Motion Planning For Humanoid Robots

Kensuke Harada,Eiichi Yoshida,Kazuhito Yokoi

Motion Planning For Humanoid Robots:

Motion Planning for Humanoid Robots Kensuke Harada,Eiichi Yoshida,Kazuhito Yokoi,2010-08-12 Research on humanoid robots has been mostly with the aim of developing robots that can replace humans in the performance of certain tasks Motion planning for these robots can be quite difficult due to their complex kinematics dynamics and environment It is consequently one of the key research topics in humanoid robotics research and the last few years have witnessed considerable progress in the field Motion Planning for Humanoid Robots surveys the remarkable recent advancement in both the theoretical and the practical aspects of humanoid motion planning Various motion planning frameworks are presented in Motion Planning for Humanoid Robots including one for skill coordination and learning and one for manipulating and grasping tasks The problem of planning sequences of contacts that support acyclic motion in a highly constrained environment is addressed and a motion planner that enables a humanoid robot to push an object to a desired location on a cluttered table is described The main areas of interest include whole body motion planning task planning biped gait planning and sensor feedback for motion planning Torque level control of multi contact behavior autonomous manipulation of moving obstacles and movement control and planning architecture are also covered Motion Planning for Humanoid Robots will help readers to understand the current research on humanoid motion planning It is written for industrial engineers advanced undergraduate and postgraduate students **Motion Planning for Humanoid Robots** Kensuke Harada,Eiichi Yoshida,Kazuhito Yokoi,2011-03-25 Research on humanoid robots has been mostly with the aim of developing robots that can replace humans in the performance of certain tasks Motion planning for these robots can be quite difficult due to their complex kinematics dynamics and environment It is consequently one of the key research topics in humanoid robotics research and the last few years have witnessed considerable progress in the field Motion Planning for Humanoid Robots surveys the remarkable recent advancement in both the theoretical and the practical aspects of humanoid motion planning Various motion planning frameworks are presented in Motion Planning for Humanoid Robots including one for skill coordination and learning and one for manipulating and grasping tasks The problem of planning sequences of contacts that support acyclic motion in a highly constrained environment is addressed and a motion planner that enables a humanoid robot to push an object to a desired location on a cluttered table is described The main areas of interest include whole body motion planning task planning biped gait planning and sensor feedback for motion planning Torque level control of multi contact behavior autonomous manipulation of moving obstacles and movement control and planning architecture are also covered Motion Planning for Humanoid Robots will help readers to understand the current research on humanoid motion planning It is written for industrial engineers advanced undergraduate and postgraduate students *Motion and Operation Planning of Robotic Systems* Giuseppe Carbone,Fernando Gomez-Bravo,2015-03-12 This book addresses the broad multi disciplinary topic of robotics and presents the basic techniques for motion and operation planning in robotics systems Gathering contributions from experts in diverse and wide ranging fields it offers an overview of the most recent and cutting edge practical applications of these methodologies It covers both theoretical and practical approaches and elucidates the transition from theory to implementation An extensive analysis is provided including humanoids manipulators aerial robots and ground mobile robots Motion and Operation Planning of Robotic Systems addresses the following topics The theoretical background of robotics Application of motion planning techniques to manipulators such as serial and parallel manipulators Mobile robots planning including robotic applications related to aerial robots large scale robots and traditional wheeled robots Motion planning for humanoid robots An invaluable reference text for graduate students and researchers in robotics this book is also intended for researchers studying robotics control design user interfaces modelling simulation sensors humanoid robotics **Motion Planning for Legged and Humanoid Robots** Kris Hauser,2008 Motion Planning and Perception Alireza Nakhaei,2009 This thesis starts by proposing a new framework for motion planning using stochastic maps such as occupancy grid maps In autonomous robotics applications the robot s map of the environment is typically constructed online using techniques from SLAM These methods can construct a dense map of the environment or a sparse map that contains a set of identifiable landmarks In this situation path planning would be performed using the dense map and the path would be executed in a sensor based fashion using feedback control to track the reference path based on sensor information regarding landmark position Maximum likelihood estimation techniques are used to model the sensing process as well as to estimate the most likely nominal path that will be followed by the robot during execution of the plan The proposed approach is potentially a practical way to plan under the specific sorts of uncertainty confronted by a humanoid robot The next chapter presents methods for constructing free paths in dynamic environments The chapter begins with a comprehensive review of past methods ranging from modifying sampling based methods for the dynamic obstacle problem to methods that were specifically designed for this problem The thesis proposes to adapt a method reported