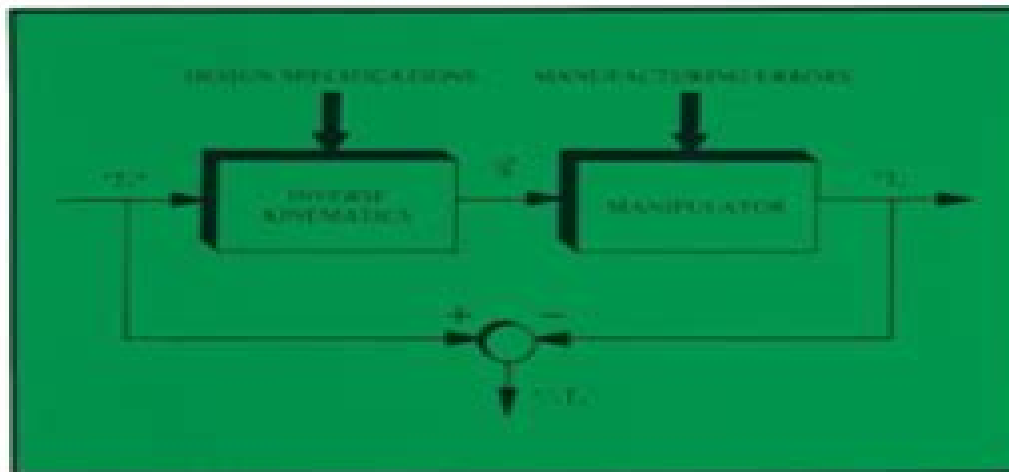

Kinematic Modeling, Identification, and Control of Robotic Manipulators

Henry W. Stone



Kinematic Modeling Identification And Control Of Robotic Manipulators

**Martin Grötschel, Sven O.
Krumke, Joerg Rambau**



Kinematic Modeling Identification And Control Of Robotic Manipulators:

Kinematic Modeling, Identification, and Control of Robotic Manipulators Henry W. Stone, 2012-12-06 The objective of this dissertation is to advance the state of the art in the kinematic modeling identification and control of robotic manipulators with rigid links in an effort to improve robot kinematic performance The positioning accuracy of commercially available industrial robotic manipulators depends upon a kinematic model which describes the robot geometry in a parametric form Manufacturing error in the machining and assembly of manipulators lead to discrepancies between the design parameters and the physical structure Improving the kinematic performance thus requires the identification of the actual kinematic parameters of each individual robot The identified kinematic parameters are referred to as the arm signature Existing robot kinematic models such as the Denavit Hartenberg model are not directly applicable to kinematic parameter identification In this dissertation we introduce a new kinematic model called the 5 Model which is applicable to kinematic parameter identification and use it as the foundation for our development of a general technique for identifying the kinematic parameters of any robot with rigid links

Kinematic Modeling, Identification, and Control of Robotic Manipulators Henry W. Stone, 1987

Kinematic Modeling, Identification, and Control of Robotic Manipulators Henry W. Stone, 1987-09-30 The objective of this dissertation is to advance the state of the art in the kinematic modeling identification and control of robotic manipulators with rigid links in an effort to improve robot kinematic performance The positioning accuracy of commercially available industrial robotic manipulators depends upon a kinematic model which describes the robot geometry in a parametric form Manufacturing error in the machining and assembly of manipulators lead to discrepancies between the design parameters and the physical structure Improving the kinematic performance thus requires the identification of the actual kinematic parameters of each individual robot The identified kinematic parameters are referred to as the arm signature Existing robot kinematic models such as the Denavit Hartenberg model are not directly applicable to kinematic parameter identification In this dissertation we introduce a new kinematic model called the 5 Model which is applicable to kinematic parameter identification and use it as the foundation for our development of a general technique for identifying the kinematic parameters of any robot with rigid links

