Scientific Fundamentals of Robotics 1

Vukobratović · Potkonjak

Dynamics of Manipulation Robots

Theory and Application

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Scientific Fundamentals Of Robotics 1 Dynamics Of Manipulation Robots Theory And Application

Vladimir G. Ivancevic,Tijana T. Ivancevic

Scientific Fundamentals Of Robotics 1 Dynamics Of Manipulation Robots Theory And Application:

Dynamics of Manipulation Robots. Theory and Application ,1982 *Dynamics of Manipulation Robots* M. Vukobratovic,V. Potkonjak,2012-12-06 This monograph represents the first book of the series entitled SCI ENTIFIC FUNDAMENTALS OF ROBOTICS The aim of this monograph is to ap proach the dynamics of active mechanisms from the standpoint of its application to the synthesis of complex motion and computer aided de sign of manipulation mechanisms with some optimal performances The rapid development of a new class of mechanisms which may be referred to as active mechanisms contributed to their application in various environments from underwater to cosmic Because of some specific fea tures these mechanisms require very careful description both in a mechanical sense kinematic and dynamic and in the synthesis of algo rithms for precise tracking of the above motion under insufficiently defined operating conditions Having also in mind the need for a very fast even real time calculation of system dynamics and for eliminating in principle the errors made when forming mathematical models by hand this monograph will primarily present methods for automatic for mUlation of dynamic equations of motion of active spatial mechanisms Apart from these computer oriented methods mention will be made of all those methods which have preceded the computer oriented procedures predominantly developed for different problems of rigid body dynamics If we wish to systematically establish the origins of the scientific discipline which could be called robot dynamics we must recall some groups and individuals who by solving actual problems in the synthe sis and control of artificial motion have contributed to a gradual formation of this discipline Applied Control of Manipulation Robots Miomir Vukobratovic,Dragan Stokic,2012-12-06 The first book of the new textbook series entitled Applied Dynamics of Manipulation Robots Modelling Analysis and Examples by M Vukobratovic published by Springer Verlag 1989 was devoted to the problems of dynamic models and dynamic analysis of robots The present book the second in the series is concerned with the problems of the robot control In conceiving this textbook several dillemas arouse The main issue was the question on what should be incorporated in a textbook on such a complex subject Namely the robot control comprises a wide range of topics related to various aspects of robotics starting from the syn thesis of the lowest executive control level through the synthesis of trajectories which is mainly related to kinematic models of robots and various algorithms for solving the problem of task and robot moti on planning including the solving of the problems by the methods of artificial intelligence to the aspects of processing the data obtai ned from sensors The robot control is closely related to the robot pro gramming i e the development of highly specialized programming lan guages for robot programming Besides numerous aspects of the con trol realization should be included here It is obvious that all these aspects of control cannot be treated in detail in the frame of a text book Control of Manipulation Robots M. Vukobratovic,D. Stokic,2012-12-06 This monograph represents the second book of the series entitled SCI ENTIFIC FUNDAl 1ENTALS OF ROBOTICS While the first volume provides a study of the dynamics of spatial mechanisms and its application to the design of these mechanisms the present one focuses on the

