

Planning,

Geometry

and

Complexity

of Robot Motion



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Joseph T. Schwartz Michael Sharir
John Hightower

Planning Geometry And Complexity Of Robot Motion

Sbornik Statei



Planning Geometry And Complexity Of Robot Motion:

Planning, Geometry, and Complexity of Robot Motion Jacob T. Schwartz, Micha Sharir, John E. Hopcroft, 1987
Robotics has come to attract the attention of mathematicians and theoretical computer scientists to a rapidly increasing degree Initial investigations have shown that robotics is a rich source of deep theoretical problems which range over computational geometry control theory and many aspects of physics and whose solutions draw upon methods developed in subjects as diverse as automata theory algebraic topology and Fourier analysis

Incremental Geometric Robot Motion Planning Michael Tracy Barbehenn, University of Illinois at Urbana-Champaign. Department of Computer Science, 1996
Algorithmic and Geometric Aspects of Robotics (Routledge Revivals) Jacob T. Schwartz, Chee-Keng Yap, 2016-07-01 First published in 1987 the seven chapters that comprise this book review contemporary work on the geometric side of robotics The first chapter defines the fundamental goal of robotics in very broad terms and outlines a research agenda each of whose items constitutes a substantial area for further research The second chapter presents recently developed techniques that have begun to address the geometric side of this research agenda and the third reviews several applied geometric ideas central to contemporary work on the problem of motion planning The use of Voronoi diagrams a theme opened in these chapters is explored further later in the book The fourth chapter develops a theme in computational geometry having obvious significance for the simplification of practical robotics problems the approximation or decomposition of complex geometric objects into simple ones The final chapters treat two examples of a class of geometric reconstruction problem that have immediate application to computer aided geometric design systems

Proceedings of the Seventh Annual ACM-SIAM Symposium on Discrete Algorithms, 1996-01-01 This text covers the proceedings of the Seventh Annual ACM SIAM Symposium on Discrete Algorithms which was held in Atlanta Georgia in January 1996

Graphics and Robotics Wolfgang Straßer, Friedrich M. Wahl, 2012-12-06 Problems common to graphics and robotics are covered in this reviewed selection of papers written following a 1993 workshop Leading experts from both disciplines met to identify common problems to present new solutions and to discuss future research directions Topics covered include robot simulation using graphics workstations simulation concepts in the framework of teleoperation path planning strategies collision detection techniques experimentation using virtual reality modeling techniques for automated programming and for objects with curved surfaces object oriented implementations various aspects of robot vision and in a paper that reflects the essence of the workshop the challenging task of designing a vision system for a domestic robot

Handbook of Discrete and Computational Geometry Csaba D. Toth, Joseph O'Rourke, Jacob E. Goodman, 2017-11-22 The Handbook of Discrete and Computational Geometry is intended as a reference book fully accessible to nonspecialists as well as specialists covering all major aspects of both fields The book offers the most important results and methods in discrete and computational geometry to those who use them in their work both in the academic world as researchers in mathematics and computer science and in the professional

world as practitioners in fields as diverse as operations research molecular biology and robotics Discrete geometry has contributed significantly to the growth of discrete mathematics in recent years This has been fueled partly by the advent of powerful computers and by the recent explosion of activity in the relatively young field of computational geometry This synthesis between discrete and computational geometry lies at the heart of this Handbook A growing list of application fields includes combinatorial optimization computer aided design computer graphics crystallography data analysis error correcting codes geographic information systems motion planning operations research pattern recognition robotics solid modeling and tomography

Theory of Automatic Robot Assembly and Programming B.O. Nnaji,2012-12-06 Machines will gradually become programmed using computers which have the knowledge of how the objects in the world relate to one another This book capitalizes on the fact that products which are manufactured can be designed on the computer and that information about the product such as its physical shape provide powerful information to reason about how to develop the process plan for their manufacture This book explores the whole aspect of using the principles of how parts behave naturally to automatically generate programs that govern how to produce them The last decade saw tremendous work on how machines can be programmed to perform a variety of tasks automatically Robotics has witnessed the most work on programming techniques But it was not until the emergence of the advanced CAD system as a proper source of information representation about objects which are to be manipulated by the robot that it became viable for automated processors to generate robot programs without human interface It became possible for objects to be described and for principles about how they interact in the world to be developed The functions which the features designed into the objects serve for the objects can be adequately represented and used in reasoning about the manufacturing of the parts using the robot This book describes the necessary principles which must be developed for a robot to generate its own programs with the knowledge of the world in the CAD system

Geometric and Numerical Foundations of Movements Jean-Paul Laumond,Nicolas Mansard,Jean-Bernard Lasserre,2017-05-02 This book aims at gathering roboticists control theorists neuroscientists and mathematicians in order to promote a multidisciplinary research on movement analysis It follows the workshop Geometric and Numerical Foundations of Movements held at LAAS CNRS in Toulouse in November 2015 1 Its objective is to lay the foundations for a mutual understanding that is essential for synergetic development in motion research In particular the book promotes applications to robotics and control in general of new optimization techniques based on recent results from real algebraic geometry