originally by Leven et al so that it can be used to plan paths for humanoid robots in dynamic environments The basic idea of this method is to construct a mapping from voxels in a discretized representation of the workspace to vertices and arcs in a configuration space network built using sampling based planning methods When an obstacle intersects a voxel in the workspace the corresponding nodes and arcs in the configuration space roadmap are marked as invalid The part of the network that remains comprises the set of valid candidate paths The specific approach described here extends previous work by imposing a two level hierarchical structure on the representation of the workspace The methods described in Chapters 2 and 3 essentially deal with low dimensional problems e g moving a bounding box The reduction in dimensionality is essential since the path planning problem confronted in these chapters is complicated by uncertainty and dynamic obstacles respectively Chapter 4 addresses the problem of planning the full motion of a humanoid robot whole body task planning The approach presented here is essentially a four step approach First multiple viable goal configurations are generated using a local task solver and these are used in a classical path planning approach with one initial condition and multiple goals This classical problem is solved using an RRT based method Once a path is found optimization methods are applied to the goal posture Finally classic path optimization algorithms are applied to the solution path and posture optimization The fifth chapter describes algorithms for building a representation of the environment using stereo vision as the sensing modality Such algorithms are necessary components of the autonomous system proposed in the first chapter of the thesis A simple occupancy grid based method is proposed in which each voxel in the grid is assigned a number indicating the probability that it is occupied The representation is updated during execution based on values received from the sensing system The sensor model used is a simple Gaussian observation model in which measured distance is assumed to be true distance plus additive Gaussian noise Sequential Bayes updating is then used to incrementally update occupancy values as new measurements are received Finally chapter 6 provides some details about the overall system architecture and in particular about those components of the architecture that have been taken from existing software and therefore do not themselves represent contributions of the thesis Several software systems are described including GIK WorldModelGrid3D HppDynamicObstacle and GenoM Motion Planning for Legged and Humanoid Robots Kris Hauser (College teacher),2008 *Online Motion Planning for Hoap-2 Humanoid Robot Navigation* Mohammed M. Elmogy,Christopher Habel,Jianwei Zhang,2015 Autonomous robot navigation is becoming an increasingly important research topic for mobile robots In the last few years significant progress has been made towards stable robotic bipedal walking This is creating an increased research interest in developing autonomous navigation strategies which are tailored specifically to humanoid robots Efficient approaches to perception and motion planning which are suited to the unique characteristics of biped humanoid robots and their typical operating environments are receiving special interest In this paper we present a time efficient motion planning system for a Fujitsu HOAP 2 humanoid robot The sampling based algorithm is used to provide the robot with minimal free configuration space which is sampled to extract the robot path For collision detection a cylinder model is used to approximate the trajectory for the body center of the humanoid robot during navigation It calculates the actual distances required to execute different actions of the robot and compares them with the distances to the nearest obstacles The A search algorithm is then implemented to find smooth and low cost footstep placements of the humanoid robot within the resulting configuration space The proposed hybrid algorithm reduces searching time and produces a smoother path for the humanoid robot at a low cost *Humanoid Robots* Armando Carlos De Pina Filho,2007-06-01 For many years the human being has been trying in all ways to recreate the complex mechanisms that form the human body Such task is extremely complicated and the results are not totally satisfactory However with increasing technological advances based on theoretical and experimental researches man gets in a way to copy or to imitate some systems of the human body These researches not only intended to create humanoid robots great part of them constituting autonomous systems but also in some way to offer a higher knowledge of the systems that form the human body objectifying possible applications in the technology of rehabilitation of human beings gathering in a whole studies related not only to Robotics but also to Biomechanics Biomimmetics Cybernetics among other areas This book presents a series of researches inspired by this ideal carried through by various researchers worldwide looking for to analyze and to discuss diverse subjects related to humanoid robots The presented contributions explore aspects about robotic hands learning language vision and locomotion **Modeling of Human Movement for the Generation of Humanoid Robot Motion** Manish Narsipura Sreenivasa,2010 Humanoid robotics is coming of age with faster and more agile robots To compliment the physical complexity of humanoid robots the robotics algorithms being developed to derive their motion have also become progressively complex The work in this thesis spans across two research fields human neuroscience and humanoid robotics and brings some ideas from the former to aid the latter By exploring the anthropological link between the structure of a human and that of