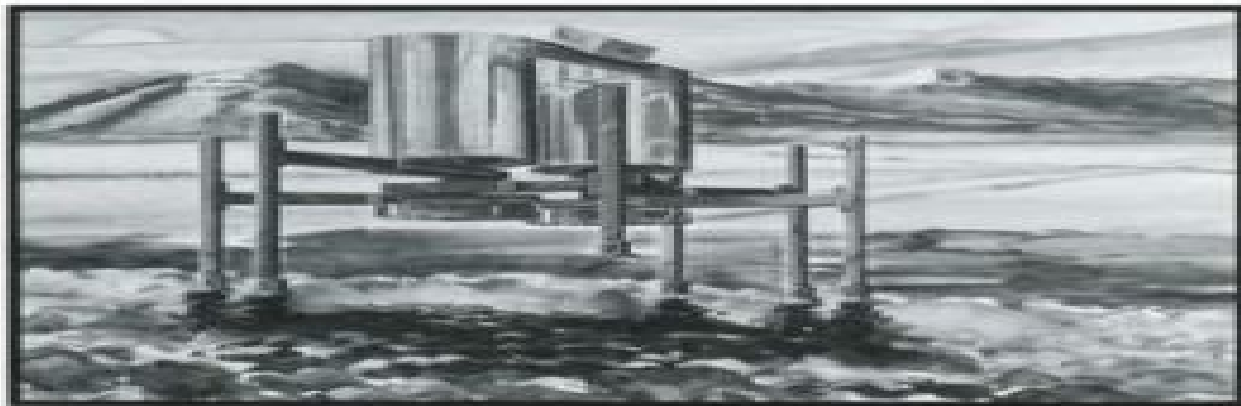

A General Model of Legged Locomotion on Natural Terrain

David J. Manko



General Model Of Legged Locomotion On Natural Terrain

Yossi Rubner, Carlo Tomasi



General Model Of Legged Locomotion On Natural Terrain:

A General Model of Legged Locomotion on Natural Terrain David J. Manko, 2012-12-06 Dynamic modeling is the fundamental building block for mechanism analysis design control and performance evaluation One class of mechanism legged machines have multiple closed chains established through intermittent ground contacts Further walking on natural terrain introduces nonlinear system compliance in the forms of foot sinkage and slippage Closed chains constrain the possible motions of a mechanism while compliances affect the redistribution of forces throughout the system A General Model of Legged Locomotion on Natural Terrain develops a dynamic mechanism model that characterizes indeterminate interactions of a closed chain robot with its environment The approach is applicable to any closed chain mechanism with sufficient contact compliance although legged locomotion on natural terrain is chosen to illustrate the methodology The modeling and solution procedures are general to all walking machine configurations including bipeds quadrupeds beam walkers and hopping machines This work develops a functional model of legged locomotion that incorporates for the first time non conservative foot soil interactions in a nonlinear dynamic formulation The model was applied to a prototype walking machine and simulations generated significant insights into walking machine performance on natural terrain The simulations are original and essential contributions to the design evaluation and control of these complex robot systems While posed in the context of walking machines the approach has wider applicability to rolling locomotors cooperating manipulators multi fingered hands and prehensile agents A general model of legged locomotion on natural terrain David John Manko, 1990

Climbing and Walking Robots and the Support Technologies for Mobile Machines Phillippe Bidaud, Faiz Ben Amar, 2002-11-08 Robotic technology advances for a wide variety of applications Climbing and Walking Robots and the Support Technologies for Mobile Machines explores the increasing interest in real world robotics and the surge in research and invention it has inspired Featuring the latest advances from leading robotics labs around the globe this book presents solutions for perennial challenges in robotics and suggests directions for future research With applications ranging from personal services and entertainment to emergency rescue and extreme environment intervention the groundbreaking work presented here provides a glimpse of the future Climbing and Walking Robots Karsten Berns, Rudiger Dillmann, 2001-11-28 Recent advances in robot technology from around the world Climbing and Walking Robots From Biology to Industrial Applications is a collection of papers presented at the 2001 CLAWAR conference Featuring current work from leading robotics labs around the globe this book presents the latest in robotics across industries and suggests directions for future research Topics include design methodology bipedal locomotion fluid actuators sensor systems control architecture and simulation and more Relevant to mechanical engineers and robotics specialists in both industry and academia these papers showcase the field s latest technological advances **Quadrupedal Locomotion** Pablo González de Santos, Elena Garcia, Joaquin Estremera, 2007-02-17 Walking machines have advantages over traditional vehicles and have already

accomplished tasks that wheeled or tracked robots cannot handle Nevertheless their use in industry and services is currently limited in scope This book brings together methods and techniques that have been developed to deal with obstacles to wider acceptance of legged robots Part I provides an historical overview Part II concentrates on control techniques as applied to Four legged robots