synthesis of control based n the knowledge of dynamic models presented in de tail in the first_ volume In this way a logical continuity is formed in which one may easily recognize a dynamic approach to the design of manipulation r obots and the synthesis of control algorithms based on exact mathematical models of dynamics of open spatial mechanisms When writing the monograph the authors had the following objective to prove that a study of dynamic properties of manipulation mechanisms is justifiable to use the dynamic properties in the synthesis of con trol algorithms and to determine from one case to another a proper measure of dynamics depending on the type of manipulation task the v locity at which it is carried out and on the type of the manipu tion mechanisms itself The authors believe they have thus made the study of dynamics aimed at synthesizing algorithms for dynamic con trol free from unnecessary academicism and allowed the readers to apply all the results presented here to practical purposes of manipu lator design in thfil broader sense of the word At this point the au thors would like to present some concepts which were their guidelines in preparing this text **CAD/CAM Robotics and Factories of the Future** Birendra Prasad,S. N. Dwivedi,R. Mahajan,2013-12-19 The complete shop floor automation a lights out factory where workers initially set up all machines turn off the lights lock the door and the machine churns up the parts remains an unfulfilled dream Yet when we look at the enormity of the process of automation and integration even for the most simply conceived part factory we can recognize that automation has been applied and is being applied more so when it made sense from a cost benefit standpoint It is our nature to be dissatisfied with near term progress but when we realize how short a time the tools to do that automation have been available the progress is clearly noteworthy considering the multitudes of factors and the environment we have to deal with Most of the automa tion problems we confront in today s environment are multidisciplinary in nature They require not just the knowledge and experience in various distinct fields but good cooperation from different disci plined organizations to adequately comprehend and solve such problems In Volume III we have many examples that reflect the current state of the art techniques of robotics and plant automation The papers for Volume III have been arranged in a logical order of automation planning automated assembly robot programming and simula tion control motion coordination communication and networking to factories of the future Non-Adaptive and Adaptive Control of Manipulation Robots M. Vukobratovic,D. Stokic,N. Kircanski,2013-12-11 The material presented in this monograph is a logical continuation of research results achieved in the control of manipulation robots This is in a way a synthesis of many year research efforts of the associates of Robotics Department Mihailo Pupin Institute in the field of dynamic control of robotic systems As in Vol 2 of this Series all results rely on the mathematical models of dynamics of active spatial mechanisms which offer the possibility for adequate dynamic control of manipula tion robots Compared with Vol 2 this monograph has three essential new character istics and a variety of new tasks arising in the control of robots which have been formulated and solved for the first time One of these novelties is nonadaptive control synthesized for the case of large variations in payload parameters under the condition that the practical stability of the overall system is satisfied Such a case

of control synthesis meets the actual today s needs in industrial robot applications The second characteristic of the monograph is the efficient adaptive control algorithm based on decentralized control structure intended for tasks in which parameter variations cannot be specified in advance To be objective this is not the case in industrial robotics today Thus nonadaptive control with and without a particular parameter variation is supplemented by adaptive dynamic control algorithms which will cer tainly be applicable in the future industrial practice when parametric identification of workpieces will be required **Robot Technology and Applications** K. Rathmill,P. MacConaill,S. O'Leary,J. Browne,2013-06-29

Geometrical Dynamics of Complex Systems Vladimir G. Ivancevic,Tijana T. Ivancevic,2006-09-10 Geometrical Dynamics of Complex Systems is a graduate level monographic textbook Itrepresentsacomprehensiveintroductionintorigorousgeometrical dynamicsofcomplexsystemsofvariousnatures By complexsystems inthis book are meant high dimensional nonlinear systems which can be but not necessarily are adaptive This monograph proposes a uni ed geometrical proachtodynamicsofcomplexsystemsofvariouskinds engineering physical biophysical psychophysical sociophysical econophysical etc As their names suggest all these multi input multi output MIMO systems have something in common the underlying physics However instead of dealing with the pop 1 ular soft complexity philosophy we rather propose a rigorous geometrical and topological approach We believe that our rigorous approach has much greater predictive power than the soft one We argue that science and te nology is all about prediction and control Observation understanding and explanation are important in education at undergraduate level but after that it should be all prediction and control The main objective of this book is to show that high dimensional nonlinear systems and processes of real life can be modelled and analyzed using rigorous mathematics which enables their complete predictability and controllability as if they were linear systems It is well known that linear systems which are completely predictable and controllable by de nition live only in Euclidean spaces of various mensions They are as simple as possible mathematically elegant and fully elaborated from either scienti c or engineering side However in nature no ing is linear In reality everything has a certain degree of nonlinearity which means unpredictability with subsequent uncontrollability **Applied Dynamics of Manipulation Robots** Miomir Vukobratovic,2012-12-06 During the period 1982 1985 six books of the series Scientific Fun damentals of Robotics were published by Springer Verlag In chronolo gical order these were Dynamics of Manipulation Robots Theory and Application by M Vukobra tovic and V Potkonjak Control of Manipulation Robots Theory and Ap plication by M vukobratovic and D Stokic Kinematics and Trajectory Synthesis of Manipulation Robots by M Vukobratovic and H Kircanski Real Time Dynamics of Hanipulation Robots by M Vukobratovic and N Kircanski Non Adaptive and Adaptive Control of Manipulation Robots by M Vukobratovic D Stokic and N Kircanski and Computer Aided De sign and Applied Dynamics of Manipulation Robots by M Vukobratovic and V Potkonjak Within the series during 1989 two monographs dealing with new sub jects will be published So far amongst the published monographs Vol 1 has been translated into Japanese

