with unpredictably moving and deforming obstacles. Chapter 12 considers a multiple robot scenario. For the Control and Automation Engineer, this book offers accessible and precise development of important mathematical models and results. All the presented results have mathematically rigorous proofs. On the other hand, the Engineer in Industry can benefit by the experiments with real robots such as Pioneer robots, autonomous wheelchairs and autonomous mobile hospital. First book on collision free reactive robot navigation in unknown dynamic environments Bridges the gap between mathematical model and practical algorithms Presents implementable and computationally efficient algorithms of robot navigation Includes mathematically rigorous proofs of their convergence A detailed review of existing reactive navigation algorithm for obstacle avoidance Describes fundamentals of sliding mode control

Recent Advances in Robotic Systems 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 offinding 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 at 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.

Safe Robot Navigation Among Moving and Steady Obstacles This book presents the most recent research advances in the theory, design, control and application of robotic systems, which are intended for a variety of purposes such as manipulation, manufacturing, automation, surgery, locomotion and biomechanics.

The Freudian Robot A provocative attempt to think about what was previously considered unthinkable: a serious philosophical case for the rights of robots. We are in the midst of a robot invasion, as devices of different configurations and capabilities slowly but surely come to take up increasingly important positions in everyday social reality—self-driving vehicles, recommendation algorithms, machine learning decision making systems, and social robots of various forms and functions. Although considerable attention has already been devoted to the subject of robots and responsibility, the question concerning the social status of these artifacts has been largely overlooked. In this book, David Gunkel offers a provocative attempt to think about what has been previously regarded as unthinkable: whether and to what extent robots and other technological artifacts of our own making can and should have any claim to moral and legal standing. In his analysis, Gunkel invokes the philosophical distinction (developed by David Hume) between “is” and “ought” in order to evaluate and analyze the different arguments regarding the question of robot rights. In the course of his examination, Gunkel finds that none of the existing positions or proposals hold up under scrutiny. In response to this, he then offers an innovative alternative proposal that effectively flips the script on the is/ought problem by introducing another, altogether different way to conceptualize the social situation of robots and the opportunities and challenges they present to existing moral and legal systems.

Robot System Reliability and Safety Humanoid Robots: Modeling and Control provides a 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.

ROBOTICS

Robot Behaviour Robots have evolved impressively since the 3-D manipulator built by C.W. K-ward (1957), the two little electromechanical turtles Elmer and Elsie [Walter, 1950, Walter, 1951], and the first mobile robots controlled by comp- ers, Shakey [Nilsson, 1984], CART [Moravec, 1979, Moravec, 1983], and -lare [Giralt et al., 1979]. Since then, we have seen industrial robot manipu- tors working in car factories, automatic guided vehicles moving heavy loads along pre-de?ned routes, human-remotely operated robots neutralising bombs, and even semi-autonomous robots, like Sojourner, going to Mars and moving from one position to another commanded from Earth. Robots will go further and further in our society. However, there is still a kind of robot that has not completely taken off so far: autonomous robots. Autonomy depends upon working without human supervision for a considerable amount of time, taking independent decisions, adapting to new challenges in dynamic environments, interacting with other systems and humans, and so on. Research on autonomy is highly motivated by the expectations of having robots that can work with us and
for us in everyday environments, assisting us at home or work, acting as servants and companions to help us in the execution of different tasks, so that we can have more spare time and a better quality of life.

Multi-body Dynamic Modeling of Multi-legged Robots 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.

Appendices. Bibliography.

Feedback Control of Dynamic Bipedal Robot Locomotion "The essential guide to learning Autodesk Robot Structural Analysis Professional."

Advances in Robot Kinematics: Analysis and Design How to educate the next generation of college students to invent, to create, and to discover—filling needs that even the most sophisticated robot cannot. Driverless cars are hitting the road, powered by artificial intelligence. Robots can climb stairs, open doors, win Jeopardy, analyze stocks, work in factories, find parking spaces, advise oncologists. In the past, automation was considered a threat to low-skilled labor. Now, many high-skilled functions, including interpreting medical images, doing legal research, and analyzing data, are within the skill sets of machines. How can higher education prepare students for their professional lives when professions themselves are disappearing? In Robot-Proof, Northeastern University president Joseph Aoun proposes a way to educate the next generation of college students to invent, to create, and to discover—to fill needs in society that even the most sophisticated artificial intelligence agent cannot. A “robot-proof” education, Aoun argues, is not concerned solely with topping up students’ minds with high-octane facts. Rather, it calibrates them with a creative mindset and the mental elasticity to invent, discover, or create something valuable to society—a scientific proof, a hip-hop recording, a web comic, a cure for cancer. Aoun lays out the framework for a new discipline, humanics, which builds on our innate strengths and prepares students to compete in a labor market in which smart machines work alongside human professionals. The new literacies of Aoun’s humanics are data literacy, technological literacy, and human literacy. Students will need data literacy to manage the flow of big data, and technological literacy to know how their machines work, but human literacy—the humanities, communication, and design—to function as a human being. Life-long learning opportunities will support their ability to adapt to change. The only certainty about the future is change. Higher education based on the new literacies of humanics can equip students for living and working through change.