a humanoid robot we aim to guide conventional robotics methods like local optimization and task based inverse kinematics towards more realistic human like solutions First we look at dynamic manipulation of human hand trajectories while playing with a yoyo By recording human yoyo playing we identify the control scheme used as well as a detailed dynamic model of the hand yoyo system Using optimization this model is then used to implement stable yoyo playing within the kinematic and dynamic limits of the humanoid HRP 2 The thesis then extends its focus to human and humanoid locomotion We take inspiration from human neuroscience research on the role of the head in human walking and implement a humanoid robotics analogy to this By allowing a user to steer the head of a humanoid we develop a control method to generate deliberative whole body humanoid motion including stepping purely as a consequence of the head movement This idea of understanding locomotion as a consequence of reaching a goal is extended in the final study where we look at human motion in more detail Here we aim to draw to a link between invariants in neuroscience and kinematic tasks in humanoid robotics We record and extract stereotypical characteristics of human movements during a walking and grasping task These results are then normalized and generalized such that they can be regenerated for other anthropomorphic figures with different kinematic limits than that of humans The final experiments show a generalized stack of tasks that can generate realistic walking and grasping motion for the humanoid HRP 2 The general contribution of this thesis is in showing that while motion planning for humanoid robots can be tackled by classical methods of robotics the production of realistic movements necessitate the combination of these methods with the systematic and formal observation of human behavior **Time Efficient Hybrid Motion Planning Algorithm for Hoap-2 Humanoid Robot** Mohammed M. Elmogy,Christopher Habel,Jianwei Zhang,2015 The development of practical motion planning algorithms and obstacle avoidance techniques is considered as one of the most important fields of study in the task of building autonomous or semiautonomous robot systems The motion planners designed for humanoid robots combine both path planning generation and the ability of executing the resulting path with respect to their characteristics These planners should consider the specific dynamical constraints and stability problems of the humanoid robots In this paper we present a time efficient hybrid motion planning system for a Fujitsu HOAP 2 humanoid robot in indoor and miniature city environments The proposed technique is a combination of sampling based planner and D Lite search to generate dynamic footstep placements in unknown environments It generates the search space depending on non uniform sampling of the free configuration space to direct the computational resources to troubled and difficult regions D Lite search is then implemented to find dynamic and low cost footstep placements within the resulting configuration space The proposed hybrid algorithm reduces the searching time and produces a smoother path for the humanoid robot with low cost **Humanoid Robots** Matthias Hackel,2007-06-01 In this book the variety of humanoid robotic research can be obtained This book is divided in four parts Hardware Development Components and Systems Biped Motion Walking Running and Self orientation Sensing the Environment Acquisition Data Processing and Control and Mind Organisation Learning and Interaction The first part of the book deals with remarkable hardware developments whereby complete humanoid robotic systems are as well described as partial solutions In the second part diverse results around the biped motion of humanoid robots are presented The autonomous efficient and adaptive two legged walking is one of the main challenge in humanoid robotics The two legged walking will enable humanoid robots to enter our environment without rearrangement Developments in the field of visual sensors data acquisition processing and control are to be observed in third part of the book In the fourth part some mind building and communication technologies are presented **Robotics Research** Nancy M. Amato,Greg Hager,Shawna Thomas,Miguel Torres-Torriti,2019-11-28 ISRR the International Symposium on Robotics Research is one of robotics pioneering Symposia which has established over the past two decades some of the field s most fundamental and lasting contributions This book presents the results of the eighteenth edition of Robotics Research ISRR17 offering a collection of a broad range of topics in robotics This symposium took place in Puerto Varas Chile from December 11th to December 14th 2017 The content of the contributions provides a wide coverage of the current state of robotics research the advances and challenges in its theoretical foundation and technology basis and the developments in its traditional and new emerging areas of applications The diversity novelty and span of the work unfolding in these areas reveal the field s increased maturity and expanded scope and define the state of the art of robotics and its future direction

Robotics Research Paolo Dario,Raja Chatila,2005-08-24 ISRR the International Symposium on Robotics Research is one of robotics pioneering symposia which has established some of the field s most fundamental and lasting contributions over the past two decades This book presents the results of the eleventh edition of Robotics Research ISRR03 offering a broad range of topics in robotics The contributions provide a wide coverage of the current state of robotics research the advances and challenges in its theoretical foundation and technology basis and the developments in its traditional and new emerging areas of applications The diversity novelty and span of the work unfolding in these areas reveal the field s increased maturity and expanded scope and define the state of the art of robotics and its future direction **Integrating Perception and**