Volumes 2 and 5 into Russian and Volumes 1 6 will appear in Chinese and Hungarian In the author s opinion the afore mentioned monographs in principle cover with sufficient breadth the topics devoted to the design of ro bots and their control systems at the level of post graduate study in robotics However if this material was also to apply to the study of robotics at under graduate level it would have to be modified so as to obtain the character of a textbook With this in mind it must be noted that the subject matter contained in the text cannot be simpli fied but can only be elaborated in more detail

Analysis of Periodically Time-Varying Systems John A. Richards,2012-12-06 Many of the practical techniques developed for treating systems described by periodic differential equations have arisen in different fields of application con sequently some procedures have not always been known to workers in areas that might benefit substantially from them Furthermore recent analytical methods are computationally based so that it now seems an opportune time for an applications oriented book to be made available that in a sense bridges the fields in which equations with periodic coefficients arise and which draws together analytical methods that are implemented readily This book seeks to ftll that role from a user s and not a theoretician s view The complexities of periodic systems often demand a computational approach Matrix treatments therefore are emphasized here although algebraic methods have been included where they are useful in their own right or where they establish properties that can be exploited by the matrix approach The matrix development given calls upon the nomenclature and treatment of H D Angelo Linear Time Varying Systems Analysis and Synthesis Boston Allyn and Bacon 1970 which deals with time varying systems in general It is recommended for its modernity and comprehensive approach to systems analysis by matrix methods Since the present work is applications oriented no attempt has been made to be complete theoretically by way of presenting all proofs existence theorems and so on These can be found in D Angelo and classic and well developed treatises such as McLachlan N W Theory and application of Mathieu functions Dynamic Analysis of Robot Manipulators Constantinos A. Balafoutis,Rajnikant V. Patel,2012-12-06 The purpose of this monograph is to present computationally efficient algorithms for solving basic problems in robot manipulator dynamics In par ticular the following problems of rigid link open chain manipulator dynam ics are considered i computation of inverse dynamics ii computation of forward dynamics and iii generation of linearized dynamic models Com putationally efficient solutions of these problems are prerequisites for real time robot applications and simulations Cartesian tensor analysis is the mathematical foundation on which the above mentioned computational algorithms are based In particular it is shown in this monograph that by exploiting the relationships between second order Cartesian tensors and their vector invariants a number of new tensor vector identities can be obtained These identities enrich the theory of Carte sian tensors and allow us to manipulate complex Cartesian tensor equations effuctively Moreover based on these identities the classical vector descrip tion for the Newton Euler equations of rigid body motion are rewritten in an equivalent tensor formulation which is shown to have computational advan tages over the classical vector formulation Thus based on Cartesian tensor analysis a conceptually

