
Neural Network Perception for Mobile Robot Guidance

Dean A. Pomerleau

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Neural Network Perception For Mobile Robot Guidance

Nils J. Nilsson



Neural Network Perception For Mobile Robot Guidance:

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.

Computational Principles of Mobile Robotics Gregory Dudek, Michael Jenkin, 2000-02-28 This is a textbook for advanced undergraduate and graduate students in the field of mobile robotics. Emphasising computation and algorithms, the authors address a range of strategies for enabling robots to perform tasks that involve motion and behavior. The book is divided into three major sections: locomotion, sensing, and reasoning. It concentrates on wheeled and legged mobile robots but discusses a variety of other propulsion systems. Kinematic models are developed for many of the more common locomotive strategies. It presents algorithms for both visual and nonvisual sensor technologies, including sonar, vision, and laser scanners. In the section on reasoning, the authors offer a thorough examination of planning and the issues related to spatial representation. They emphasize the problems of navigation, pose estimation, and autonomous exploration. The book is a comprehensive treatment of the field, offering a discussion of state-of-the-art methods with illustrations of key technologies.

Intelligent Unmanned Ground Vehicles Martial H. Hebert, Charles E. Thorpe, Anthony Stentz, 2012-12-06 *Intelligent Unmanned Ground Vehicles* describes the technology developed and the results obtained by the Carnegie Mellon Robotics Institute in the course of the DARPA Unmanned Ground Vehicle (UGV) project. The goal of this work was to equip off-road vehicles with computer-controlled unmanned driving capabilities. The book describes contributions in the area of mobility for UGVs, including tools for assembling complex autonomous mobility systems on road and off-road, navigation, sensing techniques, and route planning algorithms. In addition to basic mobility technology, the book covers a number of integrated systems demonstrated in the field in realistic scenarios. The approaches presented in this book can be applied to a wide range of mobile robotics applications, from automated passenger cars to planetary exploration and construction. *Intelligent Unmanned Ground Vehicles* shows the progress that was

achieved during this program from brittle specially built robots operating under highly constrained conditions to groups of modified commercial vehicles operating in tough environments One measure of progress is how much of this technology is being used in other applications For example much of the work in road following architectures and obstacle detection has been the basis for the Automated Highway Systems AHS prototypes currently under development AHS will lead to commercial prototypes within a few years The cross country technology is also being used in the development of planetary rovers with a projected launch date within a few years The architectural tools built under this program have been used in numerous applications from an automated harvester to an autonomous excavator The results reported in this work provide tools for further research development leading to practical reliable and economical mobile robots Artificial Intelligence

Nils J. Nilsson, 1998-04 Nilsson employs increasingly capable intelligent agents in an evolutionary approach a novel perspective from which to view and teach topics in artificial intelligence **RoboCup 2003: Robot Soccer World Cup VII**

Daniel Polani, Brett Browning, Andrea Bonarini, Kazuo Yoshida, 2004-09-02 This book constitutes the seventh official archival publication devoted to RoboCup It documents the achievements presented at the 7th Robot World Cup Soccer and Rescue Competition and Conferences held in Padua Italy in July 2003 The 39 revised full papers and 35 revised poster papers presented together with an overview and roadmap for the RoboCup initiative and 3 invited papers were carefully reviewed and selected from 125 symposium paper submissions This book is mandatory reading for the rapidly growing RoboCup community as well as a valuable source of reference and inspiration for R D professionals interested in robotics distributed artificial intelligence and multi agent systems *Scientific and Technical Aerospace Reports*, 1995 **The Handbook of Brain Theory and Neural Networks**

Michael A. Arbib, 2003 This second edition presents the enormous progress made in recent years in the many subfields related to the two great questions how does the brain work and How can we build intelligent machines This second edition greatly increases the coverage of models of fundamental neurobiology cognitive neuroscience and neural network approaches to language Midwest Computational Learning Theory and Natural Learning Systems Stephen José Hanson, Thomas Petsche, Jude W. Shavlik, 1995 **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.