Planning for Humanoid Autonomy Philipp Michel,2008 Abstract Today s agile humanoid robots are testament to the impressive advances in the design of biped mechanisms and control in recent robotics history The big challenge however remains to properly exploit the generality and flexibility of humanoid platforms during fully autonomous operation in obstacle filled and dynamically changing environments Increasing effort has thus been focused on the challenges arising for perception and motion planning as well as the interplay between both as foundations of humanoid autonomy This thesis explores appropriate approaches to perception on humanoids and ways of coupling sensing and planning to generate navigation and manipulation strategies that can be executed reliably We investigate perception methods employing on and off body sensors that are combined with an efficient motion planner to allow the humanoid robot HRP 2 and Honda s ASIMO to traverse complex and unpredictably changing environments We examine how predictive information about the future state of the world gathered from observation enables navigation in the presence of challenging moving obstacles We show how programmable graphics hardware can be exploited to create a novel model based 3D tracking system able to robustly address the difficulties of real time sensing specifically encountered on a locomoting humanoid This thesis argues furthermore that reliability of autonomous operation can be improved by reasoning about perception during the planning process rather than maintaining the traditional separation of the sensing and planning stages We use the humanoid robots ARMAR III and HRP 2 to investigate and validate such planning for perceptive capability in manipulation and navigation scenarios While humanoid robots serve as the motivating challenge and application domain for this thesis much of the resulting work is general in nature and has applications in other areas of robotics and computer vision Intelligent Robotics and Applications Xuguang Lan,Xuesong Mei,Caigui Jiang,Fei Zhao,Zhiqiang Tian,2025-01-24 The 10 volume set LNAI 15201 15210 constitutes the proceedings of the 17th International Conference on Intelligent Robotics and Applications ICIRA 2024 which took place in Xi an China during July 31 August 2 2024 The 321 full papers included in these proceedings were carefully reviewed and selected from 489 submissions They were organized in topical sections as follows Part I Innovative Design and Performance Evaluation of Robot Mechanisms Part II Robot Perception and Machine Learning Cognitive Intelligence and Security Control for Multi domain Unmanned Vehicle Systems Part III Emerging Techniques for Intelligent Robots in Unstructured Environment Soft Actuators and Sensors and Advanced Intelligent and Flexible Sensor Technologies for Robotics Part IV Optimization and Intelligent Control of Underactuated Robotic Systems and Technology and application of modular robots Part V Advanced actuation and intelligent control in medical robotics Advancements in Machine Vision for Enhancing Human Robot Interaction and Hybrid Decision making and Control for Intelligent Robots Part VI Advances in Marine Robotics Visual Linguistic Affective Agents Hybrid augmented Agents for Robotics and Wearable Robots for Assistance Augmentation and Rehabilitation of human movements Part VII Integrating World Models for Enhanced Robotic Autonomy Advanced Sensing and Control Technologies for Intelligent Human Robot Interaction and Mini

Invasive Robotics for In Situ Manipulation Part VIII Robot Skill Learning and Transfer Human Robot Dynamic System Learning Modelling and Control AI Driven Smart Industrial Systems and Natural Interaction and Coordinated Collaboration of Robots in Dynamic Unstructured Environments Part IX Robotics in Cooperative Manipulation MultiSensor Fusion and Multi Robot Systems Human machine Co adaptive Interface Brain inspired intelligence for robotics Planning control and application of bionic novel concept robots and Robust Perception for Safe Driving Part X AI Robot Technology for Healthcare as a Service Computational Neuroscience and Cognitive Models for Adaptive Human Robot Interactions Dynamics and Perception of Human Robot Hybrid Systems and Robotics for Rehabilitation Innovations Challenges and Future Directions

Computational Approaches for Human-Human and Human-Robot Social Interactions Vittorio Murino,Cigdem Beyan,Gentiane Venture,Agnieszka Wykowska,2020-06-26 This eBook is a collection of articles from a Frontiers Research Topic Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series they are collections of at least ten articles all centered on a particular subject With their unique mix of varied contributions from Original Research to Review Articles Frontiers Research Topics unify the most influential researchers the latest key findings and historical advances in a hot research area Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office frontiersin org about contact **Humanoid Robots** Dragomir N. Nenchev,Atsushi Konno,Teppei Tsujita,2018-11-21 Humanoid Robots Modeling and Control provides systematic presentation of the models used in the analysis design and control of humanoid robots The book starts with a historical overview of the field a summary of the current state of the art achievements and an outline of the related fields of research It moves on to explain the theoretical foundations in terms of kinematic kineto static and dynamic relations Further on a detailed overview of biped balance control approaches is presented Models and control algorithms for cooperative object manipulation with a multi finger hand a dual arm and a multi robot system are