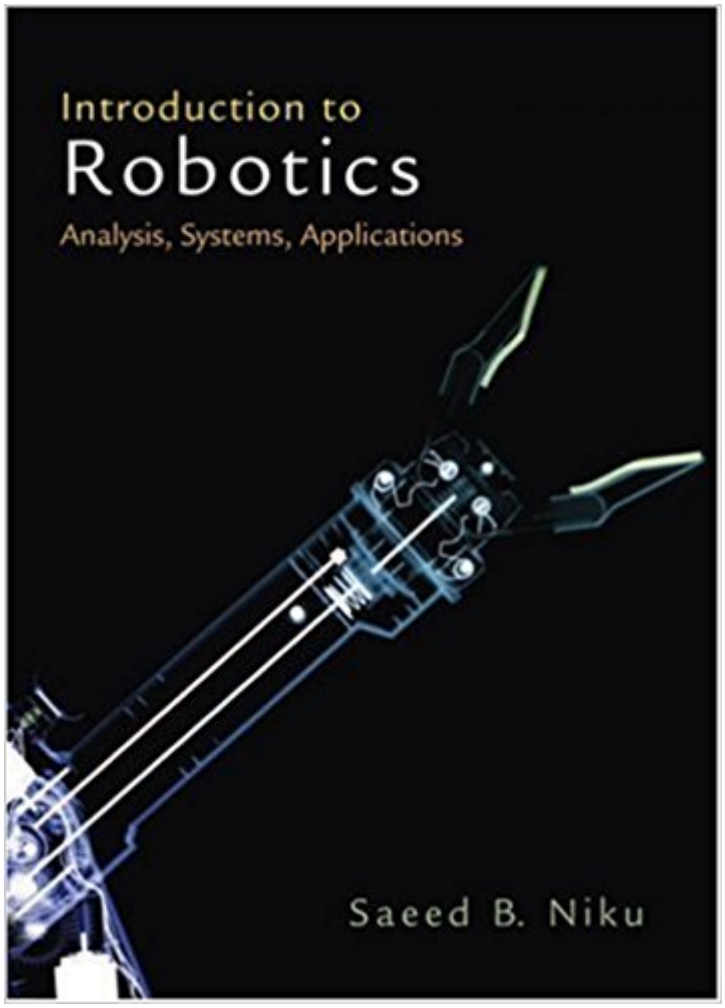
Introduction To Robotics: Analysis, Systems, Applications



Synopsis

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 coveredâ ”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.

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Customer Reviews

This book offers comprehensive, yet concise coverage of robotics. It covers analysis of robot kinematics, differential motions, robot dynamics, and trajectory planning. It then proceeds to discuss in detail such important robot subsystems as actuators, sensors, vision systems, and fuzzy logic (at an introductory level). Robotic applications are drawn from a wide variety of fields. Features: Provides comprehensive coverage of kinematics and dynamics of robotics, plus coverage of important subsystems. Includes microprocessor and mechatronic robotics applications, as well as an entire chapter on vision systems (image processing and image analysis). Applications oriented with design projects, examples, and homework problems. Introduces a running design project at the end of Chapter 2. At the end of each subsequent chapter, the reader is asked to apply the, concepts

learned to the running design example. The intended result is that by the end of the book the reader has designed a complete robot. The book is intended for senior or first-year graduate courses in robotics. It is also an excellent resource for practicing engineers to aid their development and design work in robotics.

As one of my students once said years ago, "in the life of every product, there comes a time when you have to shoot the designer and go into production." It seems that the same is true for a book. An author of a textbook such as this one may go on forever trying to cover any and every conceivable subject related to the book in order to generate an all-encompassing book that satisfies every teacher and student. But the intention behind writing this book was not that at all. The intention was to write a book that has most subjects that an undergraduate engineering student or a practicing engineer may need to know to be familiar with the subject, to be able to understand robots and robotics, to be able to design a robot, and to be able to integrate a robot in appropriate applications. As such, it covers all necessary fundamentals of robotics, its components and subsystems, and its applications. This book was originally written for Cal Poly Mechanical Engineering Department's Robotics course. With encouragement from different people, it was somewhat modified to the present form. The book is intended for senior or introductory graduate courses in robotics, as well as for practicing engineers who would like to learn about robotics. Although the book covers a fair amount of mechanics and kinematics, it also covers microprocessor applications, vision systems, sensors, and electric motors. Thus, it can easily be used by mechanical engineers, electronic and electrical engineers, computer engineers, and engineering technologists. The book comprises nine chapters. Chapter 1 covers introductory subjects that familiarize the reader with the necessary background information that is used in the rest of the book. This includes some historical information, robot components, robot characteristics, robot languages, and robotic applications. Chapter 2 covers the forward and inverse kinematics of robots, including frame representations, transformations, position and orientation analysis, and the Denavit-Hartenberg representation of robot kinematics. Chapter 3 continues with differential motions and velocity analysis of robots and frames. Chapter 4 presents an analysis of robot dynamics and forces. Lagrangian mechanics is used as the primary method of analysis and development for this chapter. Chapter 5 discusses methods of path and trajectory planning, both in joint-space and in Cartesian-space. Chapter 6 covers actuators, including hydraulic devices, electric motors such as DC servomotors and stepper motors, Pneumatic devices, as well as many other novel actuators. It also covers microprocessor control of these actuators. Although this book is not a complete