World Congress on Neural Networks Paul Werbos, Harold Szu, Bernard Widrow, 2021-09-09 Centered around 20 major topic areas of both theoretical and practical importance, the World Congress on Neural Networks provides its registrants from a diverse background encompassing industry, academia, and government with the latest research and applications in the neural network field.

Intelligent Autonomous Systems, IAS--3 F. C. A. Groen, Shigeo Hirose, Charles E. Thorpe, 1993 A collection of papers dealing with complete systems of intelligent robots focusing on autonomy. The contributions cover intelligent perception, intelligent planning and control, and integrated systems.

Mechatronics '98 J. Adolfsson, J. Karlsén, 1998-08-28 Mechatronics, a synergistic combination of mechanical, electronic, and computing engineering technologies, is a truly multidisciplinary approach to engineering. New products based on mechatronic principles are demonstrating reduced mechanical complexity, increased performance, and often previously impossible capabilities. This book contains the papers presented at the UK Mechatronics Forum's 6th International Conference held in Skövde, Sweden, in September 1998. Many of these high quality papers illustrate the tremendous influence of mechatronics on such areas as manufacturing machinery, automotive engineering, textiles manufacture, robotics, and real time control and vision systems. There are also papers describing developments in sensors, actuators, control, and data processing techniques such as fuzzy logic and neural networks, all of which have practical application to mechatronic systems.

Soft Computing for Intelligent Robotic Systems Toshio Fukuda, 2013-04-17 Research results using some of the most advanced soft computing techniques in intelligent robotic systems are presented. The main purpose of this book is to show how the power of soft computing techniques can be exploited in intelligent robotic systems. The main emphasis is on control system for a mobile robot, behavior arbitration for a mobile robot, reinforcement learning of a robot manipulation, collision avoidance, and automatic design of robots. This book will be useful for application engineers, scientists, and researchers who wish to use some of the most advanced soft computing techniques in robotics.

Darwin2K Chris Leger, 2012-12-06 *Darwin2K: An Evolutionary Approach to Automated Design for Robotics* is an essential reference tool for researchers, professionals, and students involved in robot design or in evolutionary synthesis, design, and optimization. It is also necessary for users of *Darwin2K*. Researchers and hobbyists interested in genetic algorithms and artificial life techniques will find the book interesting. The primary purpose of this book is to describe a methodology for using computers to automatically design robots to meet the specific needs of an application. Details of many novel aspects of the methodology are presented, including an evolutionary algorithm for synthesizing and optimizing multiple objective functions, an algorithm for dynamic simulation of

arbitrary robots an extensible software architecture and a new representation for robots that is appropriate for robot design. The methodology as a whole is significant in terms of its impact on robot design practices and as a case study in building evolutionary design systems. Individual parts of the systems are also relevant to other areas. For example, the evolutionary algorithm can be used for design and optimization problems other than robotics, and the dynamic simulation algorithm can be used for analysis and simulation of existing robots or as a part of a manual design tool. The book also gives an overview of previous work in automated design of robots and of evolutionary design in other engineering disciplines.

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.

Field and Service Robotics Alexander Zelinsky, 2012-12-06. Joe Engelberger, the pioneer of the robotics industry, wrote in his 1989 book *Robotics in Service* that the inspiration to write his book came as a reaction to an industry-sponsored forecast study of robot applications which predicted that in 1995 applications of robotics outside factories, the traditional domain of industrial robots, would amount to less than 1% of total sales. Engelberger believed that this forecast was very wrong and instead predicted that the non-industrial class of robot applications would become the largest class. Engelberger's prediction has yet to come to pass. However, he did correctly foresee the growth in non-traditional applications of robots. Robots are now beginning to march from the factories and into field and service applications. This book presents a selection of papers from the first major international conference dedicated to field and service applications of robotics. This selection includes papers from the leading research laboratories in the world together with papers from companies that are building and selling new and innovative robotic technology. It describes interesting aspects of robots in the field, ranging from mining, agriculture, construction, cargo handling, subsea operations, removal of landmines to terrestrial exploration. It also covers a diverse range of service applications such as cleaning.

propagating plants and aiding the elderly and handicapped and gives considerable attention to the technology required to realise robust reliable and safe robots

