

# DYNAMICS AND ROBUST CONTROL OF ROBOT-ENVIRONMENT INTERACTION



Miomir Vukobratovic • Dragoljub Surdilovic  
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# Dynamics And Robust Control Of Robot Environment Interaction Author Vukobratovic Miomir Jun 2009

**D. Katic, M. Vukobratovic**



## **Dynamics And Robust Control Of Robot Environment Interaction Author Vukobratovic Miomir Jun 2009:**

Dynamics and Robust Control of Robot-Environment Interaction Miomir Vukobratovic, 2009 This book covers the most attractive problem in robot control dealing with the direct interaction between a robot and a dynamic environment including the human robot physical interaction It provides comprehensive theoretical and experimental coverage of interaction control problems starting from the mathematical modeling of robots interacting with complex dynamic environments and proceeding to various concepts for interaction control design and implementation algorithms at different control layers Focusing on the learning principle it also shows the application of new and advanced learning algorithms for robotic contact tasks

Dynamics of Robots with Contact Tasks M. Vukobratovic, V. Potkonjak, V. Matijevic, 2003-11-30 As robots are becoming more and more sophisticated the interest in robot dynamics is increasing Within this field contact problems are among the most interesting since contacts are present in almost any robot task and introduce serious complexity to system dynamics strongly influencing robot behavior The book formulates dynamic models of robot interaction with different kinds of environment from pure geometrical constraints to complex dynamic environments It provides a number of examples Dynamic modeling is the primary interest of the book but control issues are treated as well Because dynamics and contact control tasks are strongly related the authors also provide a brief description of relevant control issues The book will be of interest to engineers working in research and development in robotics and automation and to both graduate and postgraduate students The work will also be valuable to readers involved in manufacturing robotics automation computer and control engineering

**Intelligent Control of Robotic Systems** D. Katic, M. Vukobratovic, 2013-03-14 As robotic systems make their way into standard practice they have opened the door to a wide spectrum of complex applications Such applications usually demand that the robots be highly intelligent Future robots are likely to have greater sensory capabilities more intelligence higher levels of manual dexterity and adequate mobility compared to humans In order to ensure high quality control and performance in robotics new intelligent control techniques must be developed which are capable of coping with task complexity multi objective decision making large volumes of perception data and substantial amounts of heuristic information Hence the pursuit of intelligent autonomous robotic systems has been a topic of much fascinating research in recent years On the other hand as emerging technologies Soft Computing paradigms consisting of complementary elements of Fuzzy Logic Neural Computing and Evolutionary Computation are viewed as the most promising methods towards intelligent robotic systems Due to their strong learning and cognitive ability and good tolerance of uncertainty and imprecision Soft Computing techniques have found wide application in the area of intelligent control of robotic systems

Dynamics and Control of Robotic Manipulators with Contact and Friction Shiping Liu, Gang S. Chen, 2018-11-15 A comprehensive guide to the friction contact and impact on robot control and force feedback mechanism Dynamics and Control of Robotic Manipulators with Contact and Friction offers an authoritative guide to the basic principles of robot dynamics and control

with a focus on contact and friction The authors discuss problems in interaction between human and real or virtual robot where dynamics with friction and contact are relevant The book fills a void in the literature with a need for a text that considers the contact and friction generated in robot joints during their movements Designed as a practical resource the text provides the information needed for task planning in view of contact impact and friction for the designer of a robot control system for high accuracy and long durability The authors include a review of the most up to date advancements in robot dynamics and control It contains a comprehensive resource to the effective design and fabrication of robot systems and components for engineering and scientific purposes This important guide Offers a comprehensive reference with systematic treatment and a unified framework Includes simulation and experiments used in dynamics and control of robot considering contact impact and friction Discusses the most current tribology methodology used to treat the multiple scale effects Contains valuable descriptions of experiments and software used Presents illustrative accounts on the methods employed to handle friction in the closed loop including the principles implementation application scope merits and demerits Offers a cohesive treatment that covers tribology and multi scales multi physics and nonlinear stochastic dynamics control Written for graduate students of robotics mechatronics mechanical engineering tracking control and practicing professionals and industrial researchers Dynamics and Control of Robotic Manipulators with Contact and Friction offers a review to effective design and fabrication of stable and durable robot system and components

### **Dynamics of Robots with Contact Tasks**

M. Vukobratovic,V. Potkonjak,V. Matijevic,2014-03-14 As robots are becoming more and more sophisticated the interest in robot dynamics is increasing Within this field contact problems are among the most interesting since contacts are present in almost any robot task and introduce serious complexity to system dynamics strongly influencing robot behavior The book formulates dynamic models of robot interaction with different kinds of environment from pure geometrical constraints to complex dynamic environments It provides a number of examples Dynamic modeling is the primary interest of the book but control issues are treated as well Because dynamics and contact control tasks are strongly related the authors also provide a brief description of relevant control issues The book will be of interest to engineers working in research and development in robotics and automation and to both graduate and postgraduate students The work will also be valuable to readers involved in manufacturing robotics automation computer and control engineering