Modeling, Identification and Control of Robots W. Khalil, E. Dombre, 2004-07-01 Written by two of Europe's leading robotics experts this book provides the tools for a unified approach to the modelling of robotic manipulators whatever their mechanical structure No other publication covers the three fundamental issues of robotics modelling identification and control It covers the development of various mathematical models required for the control and simulation of robots World class authority Unique range of coverage not available in any other book Provides a complete course on robotic control at an undergraduate and graduate level

Modelling and Control of Robot Manipulators Lorenzo Sciacivico, Bruno Siciliano, 2001-02-19 Fundamental and technological topics are blended uniquely and developed clearly in nine chapters with a gradually increasing level of complexity A wide variety of relevant

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

Genetic Algorithms in Applications Rustem Popa, 2012-03-21 Genetic Algorithms GAs are one of several techniques in the family of Evolutionary Algorithms algorithms that search for solutions to optimization problems by evolving better and better solutions Genetic Algorithms have been applied in science engineering business and social sciences This book consists of 16 chapters organized into five sections The first section deals with some applications in automatic control the second section contains several applications in scheduling of resources and the third section introduces some applications in electrical and electronics engineering The next section illustrates some examples of character recognition and multi criteria classification and the last one deals with trading systems These evolutionary techniques may be useful to engineers and scientists in various fields of specialization who need some optimization techniques in their work and who may be using Genetic Algorithms in their applications for the first time These applications may be useful to many other people who are getting familiar with the subject of Genetic Algorithms

Robot Calibration Roger Bernard, S. Albright, 1993-10-31 Calibration is playing an increasingly important role in industrial robotics Higher accuracy demands are being placed on flexible assembly and manufacturing systems which in turn require robot manufacturers to produce higher quality precision robots

Applied Mechanics Reviews, 1988

Stochastic Optimization Methods Kurt Marti, 2024-05-27 This book examines optimization problems that in practice involve random model parameters It outlines the computation of robust optimal solutions i e optimal solutions that are insensitive to random parameter variations where appropriate deterministic substitute problems are needed Based on the probability distribution of the random data and using decision theoretical concepts optimization problems under stochastic uncertainty are converted into corresponding deterministic problems Due to the probabilities and expectations involved the book also shows how to apply approximative solution techniques Several deterministic and stochastic approximation methods are provided Taylor expansion methods regression and response surface methods RSM probability inequalities multiple linearization of survival failure domains discretization methods convex approximation

deterministic descent directions efficient points stochastic approximation and gradient procedures and differentiation formulas for probabilities and expectations The fourth edition of this classic text has been carefully and thoroughly revised It includes new chapters on the solution of stochastic linear programs by discretization of the underlying probability distribution and on solving deterministic optimization problems by means of controlled random search methods and multiple random search procedures It also presents a new application of stochastic optimization methods to machine learning problems with different loss functions For the computation of optimal feedback controls under stochastic uncertainty besides the open loop feedback procedures a new method based on Taylor expansions with respect to the gain parameters is presented The book is intended for researchers and graduate students who are interested in stochastics stochastic optimization and control It will also benefit professionals and practitioners whose work involves technical economic and operations research problems under stochastic uncertainty

Service Robotics and Mechatronics Keiichi Shirase, Seiji Aoyagi, 2009-10-24 In a world suffering from an ageing population and declining birth rate service robotics and mechatronics have an increasingly vital role to play in maintaining a safe and sustainable environment for everyone Mechatronics can be used in the reconstruction or restoration of various environments which we rely upon to survive for example the reconstruction of a city after an earthquake or the restoration of polluted waters This collection of papers was originally presented at the 7th International Conference on Machine Automation 2008 in Awaji Japan and covers a variety of new trends in service robotics and mechatronics Service Robotics and Mechatronics showcases the latest research in the area to provide researchers and scientists with an up to date source of knowledge and basis for further study as well as offering graduate students valuable reference material