Modeling from Reality Katsushi Ikeuchi, Yoichi Sato, 2012-12-06 This book summarizes the results of our modeling from reality MFR project which took place over the last decade or so The goal of this project is to develop techniques for modeling real objects and or environments into geometric and photometric models through computer vision techniques By developing such techniques time consuming modeling process currently undertaken by human programmers can be semi automatically performed and as a result we can drastically shorten the developing time of such virtual reality systems reduce their developing cost and widen their application areas Originally we began to develop geometric modeling techniques that acquire shape information of objects environments for object recognition Soon this effort evolved into an independent modeling project virtual reality modeling with the inclusion of photometric modeling aspects that acquire appearance information such as color texture and smoothness Over the course of this development it became apparent that environmental modeling techniques were necessary when applying our techniques to mixed realities that seamlessly combine generated virtual models with other real virtual images The material in his book covers these aspects of development

Advanced Polymeric Materials Gabriel O. Shonaige, Suresh G. Advani, 2003-04-14 Featuring contributions from experts at some of the world's leading academic and industrial institutions Advanced Polymeric Materials Structure Property Relationships brings into book form a wealth of information previously available primarily only within computer programs In a welcome narrative treatment it provides comprehensive coverage of p

Lifelong Machine Learning, Second Edition Zhiyuan Chen, Bing Liu, 2022-06-01 Lifelong Machine Learning Second Edition is an introduction to an advanced machine learning paradigm that continuously learns by accumulating past knowledge that it then uses in future learning and problem solving In contrast the current dominant machine learning paradigm learns in isolation given a training dataset it runs a machine learning algorithm on the dataset to produce a model that is then used in its intended application It makes no attempt to retain the learned knowledge and use it in subsequent learning Unlike this isolated system humans learn effectively with only a few examples precisely because our learning is very knowledge driven the knowledge learned in the past helps us learn new things with little data or effort Lifelong learning aims to emulate this capability because without it an AI system cannot be considered truly intelligent Research in lifelong learning has developed significantly in the relatively short time since the first edition of this book was published The purpose of this second edition is to expand the definition of lifelong learning update the content of several chapters and add a new chapter about continual learning in deep neural networks which has been actively researched over the past two or three years A few chapters have also been reorganized to make each of them more coherent for the reader Moreover the authors want to propose a unified framework for the research area Currently there are several research topics in machine learning that are closely related to lifelong learning most notably multi task learning transfer learning and meta learning because they also employ the idea of

knowledge sharing and transfer This book brings all these topics under one roof and discusses their similarities and differences Its goal is to introduce this emerging machine learning paradigm and present a comprehensive survey and review of the important research results and latest ideas in the area This book is thus suitable for students researchers and practitioners who are interested in machine learning data mining natural language processing or pattern recognition Lecturers can readily use the book for courses in any of these related fields

Understanding Intelligence Rolf Pfeifer,Christian Scheier,2001-07-27 The book includes all the background material required to understand the principles underlying intelligence as well as enough detailed information on intelligent robotics and simulated agents so readers can begin experiments and projects on their own By the mid 1980s researchers from artificial intelligence computer science brain and cognitive science and psychology realized that the idea of computers as intelligent machines was inappropriate The brain does not run programs it does something entirely different But what Evolutionary theory says that the brain has evolved not to do mathematical proofs but to control our behavior to ensure our survival Researchers now agree that intelligence always manifests itself in behavior thus it is behavior that we must understand An exciting new field has grown around the study of behavior based intelligence also known as embodied cognitive science new AI and behavior based AI This book provides a systematic introduction to this new way of thinking After discussing concepts and approaches such as subsumption architecture Braitenberg vehicles evolutionary robotics artificial life self organization and learning the authors derive a set of principles and a coherent framework for the study of naturally and artificially intelligent systems or autonomous agents This framework is based on a synthetic methodology whose goal is understanding by designing and building The book includes all the background material required to understand the principles underlying intelligence as well as enough detailed information on intelligent robotics and simulated agents so readers can begin experiments and projects on their own The reader is guided through a series of case studies that illustrate the design principles of embodied cognitive science

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