The Mechanics of Robot Grasping 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.

Robot and Multibody Dynamics This book addresses optimization in robotics, in terms of both the configuration space and the metal structure of the robot arm itself; and discusses, describes and builds different types of heuristics and algorithms in MATLAB. In addition, the book includes a wealth of examples and exercises. In particular, it enables the reader to write a MATLAB code for all the related problems in robotics. The book also offers detailed descriptions of and builds from scratch several types of optimization algorithms
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using MATLAB and simplified methods, especially for inverse problems and avoiding singularities. Each chapter features examples and exercises to enhance the reader's comprehension. Accordingly, the book offers the reader a better understanding of robot analysis from an optimization standpoint.

Creating Precision Robots A modern and unified treatment of the mechanics, planning, and control of robots, suitable for a first course in robotics.

Robot Manipulators Robot Hands and the Mechanics of Manipulation explores several aspects of the basic mechanics of grasping, pushing, and in general, manipulating objects. It makes a significant contribution to the understanding of the motion of objects in the presence of friction, and to the development of fine position and force controlled articulated hands capable of doing useful work. In the book's first section, kinematic and force analysis is applied to the problem of designing and controlling articulated hands for manipulation. The analysis of the interface between fingertip and grasped object then becomes the basis for the specification of acceptable hand kinematics. A practical result of this work has been the development of the Stanford/JPL robot hand - a tendon-actuated, 9 degree-of-freedom hand which is being used at various laboratories around the country to study the associated control and programming problems aimed at improving robot dexterity. Chapters in the second section study the characteristics of object motion in the presence of friction. Systematic exploration of the mechanics of pushing leads to a model of how an object moves under the combined influence of the manipulator and the forces of sliding friction. The results of these analyses are then used to demonstrate verification and automatic planning of some simple manipulator operations. Matthew T. Mason is Assistant Professor of Computer Science at Carnegie-Mellon University, and coeditor of Robot Motion (MIT Press 1983). J. Kenneth Salisbury, Jr. is a Research Scientist at MIT's Artificial Intelligence Laboratory, and president of Salisbury Robotics, Inc. Robot Hands and the Mechanics of Manipulation is 14th in the Artificial Intelligence Series, edited by Patrick Henry Winston and Michael Brady.

Introduction to Robotics As robots are used more and more to perform a variety of tasks in a range of fields, it is imperative to make the robots as reliable and safe as possible. Yet no book currently covers robot reliability and safety within one framework. Robot System Reliability and Safety: A Modern Approach presents up-to-date information on robot reliability, safety, and related areas in a single volume, eliminating the need to consult diverse sources. After introducing historical, mathematical, and introductory aspects, the book presents methods for analyzing robot system reliability and safety. It next focuses on topics related to robot reliability, including classifications of robot failures and their causes and hydraulic and electric robots' reliability analysis. The book then explains the analysis of robot-related safety and accidents, covers key elements of robot maintenance and robotics applications in maintenance and repair, and addresses human factors and safety considerations in robotics workplaces. The book concludes with chapters on robot testing, costing, and failure data as well as six mathematical models for reliability and safety analysis. Written by a well-known expert in reliability engineering, this book will be useful to system, design, reliability, and safety engineers along with other engineering professionals working in the area of robotics. It can also be used in courses on system engineering, reliability engineering, and safety engineering.

Robot Analysis foreword by Lashon Booker To program an autonomous robot to act reliably in a dynamic environment is a complex task. The dynamics of the environment are unpredictable, and the robots' sensors provide noisy input. A learning autonomous robot, one that can acquire knowledge through interaction with its environment and then adapt its behavior, greatly simplifies the designer's work. A learning robot need not be given all of the details of its environment, and its sensors and actuators need not be finely tuned. Robot Shaping is about designing and building learning autonomous robots. The term "shaping" comes from experimental psychology, where it describes the incremental training of animals. The authors propose a new engineering discipline, "behavior engineering," to provide the methodologies and tools for creating autonomous robots. Their techniques are based on classifier systems, a reinforcement learning architecture originated by John Holland, to which they have added several new ideas, such as "mutspec," classifier system "energy," and dynamic population size. In the book they present Behavior Analysis and Training (BAT) as an example of a behavior engineering methodology.