*Robust Control of Robots* Adriano A. G. Siqueira,Marco H. Terra,Marcel Bergerman,2011-08-14 Robust Control of Robots bridges the gap between robust control theory and applications with a special focus on robotic manipulators It is divided into three parts robust control of regular fully actuated robotic manipulators robust post failure control of robotic manipulators and robust control of cooperative robotic manipulators In each chapter the mathematical concepts are illustrated with experimental results obtained with a two manipulator system They are presented in enough detail to allow readers to implement the concepts in their own systems or in Control Environment for Robots a MATLAB based simulation program freely available from the authors The target

audience for Robust Control of Robots includes researchers practicing engineers and graduate students interested in implementing robust and fault tolerant control methodologies to robotic manipulators

*Human-Robot Interaction Control Using Reinforcement Learning* Wen Yu, Adolfo Perrusquia, 2021-10-06 A comprehensive exploration of the control schemes of human robot interactions In Human Robot Interaction Control Using Reinforcement Learning an expert team of authors delivers a concise overview of human robot interaction control schemes and insightful presentations of novel model free and reinforcement learning controllers The book begins with a brief introduction to state of the art human robot interaction control and reinforcement learning before moving on to describe the typical environment model The authors also describe some of the most famous identification techniques for parameter estimation Human Robot Interaction Control Using Reinforcement Learning offers rigorous mathematical treatments and demonstrations that facilitate the understanding of control schemes and algorithms It also describes stability and convergence analysis of human robot interaction control and reinforcement learning based control The authors also discuss advanced and cutting edge topics like inverse and velocity kinematics solutions H2 neural control and likely upcoming developments in the field of robotics Readers will also enjoy A thorough introduction to model based human robot interaction control Comprehensive explorations of model free human robot interaction control and human in the loop control using Euler angles Practical discussions of reinforcement learning for robot position and force control as well as continuous time reinforcement learning for robot force control In depth examinations of robot control in worst case uncertainty using reinforcement learning and the control of redundant robots using multi agent reinforcement learning Perfect for senior undergraduate and graduate students academic researchers and industrial practitioners studying and working in the fields of robotics learning control systems neural networks and computational intelligence Human Robot Interaction Control Using Reinforcement Learning is also an indispensable resource for students and professionals studying reinforcement learning

#### **Non-adaptive and Adaptive Control of Manipulation**

**Robots** M. Vukobratovic, Dragan Stokić, Nenad Kirćanski, 1985 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 manipulation robots Compared with Vol 2 this monograph has three essential new characteristics 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 certainly be applicable in the future industrial practice when parametric identification of workpieces will be required **Applied**

**Control of Manipulation Robots** Miomir Vukobratović, Dragan Stokić, 1989 The main purpose of this book is to serve as a textbook for courses on robot control at junior senior undergraduate or postgraduate level It presents in a simple and systematic fashion relevant problems of robot control as well as approaches and methods for their solution which have been verified in practice The reader will gain a complete insight into the field of robot control whereby practical aspects are particularly emphasized The presentation is complemented by a number of numerical examples illustrating all methods and control approaches presented and a large number of exercises and software for control synthesis and analysis for the computer aided synthesis of robot control **Real-time Dynamics of Manipulation Robots** M. Vukobratovic, Nenad

Kirčanski, 1985 This is the fourth book from the Series Scientific Fundamentals of Robotics The first two volumes have established a background for studying the dynamics and control of robots While the first book was exclusively devoted to the dynamics of active spatial mechanisms the second treated the problems of the dynamic control of manipulation robots In contrast to the first two books where recursive computer aided methods for setting robot dynamic equations were described this monograph presents a new approach to the formation of robot dynamics The goal is to achieve the real time model computation using up to date microcomputers The presented concept could be called a numeric symbolic or analytic approach to robot modelling It will be shown that the generation of analytical robot model may give new excellent possibilities concerning real time applications It is of essential importance in synthesizing the algorithms for nonadaptive and adaptive control of manipulation robots It should be pointed out that the high computational efficiency has been achieved by off line computer aided preparation of robot equations The parameters of a specified robot must be given in advance This after each significant variation in robot structure geometrical and dynamical parameters we must repeat the off line stage Thus is why the numerical procedures will always have their place in studying the dynamic properties of robotic systems This monograph is organized in 5 chapters

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**Introduction**

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