The Electrical Engineering Handbook - Six Volume Set Richard C. Dorf, 2018-12-14 In two editions spanning more than a decade The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering Our knowledge continues to grow and so does the Handbook For the third edition it has grown into a set of six books carefully focused on specialized areas or fields of study Each one represents a concise yet definitive collection of key concepts models and equations in its respective domain thoughtfully gathered for convenient access Combined they constitute the most comprehensive authoritative resource available

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Applications Climbing Robots Actuators Sensors Navigation and Sensors Fusion CLAWAR Network Workpackages

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.

Efficient Dynamic Simulation of Robotic Mechanisms Kathryn Lilly, 2012-12-06 Efficient Dynamic Simulation of Robotic Mechanisms presents computationally efficient algorithms for the dynamic simulation of closed chain robotic systems. In particular, the simulation of single closed chains and simple closed chain mechanisms is investigated in detail. Single closed chains are common in many applications, including industrial assembly operations, hazardous remediation, and space exploration. Simple closed chain mechanisms include such familiar configurations as multiple manipulators moving a common load, dexterous hands, and multi-legged vehicles. The efficient dynamics simulation of these systems is often required for testing an advanced control scheme prior to its implementation, to aid a human operator during remote teleoperation, or to improve system performance. In conjunction with the dynamic simulation algorithms, efficient algorithms are also derived for the computation of the joint space and operational space inertia matrices of a manipulator. The manipulator inertia matrix is a significant component of any robot dynamics formulation and plays an important role in both simulation and control. The efficient computation of the inertia matrix is highly desirable for real-time implementation of robot dynamics algorithms. Several alternate formulations are provided for each inertia matrix. Computational efficiency in the algorithm is achieved by several means, including the development of recursive formulations and the use of efficient spatial transformations and mathematics. All algorithms are derived and presented in a convenient tabular format using a modified form of spatial notation, a six-dimensional vector notation which greatly simplifies the presentation and analysis of multibody dynamics. Basic definitions and fundamental principles required to use and understand this notation are provided. The implementation of the efficient spatial transformations is also discussed in some detail. As a means of evaluating efficiency, the number of scalar operations, multiplications, and additions required for each algorithm is tabulated after its derivation. Specification of the

computational complexity of each algorithm in this manner makes comparison with other algorithms both easy and convenient. The algorithms presented in *Efficient Dynamic Simulation of Robotic Mechanisms* are among the most efficient robot dynamics algorithms available at this time. In addition to computational efficiency, special emphasis is also placed on retaining as much physical insight as possible during algorithm derivation. The algorithms are easy to follow and understand whether the reader is a robotics novice or a seasoned specialist.

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.

Neural Networks in Robotics George A. Bekey, Kenneth Y. Goldberg, 2012-12-06 *Neural Networks in Robotics* is the first book to present an integrated view of both the application of artificial neural networks to robot control and the neuromuscular models from which robots were created. The behavior of biological systems provides both the inspiration and the challenge for robotics. The goal is to build robots which can emulate the ability of living organisms to integrate perceptual inputs smoothly with motor responses, even in the presence of novel stimuli and changes in the environment. The ability of living systems to learn and to adapt provides the standard against which robotic systems are judged. In order to emulate these abilities, a number of investigators have attempted to create robot controllers which are modelled on known processes in the brain and musculo-skeletal system. Several of these models are described in this book. On the other hand, connectionist artificial neural network formulations are attractive for the computation of inverse kinematics and dynamics of robots because they can be trained for this purpose without explicit programming. Some of the computational advantages and problems of this approach are also presented. For any serious student of robotics, *Neural Networks in Robotics* provides an indispensable reference to the work of major researchers in the field. Similarly, since robotics is an outstanding application area for artificial neural networks, *Neural Networks in Robotics* is equally important to workers in connectionism and to students for sensor/monitor control in living systems.