Computational Geometry in C Joseph O'Rourke,1998-10-13 This is the revised and expanded 1998 edition of a popular introduction to the design and implementation of geometry algorithms arising in areas such as computer graphics robotics and engineering design The basic techniques used in computational geometry are all covered polygon triangulations convex hulls Voronoi diagrams arrangements geometric searching and motion planning The self contained treatment presumes only an elementary knowledge of mathematics but reaches topics on the frontier of current research

making it a useful reference for practitioners at all levels The second edition contains material on several new topics such as randomized algorithms for polygon triangulation planar point location 3D convex hull construction intersection algorithms for ray segment and ray triangle and point in polyhedron The code in this edition is significantly improved from the first edition more efficient and more robust and four new routines are included Java versions for this new edition are also available All code is accessible from the book's Web site <http://cs.smith.edu/orourke> or by anonymous ftp

Handbook of Geometric Computing Eduardo Bayro Corrochano, 2005-12-06 Many computer scientists engineers applied mathematicians and physicists use geometry theory and geometric computing methods in the design of perception action systems intelligent autonomous systems and man machine interfaces This handbook brings together the most recent advances in the application of geometric computing for building such systems with contributions from leading experts in the important fields of neuroscience neural networks image processing pattern recognition computer vision uncertainty in geometric computations conformal computational geometry computer graphics and visualization medical imagery geometry and robotics and reaching and motion planning For the first time the various methods are presented in a comprehensive unified manner This handbook is highly recommended for postgraduate students and researchers working on applications such as automated learning geometric and fuzzy reasoning human like artificial vision tele operation space maneuvering haptics rescue robots man machine interfaces tele immersion computer and robotics aided neurosurgery or orthopedics the assembly and design of humanoids and systems for metalevel reasoning

Robotics in Alpe-Adria Region Peter Kopacek, 2012-12-06 Industrial robots as a kind of a mechatronic system were the objects for intensive scientific research in the last years Kinematics and kinetics advanced control algorithms flexible robots mobile robots cooperation of robots were research topics Meanwhile the industrial robot is more or less a tool on the shop floor level like NC and CNC machines transportation and storage devices The current research landscape on industrial robots can be divided in two directions The first direction is the scientific one and topics like fuzzy control applications of neuronal networks application of methods of artificial intelligence for robot control optimal path planning are currently headlines in this field On the other hand the application oriented research goes in the direction to develop and create new low cost concepts including industrial robots applicable in a commercially efficient way mainly in small and medium sized companies The industry in most of the member countries of the Alpe Adria Group are dominated by small and medium sized companies Industrial robots together with the appropriate CIM concepts are a very efficient tool for increasing the flexibility of such companies At the first meeting in Portoroz June 1992 a first overview on robotics research and applications in Alpe Adria countries was given First steps were done in the direction of a broader cooperation in science development production and level of education among these countries

ICT Innovations 2013 Vladimir Trajkovik, Anastas Mishev, 2013-07-20 Information communication technologies have become the necessity in everyday life enabling increased level of communication processing and information exchange to extent that one could not

imagine only a decade ago Innovations in these technologies open new fields in areas such as language processing biology medicine robotics security urban planning networking governance and many others The applications of these innovations are used to define services that not only ease but also increase the quality of life Good education is essential for establishing solid basis of individual development and performance ICT is integrated part of education at every level and type Therefore the special focus should be given to possible deployment of the novel technologies in order to achieve educational paradigms adapted to possible educational consumer specific and individual needs This book offers a collection of papers presented at the Fifth International Conference on ICT Innovations held in September 2013 in Ohrid Macedonia The conference gathered academics professionals and practitioners in developing solutions and systems in the industrial and business arena especially innovative commercial implementations novel applications of technology and experience in applying recent ICT research advances to practical solutions

Dynamics of Controlled Mechanical Systems Gerhard Schweitzer,M.

Mansour,2012-12-06 Many mechanical systems are actively controlled in order to improve their dynamic performance Examples are elastic satellites active vehicle suspension systems robots magnetic bearings automatic machine tools Problems that are typical for mechanical systems arise in the following areas Modeling the mechanical system in such a way that the model is suitable for control design Designing multivariable controls to be robust with respect to parameter variations and uncertainties in system order of elastic structures Fast real time signal processing Generating high dynamic control forces and providing the necessary control power Reliability and safety concepts taking into account the growing role of software within the system The objective of the Symposium has been to present methods that contribute to the solutions of such problems Typical examples are demonstrating the state of the art It intends to evaluate the limits of performance that can be achieved by controlling the dynamics and it should point to gaps in present research and areas for future research Mainly it has brought together leading experts from quite different areas presenting their points of view The International Union of Theoretical and Applied Mechanics IUTAM has initiated and sponsored in cooperation with the International Federation of Automatic Control IFAC this Symposium on Dynamics of Controlled Mechanical Systems held at the Swiss Federal Institute of Technology ETH in Zurich Switzerland May 3D June 3 1988