simple easy to implement and computationally efficient tensor methodology is presented in this monograph for studying classical rigid body dynamics XlI Application of this tensor methodology to the dynamic analysis of rigid link open chain robot manipulators is simple and leads to an efficient fonnulation of the dynamic equations of motion **Applied mechanics reviews** ,1948 *Applied Dynamics and CAD of Manipulation Robots* M. Vukobratovic,V. Potkonjak,2013-12-11 This book is a logical continuation of Volume 1 of the series entitled Scientific Fundamentals of Robotics which presents all of the basic methods for computerized construction of dynamics of manipulation ro bots as well as the essential concepts of computer aided design of their mechanics Vol 1 of the Series also contains the main practical re sults from the elastodynamics of manipulation robots having in mind a need for forming a computer procedure which allows efficient checks of elastic deformations of a manipulator tip or some other of its charac teristic points Wishing to add a highly applications oriented dimension to the dynamic aspect of studies of manipulation robots the authors have made a kind of a topic based selection by leaving unconsidered some aspects of studies of robots such as elasticity and discussing others more im portant in their opinion to such an extent as suffices to make them practically applicable The authors have decided not to treat in detail the problem of flexible manipulation robots for two reasons The first results from the atti tude that the permissible desired robot elasticity may satisfacto rily well be tested using the method described in Vol 1 of the Series *Biped Locomotion* Miomir Vukobratovic,Branislav Borovac,Dusan Surla,Dragan Stokic,2012-12-06 Here for the first time in one book is a comprehensive and systematic approach to the dynamic modeling and control of biped locomotion robots A survey is included of various approaches to the control of biped robots and a new approach to the control of biped systems based on a complete dynamic model is presented in detail The stability of complete biped system is presented for the first time as a highly nonlinear dynamic system Also included is new software for the synthesis of a dynamically stable walk for arbitrary biped systems presented here for the first time A survey of various realizations of biped systems and numerous numerical examples are given The reader is given a deep insight into the entire area of biped locomotion The book covers all relevant approaches to the subject and gives the most complete account to date of dynamic modeling control and realizations of biped systems **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 **Introduction to Robotics** Miomir Vukobratovic,2012-12-06 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 *Theory of Robot Control* Carlos Canudas de Wit,Bruno Siciliano,Georges Bastin,2012-12-06 The advent of new high speed microprocessor technology together with the need for high performance robots created substantial and realistic place for control theory in the field of robotics Since the beginning of the 80 s robotics and control theory have greatly benefited from a mutual fertiliza

tion On one hand robot models inherently highly nonlinear have been used as good case studies for exemplifying general concepts of analysis and design of advanced control theory on the other hand robot manipulator by using new control algorithms Fur performance has been improved thermore many interesting robotics problems e g in mobile robots have brought new control theory research lines and given rise to the development of new controllers time varying and nonlinear Robots in control are more than a simple case study They represent a natural source of inspiration and a great pedagogical tool for research and teaching in control theory Several advanced control algorithms have been developed for different types of robots rigid flexible and mobile based either on existing control techniques e g feedback linearization and adaptive control or on new control techniques that have been developed on purpose Most of those results although widely spread are nowadays rather dispersed in different journals and conference proceedings The purpose of this book is to collect some of the most fundamental and current results on theory of robot control in a unified framework by editing improving and completing previous works in the area **RoManSy 6** A. Morecki,G. Bianchi,K. K?dzior,2012-12-06 Journal of Mechanisms, Transmissions, and Automation in Design ,1984 The Mechanical Systems Design Handbook Yildirim Hurmuzlu,Osita D.I. Nwokah,2017-12-19 With a specific focus on the needs of the designers and engineers in industrial settings The Mechanical Systems Design Handbook Modeling Measurement and Control presents a practical overview of basic issues associated with design and control of mechanical systems In four sections each edited by a renowned expert this book answers diverse questions fundamental to the successful design and implementation of mechanical systems in a variety of applications Manufacturing addresses design and control issues related to manufacturing systems From fundamental design principles to control of discrete events machine tools and machining operations to polymer processing and precision manufacturing systems Vibration Control explores a range of topics related to active vibration control including piezoelectric networks the boundary control method and semi active suspension systems Aerospace Systems presents a detailed analysis of the mechanics and dynamics of tensegrity structures Robotics offers encyclopedic coverage of the control and design of robotic systems including kinematics dynamics soft computing techniques and teleoperation Mechanical systems designers and engineers have few resources dedicated to their particular and often unique problems The Mechanical Systems Design Handbook clearly shows how theory applies to real world challenges and will be a welcomed and valuable addition to your library

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