also discussed One of the chapters is devoted to selected topics from the area of motion generation and control and their applications The final chapter focuses on simulation environments specifically on the step by step design of a simulator using the Matlab environment and tools This book will benefit readers with an advanced level of understanding of robotics mechanics and control such as graduate students academic and industrial researchers and professional engineers Researchers in the related fields of multi legged robots biomechanics physical therapy and physics based computer animation of articulated figures can also benefit from the models and computational algorithms presented in the book Provides a firm theoretical basis for modelling and control algorithm design Gives a systematic presentation of models and control algorithms Contains numerous implementation examples demonstrated with 43 video clips *Experimental Robotics* Oussama Khatib,Vijay Kumar,George Pappas,2009-03-28 By the dawn of the new millennium robotics has undergone a major transformation in scope and dimensions This expansion has been brought about by the maturity of the field and the advances in its related technologies From a largely dominant industrial focus robotics has been rapidly expanding into the challenges of the human world The new generation of robots is expected to safely and dependably co habitat with humans in homes workplaces and communities providing support in services entertainment education healthcare manufacturing and assistance Beyond its impact on physical robots the body of knowledge robotics has produced is revealing a much wider range of applications reaching across diverse research areas and scientific disciplines such as biomechanics haptics neuros ences virtual simulation animation surgery and sensor networks among others In return the challenges of the new emerging areas are proving an abundant source of stimulation and insights for the field of robotics It is indeed at the intersection of disciplines that the most striking advances happen The goal of the series of Springer Tracts in Advanced Robotics STAR is to bring in a timely fashion the latest advances and developments in robotics on the basis of their significance and quality It is our hope that the wider dissemination of research developments will stimulate more exchanges and collaborations among the research community and contribute to further advancement of this rapidly growing field Advances In Climbing And Walking Robots - Proceedings Of 10th International Conference (Clawar 2007) Ming Xie,Steven Dubowsky,Jean-guy Fontaine,Mohammad Osman Tokhi,Gurvinder S Virk,2007-07-11 Robotics is an exciting field in engineering and natural sciences Robotics has already made a significant contribution to many industries with the widespread use of industrial robots for tasks such as assembly welding painting and handling materials In parallel we have witnessed the emergence of special robots which can undertake assistive jobs such as search and rescue de mining surveillance exploration and security functions Indeed the interest in mobile machines such as climbing and walking robots has broadened the scope of investigation in robotics This volume covers broad topics related to mobile machines in general and climbing and walking robots in particular Papers from the following keynote speakers are included Heinz Worn University of Karlsruhe Germany Atsuo Takanishi University of Waseda Japan John Billingsley University of Southern Queensland Australia Bryan Bridge London South Bank University UK and Neville Hogan Massachusetts Institute of Technology USA **Springer Handbook of Robotics** Bruno Siciliano,Oussama Khatib,2016-07-27 The second edition of this handbook provides a state of the art overview on the various aspects in the rapidly developing field of robotics Reaching for the human frontier robotics is vigorously engaged in the growing challenges of new emerging domains Interacting exploring and working with humans the new generation of robots will increasingly touch people and their lives The credible prospect of practical robots among humans is the result of the scientific endeavour of a half a century of robotic developments that established robotics as a modern scientific discipline The ongoing vibrant expansion and strong growth of the field during the last decade has fueled this second edition of the Springer Handbook of Robotics The first edition of the handbook soon became a landmark in robotics publishing and won the American Association of Publishers PROSE Award for Excellence in Physical Sciences Mathematics as well as the organization s Award for Engineering Technology The second edition of the handbook edited by two internationally renowned scientists with the support of an outstanding team of seven part editors and more than 200 authors continues to be an authoritative reference for robotics researchers newcomers to the field and scholars from related disciplines The contents have been restructured to achieve four main objectives the enlargement of foundational topics for robotics the enlightenment of design of various types of robotic systems the extension of the treatment on robots moving in the environment and the enrichment of advanced robotics applications Further to an extensive update fifteen new chapters have been introduced on emerging topics and a new generation of authors have joined the handbook s team A novel addition to the second edition is a comprehensive collection of multimedia references to more than 700 videos which bring valuable insight into the contents The videos can be viewed directly augmented into the text with a smartphone or tablet using a unique and specially designed app Springer Handbook of Robotics Multimedia Extension Portal http handbookofrobotics org

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