Scientific and Technical Aerospace Reports, 1994 Modeling Identification and Control of Robots Wisama Khalil, Etienne Dombre, 2002 Intelligent Robotic Systems: Theory, Design and Applications Kimon P. Valavanis, George N. Saridis, 2012-12-06 Since the late 1960s there has been a revolution in robots and industrial automation from the design of robots with no computing or sensory capabilities first generation to the design of robots with limited computational power and feedback capabilities second generation and the design of intelligent robots third generation which possess diverse sensing and decision making capabilities The development of the theory of intelligent machines has been developed in parallel to the advances in robot design This theory is the natural outcome of research and development in classical control 1950s adaptive and learning control 1960s self organizing control 1970s and intelligent control systems 1980s The theory of intelligent machines involves utilization and integration of concepts and ideas from the diverse disciplines of science engineering and mathematics and fields like artificial intelligence system theory and operations research The main focus and motivation is to bridge the gap between diverse disciplines involved and bring under a common cover several generic methodologies pertaining to what has been defined as machine intelligence Intelligent robotic systems are a specific application of intelligent machines They are complex computer controlled robotic systems equipped with a

diverse set of visual and non visual sensors and possess decision making and problem solving capabilities within their domain of operation Their modeling and control is accomplished via analytical and heuristic methodologies and techniques pertaining to generalized system theory and artificial intelligence Intelligent Robotic Systems Theory Design and Applications presents and justifies the fundamental concepts and ideas associated with the modeling and analysis of intelligent robotic systems Appropriate for researchers and engineers in the general area of robotics and automation Intelligent Robotic Systems is both a solid reference as well as a text for a graduate level course in intelligent robotics machines

Intelligent Robotic Systems Spyros G. Tzafestas, 2020-08-27 A multiplicity of techniques and angles of attack are incorporated in 18 contributions describing recent developments in the structure architecture programming control and implementation of industrial robots capable of performing intelligent action and decision making Annotation copyright Book

Qualitative Motion Understanding Wilhelm Burger, Bir Bhanu, 2012-12-06 Mobile robots operating in real world outdoor scenarios depend on dynamic scene understanding for detecting and avoiding obstacles recognizing landmarks acquiring models and for detecting and tracking moving objects Motion understanding has been an active research effort for more than a decade searching for solutions to some of these problems however it still remains one of the more difficult and challenging areas of computer vision research Qualitative Motion Understanding describes a qualitative approach to dynamic scene and motion analysis called DRIVE Dynamic Reasoning from Integrated Visual Evidence The DRIVE system addresses the problems of a estimating the robot s egomotion b reconstructing the observed 3 D scene structure and c evaluating the motion of individual objects from a sequence of monocular images The approach is based on the FOE focus of expansion concept but it takes a somewhat unconventional route The DRIVE system uses a qualitative scene model and a fuzzy focus of expansion to estimate robot motion from visual cues to detect and track moving objects and to construct and maintain a global dynamic reference model

Control and Dynamic Systems V39: Advances in Robotic Systems Part 1 of 2 C.T. Leonides, 2012-12-02 Advances in Robotic Systems Part 1 shows how the activity in robotic systems has increased significantly over the past decade Major centers of research and development in robotic systems were established on the international scene and these became focal points for the brilliant research efforts of many academicians and industrial professionals The systems aspects of robotics in general and of robot control in particular are manifested through a number of technical facts This book comprises 10 chapters with the first focusing on applications of neural networks to robotics The following chapters then discuss a unified approach to kinematic modeling identification and compensation for robot calibration nonlinear control algorithms in robotic systems and kinematic and dynamic task space motion planning for robot control Other chapters cover discrete kinematic modeling techniques in Cartesian space for robotic system force distribution algorithms for multifingered grippers frequency analysis for a discrete time robot system minimum cost trajectory planning for industrial robots tactile sensing techniques in robotic systems and sensor data fusion in robotic systems This book will be

of interest to practitioners in the fields of computer science systems science and mathematics

Nonholonomic Motion Planning Zexiang Li, J.F. Canny, 2012-12-06 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.