Computational Geometry Mark de Berg,Otfried

Cheong,Marc van Kreveld,Mark Overmars,2008-03-07 Computational geometry emerged from the eld of algorithms design and analysis in the late 1970s It has grown into a recognized discipline with its own journals conferences and a large community of active researchers The success of the eld as a research discipline can on the one hand be explained from the beauty of the problems studied and the solutions obtained and on the other hand by the many application domains computer graphics geographic information systems GIS robotics and others in which geometric algorithms play a fundamental role For many geometric problems the early algorithmic solutions were either slow or dif cult to understand and implement In recent years a number of new algorithmic techniques have been developed that improved and simpli ed many of the previous

approaches In this textbook we have tried to make these modern algorithmic solutions accessible to a large audience The book has been written as a textbook for a course in computational geometry but it can also be used for self study

Davenport-Schinzel Sequences and Their Geometric Applications Micha Sharir,Pankaj K. Agarwal,1995-05-26 These sequences exhibit some surprising properties that make them a fascinating subject for research in combinatorial analysis This 1995 book on the subject by two of its leading researchers will be an important resource for students and professionals in combinatorics computational geometry and related fields

The Complexity of Robot Motion Planning John Canny,1988 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 of finding 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 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

The World Yearbook of Robotics Research and Development Sbornik Statei,2013-04-17 How quickly the technological flavour of the month changes At the beginning of the 1980's many saw robotics as being something of a panacea for those problems in the manufacturing industries which had been exacerbated by the world recession Those working at the time in the field of robotics stressed that robots themselves were only part of the solution Yet in many quarters the hype for the new technology apparently knew few bounds resulting inexorably in many industries painfully discovering for themselves a new realism closely followed by disillusionment In its wider sense the term robotics covers an extremely broad spectrum of technologies ranging from extremely flexible highly sensory and integrated

systems capable of handling a very diverse product range through to comparatively inflexible high volume systems which can merely handle slightly different variations of the same basic product As a result of the one buzzword referring to such a variety of actual system types the disillusionment which started to become apparent during the early 1980 s acted as something of a double edged sword A given company might consider a particular robotics based technological solution to its production problems find that it was unsuitable and so renounce all robotics approaches as inappropriate Yet just because one position on that spectrum of technological solutions was unsuitable for the company should not have led them to assume that there was no other robotics solution that was appropriate

CAD/CAM Robotics and Factories of the Future '90 Suren N. Dwivedi, Alok K. Verma, John E. Sneckenberger, 2012-12-06 Flexibility is as acceptable an objective for today's industrial community as is automation Thus the title of this conference proceedings volume Flexible Automation reflects an added emphasis to the usual industrial automation As with general automation that has impacted every component of the manufacturing office and plant the identity of flexible automation can possess various forms and functions The papers in this volume have been grouped into two main categories One category deals with implementation of so called intelligent manufacturing This means use of algorithmic methods and artificial intelligence approaches to various problems encountered in practical factory automation tasks The placement of papers into five chapters of this part cannot be very precise due to multidisciplinary nature and constant rapid change of the field The categories are arranged starting from problems of enhancement of current factory settings and followed by the papers addressing more specific issues of production planning process technology and product engineering The fifth chapter contains papers on the very important aspects of factory automation problems of design simulation operation and monitoring of manufacturing cells

From Linear Operators to Computational Biology Martin Davis, Edmond Schonberg, 2012-07-28 In his rich and varied career as a mathematician computer scientist and educator Jacob T Schwartz wrote seminal works in analysis mathematical economics programming languages algorithmics and computational geometry In this volume of essays his friends students and collaborators at the Courant Institute of Mathematical Sciences present recent results in some of the fields that Schwartz explored quantum theory the theory and practice of programming program correctness and decision procedures dextrous manipulation in Robotics motion planning and genomics In addition to presenting recent results in these fields these essays illuminate the astonishingly productive trajectory of a brilliant and original scientist and thinker

Computer Algebra in Scientific Computing CASC 2001 Viktor G. Ganzha, Ernst W. Mayr, Evgenii V. Vorozhtsov, 2012-12-06 CASC 2001 continues a tradition started in 1998 of international conferences on the latest advances in the application of computer algebra systems to the solution of various problems in scientific computing The three earlier CASs' conferences in this sequence CASC 98 CASC 99 and CASC 2000 were held Petersburg Russia in Munich Germany and in Samarkand respectively in St Uzbekistan and proved to be very successful We have to thank the program committee listed overleaf for a tremendous job in soliciting and

providing reviews for the submitted papers There were more than three reviews per submission on average The result of this job is reflected in the present volume which contains revised versions of the accepted papers The collection of papers included in the proceedings covers various topics of computer algebra methods algorithms and software applied to scientific computing In particular five papers are devoted to the implementation of the analysis of involutive systems with the aid of CASs The specific examples include new efficient algorithms for the computation of Janet bases for monomial ideals involutive division involutive reduction method etc A number of papers deal with application of CASs for obtaining and validating new exact solutions to initial and boundary value problems for partial differential equations in mathematical physics Several papers show how CASs can be used to obtain analytic solutions of initial and boundary value problems for ordinary differential equations and for studying their properties

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