Space Robotics: Dynamics and Control Yangsheng Xu, Takeo Kanade, 2012-12-06 Robotic technology offers two potential benefits for future space exploration. One benefit is minimizing

the risk that astronauts face The other benefit is increasing their productivity Realizing the benefits of robotic technology in space will require solving several problems which are unique and now becoming active research topics One of the most important research areas is dynamics control motion and planning for space robots by considering the dynamic interaction between the robot and the base space station space shuttle or satellite Any inefficiency in the planning and control can considerably risk by success of the space mission Space Robotics Dynamics and Control presents a collection of papers concerning fundamental problems in dynamics and control of space robots focussing on issues relevant to dynamic base robot interaction The authors are all pioneers in theoretical analysis and experimental systems development of space robot technology The chapters are organized within three problem areas dynamics problems nonholonomic nature problems and control problems This collection provides a solid reference for researchers in robotics mechanics control and astronautical science

Technology Drivers: Engine for Growth Alka Mahajan, B.A. Modi, Parul Patel, 2018-10-17 This volume of proceedings from the conference provides an opportunity for readers to engage with a selection of refereed papers that were presented during the 6th International Conference NUiCONE 17 Researchers from industry and academia were invited to present their research work in the areas as listed below The research papers presented in these tracks have been published in this proceeding with the support of CRC Press Taylor Francis Group This proceeding will definitely provide a platform to proliferate new findings among the researchers Chemical Process Development and Design Technologies for Green Environment Advances in Transportation Engineering Emerging Trends in Water Resources and Environmental Engineering Construction Technology and Management Concrete and Structural Engineering Sustainable Manufacturing Processes Design and Analysis of Machine and Mechanism Energy Conservation and Management

Neural Network Perception for Mobile Robot Guidance Dean A. Pomerleau, 2012-12-06 Dean Pomerleau's trainable road tracker ALVINN is arguably the world's most famous neural net application It currently holds the world's record for distance traveled by an autonomous robot without interruption 21.2 miles along a highway in traffic at speeds of up to 55 miles per hour Pomerleau's work has received worldwide attention including articles in Business Week March 2 1992 Discover July 1992 and German and Japanese science magazines It has been featured in two PBS series The Machine That Changed the World and By the Year 2000 and appeared in news segments on CNN the Canadian news and entertainment program Live It Up and the Danish science program Chaos What makes ALVINN especially appealing is that it does not merely drive it learns to drive by watching a human driver for roughly five minutes The training inputs to the neural network are a video image of the road ahead and the current position of the steering wheel ALVINN has learned to drive on single lane multi lane and unpaved roads It rapidly adapts to other sensors it learned to drive at night using laser reflectance imaging and by using a laser rangefinder it learned to swerve to avoid obstacles and maintain a fixed distance from a row of parked cars It has even learned to drive backwards

Engineering Approaches to Mechanical and Robotic Design for Minimally Invasive Surgery (MIS) Ali

Faraz, Shahram Payandeh, 2012-12-06 Within the past twenty years the field of robotics has been finding many areas of applications ranging from space to underwater explorations One of these areas which is slowly gaining popularity among the users group is the notion of service robotics This book is an investigation and exploration of engineering principles in the design and development of mechanisms and robotic devices that can be used in the field of surgery Specifically the results of this book can be used for designing tools for class of Minimally Invasive Surgery MIS Generally Minimal Invasive Surgery MIS e g laparoscopic surgery is performed by using long surgical tools that are inserted through small incisions at the ports of entry to the body e g abdominal wall for reaching the surgical site The main drawback of current designs of endoscopic tools is that they are not able to extend all the movements and sensory capabilities of the surgeon's hand to the surgical site By improving surgical procedures training and more practice it is possible for surgeons to reduce completion time for each task and increase their level of skill However even in the best cases the level of performance of a surgeon in Minimally Invasive Surgery is still a fraction of the conventional surgery Any dramatic improvement is usually driven by introduction of new tools or systems that in turn bring totally new procedures and set of skills Perceptual Metrics for Image Database Navigation Yossi Rubner, Carlo Tomasi, 2013-03-14 The increasing amount of information available in today's world raises the need to retrieve relevant data efficiently Unlike text-based retrieval where keywords are successfully used to index into documents content-based image retrieval poses up front the fundamental questions how to extract useful image features and how to use them for intuitive retrieval We present a novel approach to the problem of navigating through a collection of images for the purpose of image retrieval which leads to a new paradigm for image database search We summarize the appearance of images by distributions of color or texture features and we define a metric between any two such distributions This metric which we call the Earth Mover's Distance EMD represents the least amount of work that is needed to rearrange the mass in one distribution in order to obtain the other We show that the EMD matches perceptual dissimilarity better than other dissimilarity measures and argue that it has many desirable properties for image retrieval Using this metric we employ Multi Dimensional Scaling techniques to embed a group of images as points in a two or three dimensional Euclidean space so that their distances reflect image dissimilarities as well as possible Such geometric embeddings exhibit the structure in the image set at hand allowing the user to understand better the result of a database query and to refine the query in a perceptually intuitive way

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