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.

Online Optimization of Large Scale Systems Martin Grötschel, Sven O. Krumke, Joerg Rambau, 2013-03-14 In its thousands of years of history, mathematics has made an extraordinary career. It started from rules for bookkeeping and computation of areas to become the language of science. Its potential for decision support was fully recognized in the twentieth century, only vitally aided by the evolution of computing and communication technology. Mathematical optimization, in particular, has developed into a powerful machinery to help planners. Whether costs are to be reduced, profits to be maximized, or scarce resources to be used wisely, optimization

methods are available to guide decision making Optimization is particularly strong if precise models of real phenomena and data of high quality are at hand often yielding reliable automated control and decision procedures But what if the models are soft and not all data are around Can mathematics help as well This book addresses such issues e g problems of the following type An elevator cannot know all transportation requests in advance In which order should it serve the passengers Wing profiles of aircrafts influence the fuel consumption Is it possible to continuously adapt the shape of a wing during the flight under rapidly changing conditions Robots are designed to accomplish specific tasks as efficiently as possible But what if a robot navigates in an unknown environment Energy demand changes quickly and is not easily predictable over time Some types of power plants can only react slowly

Camera-Aided Robot Calibration Hangi Zhuang, Zvi S. Roth, 2018-04-24 Robot calibration is the process of enhancing the accuracy of a robot by modifying its control software This book provides a comprehensive treatment of the theory and implementation of robot calibration using computer vision technology It is the only book to cover the entire process of vision based robot calibration including kinematic modeling camera calibration pose measurement error parameter identification and compensation The book starts with an overview of available techniques for robot calibration with an emphasis on vision based techniques It then describes various robot camera systems Since cameras are used as major measuring devices camera calibration techniques are reviewed Camera Aided Robot Calibration studies the properties of kinematic modeling techniques that are suitable for robot calibration It summarizes the well known Denavit Hartenberg D H modeling convention and indicates the drawbacks of the D H model for robot calibration The book develops the Complete and Parametrically Continuous CPC model and the modified CPC model that overcome the D H model singularities The error models based on these robot kinematic modeling conventions are presented No other book available addresses the important practical issue of hand eye calibration This book summarizes current research developments and demonstrates the pros and cons of various approaches in this area The book discusses in detail the final stage of robot calibration accuracy compensation using the identified kinematic error parameters It offers accuracy compensation algorithms including the intuitive task point redefinition and inverse Jacobian algorithms and more advanced algorithms based on optimal control theory which are particularly attractive for highly redundant manipulators Camera Aided Robot Calibration defines performance indices that are designed for off line optimal selection of measurement configurations It then describes three approaches closed form gradient based and statistical optimization The included case study presents experimental results that were obtained by calibrating common industrial robots Different stages of operation are detailed illustrating the applicability of the suggested techniques for robot calibration Appendices provide readers with preliminary materials for easier comprehension of the subject matter Camera Aided Robot Calibration is a must have reference for researchers and practicing engineers the only one with all the information

Embracing the Track of Expression: An Psychological Symphony within **Kinematic Modeling Identification And Control Of Robotic Manipulators**

In some sort of consumed by displays and the ceaseless chatter of instantaneous interaction, the melodic beauty and mental symphony created by the written word frequently fade in to the background, eclipsed by the persistent sound and disturbances that permeate our lives. But, set within the pages of **Kinematic Modeling Identification And Control Of Robotic Manipulators** a stunning literary prize brimming with raw emotions, lies an immersive symphony waiting to be embraced. Constructed by an outstanding musician of language, that fascinating masterpiece conducts readers on a psychological journey, skillfully unraveling the concealed tunes and profound impact resonating within each cautiously crafted phrase. Within the depths with this moving evaluation, we shall examine the book is main harmonies, analyze their enthralling writing fashion, and surrender ourselves to the profound resonance that echoes in the depths of readers souls.

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