mechatronics book, it does cover a fair amount of mechatronics. Except for the design of a microprocessor, many aspects of mechatronic applications are covered in this chapter. Chapter 7 is a discussion of sensors that are used in robotics and robotic applications. Chapter 8 covers vision systems, including many different techniques for image processing and image analysis. Chapter 9 cover some basic principles of fuzzy logic and its applications in microprocessor control and robotics. This coverage is not intended to be a complete and thorough analysis of fuzzy logic, but instead an introduction to it. It is believed that students and engineers who find it interesting will continue on their own. Appendix A is a quick review of matrix algebra and some other mathematical facts that are needed throughout this book. Since the book is written for senior-level engineering students or for practicing engineers, the assumption is that the users are familiar with matrix algebra, as well as with basic feedback control theory and analysis. For this reason, except for some basic review, this material is not separately covered in this book. Obviously, to know enough control theory to be proficient in it, one has to have access to a complete controls book, something that is beyond the scope of a robotics book. Most of the material in this book is generally covered in a four-unit, 10-weeklong course at Cal Poly, with three one-hour lectures and one three-hour lab. However, it is easily possible to cover the entire course in a semester-long course as well. The following breakdown can be used as a model for setting up a course in robotics in a quarter system (in this case, certain subjects must be eliminated or shortened as shown): Introductory material and review: 3 lectures Kinematics of position: 7 lectures Differential motions: 4 lectures Robot dynamics and force control: 2 lectures Path and trajectory planning: 1 lecture Actuators: 3 lectures Sensors: 3 lectures Vision systems: 4 lectures Fuzzy logic: 1 lectures Exam and review: 2 lectures Alternatively, for a 14-week long semester course with three lectures per week, the course may be set up as follows: Introductory material and review: 3 lectures Kinematics of position: 9 lectures Differential motions: 5 lectures Robot dynamics and force control: 5 lectures Path and trajectory planning: 4 lectures Actuators: 4 lectures Sensors: 3 lectures Vision systems: 5 lectures Fuzzy logic: 2 lectures Exams and review: 2 lectures The book also features a design project that starts in Chapter 2 and continues throughout the book. At the end of each chapter, the student is directed to continue with the design project as it relates to the present chapter. Thus, by the end of the book, a complete robot is designed. In addition, a rolling-cylinder robot rover design project is also introduced in Chapter 6 and continues in Chapter 7. I would like to thank all the people who, in one way or another, have contributed to this book. This includes my colleagues in the mechanical engineering department and the university who provided me with a sabbatical to write the first draft, all the countless individuals who did the research, development, and the hard work that came before

my time and that enabled me to learn the subject myself, all the students and anonymous reviewers who made countless suggestions to improve the first draft, my editors Eric Frank and Lakshmi Balasubramanian, all the staff at Prentice Hall, who worked diligently to get a professional book out on time, and, of course, my family, who let me work on this manuscript for long hours instead of spending the time with them. To all of you, my sincere thanks. I hope that you will enjoy reading the book, and more importantly, that you will learn the subject. The joy of robotics comes from learning it. Saeed Benjamin Niku, Ph.D., P.E. San Luis Obispo, California

This is a good "Textbook", I took a robotics class and it served well for that purpose; but as a Stand-alone / Learn-alone book, I do not recommend this book. It is not that intuitive; there are few typos in some problems/examples that probably are corrected in the latest versions, so take care of that if you’re planning to learn alone or use it as reference.It touches many aspects of robotics; it that regard is very complete, but might not be very detailed every concept, not even the key ones; and you better have your linear algebra and overall math skills well polished.

This is a good book for people who are just starting out studying robotics, it has basic homogeneous matrix equation in it.

since the class required me to read this book, so I bought one. Actually it’s a good choice. love it

It starts off well. The sections on kinematics and motion are okay, and even the dynamic analysis is not bad, though a bit light for electrical engineers. Then it takes a turn for the worse and gives a generalized picture of sensors and actuators and vision systems, which is okay if it has never been seen before, but for electrical engineers it is not needed. The section on fuzzy logic is interesting but it is dissapointing that there is not a section on real control systems. I hope that fuzzy logic is not a substitute for convention control as this book seems to imply. Paul’s book has much more substance dispite its age. Still, for a survey of the topic or for the computer scientist, maybe it is not that bad of a text.

I was looking for an overview of robotics parts so I borrowed this form the library. While there was a lot of math, it was a good opportunity to review linear algebra from college. There was an appendix for people like me who have forgotten a lot.The concepts were explained well for someone who didn’t know them. I especially liked the degrees of freedom at the beginning. Later on, I started

skimming. Once I got the concepts, I flipped through to the next chapter. If this were for a course, I'm sure that part would have been more useful.

This books is fairly easy to read, the class that I needed this book for is a senior level robotics class. The class itself is fairly confusing. This books is easy to read comparably to other texts I've had in the past. Quick and easy ordering. Prompt delivery.

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