Progress in System and Robot Analysis and Control Design The book presents the state of the art and recent advances in the area of kinematics of robots and mechanisms. It consists of about fifty outstanding contributions dedicated to various aspects of kinematic modelling and control, emphasising in particular the kinematic performances of robots and mechanisms, workspace and trajectory analysis, numerical and symbolic computational methods and algorithms, analysis, simulation and optimization. The book is of interest to researchers,
Parallel Robots Robots and Screw Theory describes the mathematical foundations, especially geometric, underlying the motions and force-transfers in robots. The principles developed in the book are used in the control of robots and in the design of their major moving parts. The illustrative examples and the exercises in the book are taken principally from robotic machinery used for manufacturing and construction, but the principles apply equally well to miniature robotic devices and to those used in other industries. The comprehensive coverage of the screw and its geometry lead to reciprocal screw systems for statics and instantaneous kinematics. These screw systems are brought together in a unique way to show many cross-relationships between the force-systems that support a body equivalently to a kinematic serial connection of joints and links. No prior knowledge of screw theory is assumed. The reader is introduced to the screw with a simple planar example yet most of the book applies to robots that move three-dimensionally. Consequently, the book is suitable both as a text at the graduate-course level and as a reference book for the professional. Worked examples on every major topic and over 300 exercises clarify and reinforce the principles covered in the text. A chapter-length list of references gives the reader source-material and opportunities to pursue more fully topics contained in the text.

Robot 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.

Robot Mechanisms Advanced Theory of Constraint and Motion Analysis for Robot Mechanisms provides a complete analytical approach to the invention of new robot mechanisms and the analysis of existing designs based on a unified mathematical description of the kinematic and geometric constraints of mechanisms. Beginning with a high level introduction to mechanisms and components, the book moves on to present a new analytical theory of terminal constraints for use in the development of new spatial mechanisms and structures. It clearly describes the application of screw theory to kinematic problems and provides tools that students, engineers and researchers can use for investigation of critical factors such as workspace, dexterity and singularity. Combines constraint and free motion analysis and design, offering a new approach to robot mechanism innovation and improvement. Clearly describes the use of screw theory in robot kinematic analysis, allowing for concise representation of motion and static forces when compared to conventional analysis methods. Includes worked examples to translate theory into practice and demonstrate the application of new analytical methods to critical robotics problems.

Modern Robotics This book offers an excellent complementary text for an advanced course on the modelling and dynamic analysis of multi-body mechanical systems, and provides readers an in-depth understanding of the modelling and control of robots. While the Lagrangian formulation is well suited to multi-body systems, its physical meaning becomes paradoxically complicated for single rigid bodies. Yet the most advanced numerical methods rely on the physics of these single rigid bodies, whose dynamic is then given among multiple formulations by the set of the Newton–Euler equations in any of their multiple expression forms. This book presents a range of simple tools to express in succinct form the dynamic equation for the motion of a single rigid body, either free motion (6-dimension), such as that of any free space navigation robot or constrained motion (less than 6-dimension), such as that of ground or surface vehicles. In the process, the book also explains the equivalences of (and differences between) the different formulations.
Advances in Robot Kinematics 2016 Complete, state-of-the-art coverage of robot analysis

This unique book provides the fundamental knowledge needed for understanding the mechanics of both serial and parallel manipulators. Presenting fresh and authoritative material on parallel manipulators that is not available in any other resource, it offers an in-depth treatment of position analysis, Jacobian analysis, statics and stiffness analysis, and dynamical analysis of both types of manipulators, including a discussion of industrial and research applications. It also features: * The homotopy continuation method and dialytic elimination method for solving polynomial systems that apply to robot kinematics * Numerous worked examples and problems to reinforce learning * An extensive bibliography offering many resources for more advanced study Drawing on Dr. Lung-Wen Tsai's vast experience in the field as well as recent research publications, Robot Analysis is a first-rate text for upper-level undergraduate and graduate students in mechanical engineering, electrical engineering, and computer studies, as well as an excellent desktop reference for robotics researchers working in industry or in government.

Robot Shaping This book presents the most recent research results on modeling and control of robot manipulators. Chapter 1 gives unified tools to derive direct and inverse geometric, kinematic and dynamic models of serial robots and addresses the issue of identification of the geometric and dynamic parameters of these models. Chapter 2 describes the main features of serial robots, the different architectures and the methods used to obtain direct and inverse geometric, kinematic and dynamic models, paying special attention to singularity analysis. Chapter 3 introduces global and local tools for performance analysis of serial robots. Chapter 4 presents an original optimization technique for point-to-point trajectory generation accounting for robot dynamics. Chapter 5 presents standard control techniques in the joint space and task space for free motion (PID, computed torque, adaptive dynamic control and variable structure control) and constrained motion (compliant force-position control). In Chapter 6, the concept of vision-based control is developed and Chapter 7 is devoted to specific issue of robots with flexible links. Efficient recursive Newton-Euler algorithms for both inverse and direct modeling are presented, as well as control methods ensuring position setting and vibration damping.

Robot Hands and the Mechanics of Manipulation This book provides a comprehensive introduction to the area of robot mechanisms, primarily considering industrial manipulators and humanoid arms. The book is intended for both teaching and self-study. Emphasis is given to the fundamentals of kinematic analysis and the design of robot mechanisms. The coverage of topics is untypical. The focus is on robot kinematics. The book creates a balance between theoretical and practical aspects in the development and application of robot mechanisms, and includes the latest achievements and trends in robot science and technology.

Robot Analysis This book brings together 46 peer-reviewed papers that are of interest to researchers wanting to know more about the latest topics and methods in the fields of the kinematics, control and design of robotic systems. These papers cover the full range of robotic systems, including serial, parallel and cable-driven manipulators, both planar and spatial. The systems range from being less than fully mobile, to kinematically redundant, to over-constrained. In addition to these more familiar areas, the book also highlights recent advances in some emerging areas: such as the design and control of humanoids and humanoid subsystems; the analysis, modeling and simulation of human-body motions; mobility analyses of protein molecules; and the development of machines that incorporate man.

Humanoid Robots 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. Illustative 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. Appendices give compact reviews of the function 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...
Kinematic Analysis of Robot Manipulators This book brings together some recent advances and development in robotics. In 12 chapters, written by experts and researchers in respective fields, the book presents some up-to-date research ideas and findings in a wide range of robotics, including the design, modeling, control, learning, interaction, and navigation of robots. From an application perspective, the book covers UAVs, USVs, mobile robots, humanoid robots, graspers, and underwater robots. The unique text offers practical guidance to graduate students and researchers in research and applications in the field of robotics.

Robot Manipulators The fields of control and robotics are now at an advanced level of maturity both in theory and practice. Numerous systems are used effectively in industrial production and other sectors of modern life. This volume contains a well-balanced collection of over fifty papers focusing on analysis and design problems. The current trends and advances in the fields are reflected. Topics covered include: system analysis, identification and stability optimal, adaptive, robust and QFT controller design design and application of driving simulators industrial robots and telemanipulators mobile, service, and legged robots virtual reality in robotics The book brings together important original results derived from a variety of academic and engineering environments. Also, it serves as a timely reference volume for the researcher and practitioner.

Autodesk Robot Structural Analysis Professional 2014 Robotics: Fundamental Concepts and Analysis introduces the science and engineering of robotics and covers mechanical manipulation and sensing. Comprehensive in its coverage, the book also covers some advanced topics which would be useful to both undergraduate and postgraduate students. Written in a lucid style, the text is student-friendly with a large number of examples and exercise problems.

3D Motion of Rigid Bodies 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

Robots and Screw Theory 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.

Behavior Trees in Robotics and AI Homogeneous transformations; Kinematic equations; Solving kinematic equations; Differential relationships; Motion trajectories; Dynamics; Control; Static forces; Compliance; Programming.

Robot-Proof Introduction to robot manipulators, with case studies of industrial robots.

Advances in Robot Kinematics: Analysis and Control

Robot Rights Parallel robots are closed-loop mechanisms presenting very good performances in terms of accuracy, rigidity and ability to manipulate large loads. Parallel robots have been used in a large number of applications ranging from astronomy to flight simulators and are becoming increasingly popular in the field of machine-tool industry. This book presents a complete synthesis of the latest results on the possible mechanical architectures, analysis and synthesis of this type of mechanism. It is intended to be used by students (with over 100 exercises and numerous Internet addresses), researchers (with over 500 references and anonymous ftp access to the code of some algorithms presented in this book) and engineers (for which practical results and applications are presented).

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