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# VISUAL NAVIGATION

From Biological Systems to  
Unmanned Ground Vehicles

Edited by  
Yiannis Aloimonos

# Visual Navigation From Biological Systems To Unmanned Ground Vehicles

**Victor M. Corman**



## **Visual Navigation From Biological Systems To Unmanned Ground Vehicles:**

**Visual Navigation** Yiannis Aloimonos, 2013-05-13 All biological systems with vision move about their environments and successfully perform many tasks. The same capabilities are needed in the world of robots. To that end, recent results in empirical fields that study insects and primates as well as in theoretical and applied disciplines that design robots have uncovered a number of the principles of navigation. To offer a unifying approach to the situation, this book brings together ideas from zoology, psychology, neurobiology, mathematics, geometry, computer science, and engineering. It contains theoretical developments that will be essential in future research on the topic, especially new representations of space with less complexity than Euclidean representations possess. These representations allow biological and artificial systems to compute from images in order to successfully deal with their environments. In this book, the barriers between different disciplines have been smoothed, and the workings of vision systems of biological organisms are made clear in computational terms to computer scientists and engineers. At the same time, fundamental principles arising from computational considerations are made clear both to empirical scientists and engineers. Empiricists can generate a number of hypotheses that they could then study through various experiments. Engineers can gain insight for designing robotic systems that perceive aspects of their environment. For the first time, readers will find the insect vision system presented in a way that can be understood by computational scientists working in computer vision and engineering. Three complete working robotic navigation systems are presented with all the issues related to their design analyzed in detail. The beginning of a computational theory of direct perception as advocated by Gibson is presented in detail with applications for a variety of problems, and the idea that vision systems could compute space representations different from perfect metric descriptions and be used in robotic tasks advanced for both artificial and biological systems.

## **Advanced Autonomous Vehicle Design for Severe Environments**

V.V. Vantsevich, M.V. Blundell, 2015-10-20 Classical vehicle dynamics, which is the basis for manned ground vehicle design, has exhausted its potential for providing novel design concepts to a large degree. At the same time, unmanned ground vehicle (UGV) dynamics is still in its infancy and is currently being developed using general analytical dynamics principles with very little input from actual vehicle dynamics theory. This technical book presents outcomes from the NATO Advanced Study Institute (ASI) Advanced Autonomous Vehicle Design for Severe Environments, held in Coventry, UK, in July 2014. The ASI provided a platform for world-class professionals to meet and discuss leading-edge research, engineering accomplishments, and future trends in manned and unmanned ground vehicle dynamics, terrain mobility, and energy efficiency. The outcomes of this collective effort serve as an analytical foundation for autonomous vehicle design. Topics covered include historical aspects, pivotal accomplishments, and the analysis of future trends in on and off-road manned and unmanned vehicle dynamics, terramechanics, soil dynamic characteristics, uncertainties, and stochastic characteristics of vehicle environment interaction for agile vehicle dynamics modeling, new methods and techniques in on-line control, and learning for vehicle

autonomy fundamentals of agility and severe environments mechatronics and cyber physics issues of agile vehicle dynamics to design for control energy harvesting and cyber security and case studies of agile and inverse vehicle dynamics and vehicle systems design including optimisation of suspension and driveline systems The book targets graduate students who desire to advance further in leading edge vehicle dynamics topics in manned and unmanned ground vehicles PhD students continuing their research work and building advanced curricula in academia and industry and researchers in government agencies and private companies

**From Automated to Autonomous Driving** Fabian Kröger,2024-04-01 This book presents the most important milestones of the research on automated and autonomous driving in the United States Japan and Europe throughout five decades 1950 2000 Drawing on sources from the automotive industry electrical engineering the robotics and AI domain and military institutions it retraces the transition from the guidance cable approach to vehicle based sensor and vision systems Giving a detailed overview of the technical concepts artefacts research vehicles and robots the book presents the transnational engineering efforts that started long before Silicon Valley entered the field In addition the book also uniquely details the role of the military in the domain of vehicle automation This all ensures the book is of great interest to historians of technology practitioners in engineering disciplines scholars working in mobility studies journalists and political decision makers

Multi-Image Analysis Reinhard Klette,Thomas Huang,Georgy Gimel'farb,2003-06-29 This book constitutes the thoroughly refereed post proceedings of the 10th International Workshop on Theoretical Foundations of Computer Vision held at Dagstuhl Castle Germany in March 2000 The 20 revised full papers presented have been through two rounds of reviewing selection and revision and give a representative assessment of the foundational issues in multiple image processing The papers are organized in topical sections on 3D data acquisition and sensor design multi image analysis data fusion in 3D scene description and applied 3D vision and virtual reality

**Fixed and Flapping Wing Aerodynamics for Micro Air Vehicle Applications** Thomas J. Mueller,2001 This title reports on the latest research in the area of aerodynamic efficiency of various fixed wing flapping wing and rotary wing concepts It presents the progress made by over fifty active researchers in the field

**Advances in Robot Learning** Jeremy Wyatt,John Demiris,2000-10-11 This book constitutes the thoroughly refereed post workshop proceedings of the 8th European Workshop on Learning Robots EWLRL 99 held in Lausanne Switzerland in September 1999 The seven revised full workshop papers presented were carefully reviewed and selected for inclusion in the book Also included are two invited full papers Among the topics addressed are map building for robot navigation multi task reinforcement learning neural network approaches example based learning situated agents planning maps for mobile robots path finding autonomous robots and biologically inspired approaches

*Computer Vision and Robotics* John X. Liu,2006 This book deals with control and learning in robotic systems and computers

**Technology Development for Army Unmanned Ground Vehicles** National Research Council,Division on Engineering and Physical Sciences,Board on Army Science and Technology,Committee on Army Unmanned Ground Vehicle Technology,2003-02-01

Unmanned ground vehicles UGV are expected to play a key role in the Army's Objective Force structure. These UGVs would be used for weapons platforms, logistics carriers, and reconnaissance, surveillance, and target acquisition among other things. To examine aspects of the Army's UGV program, assess technology readiness, and identify key issues in implementing UGV systems, among other questions, the Deputy Assistant Secretary of the Army for Research and Technology asked the National Research Council (NRC) to conduct a study of UGV technologies. This report discusses UGV operational requirements, current development efforts, and technology integration and roadmaps to the future. Key recommendations are presented, addressing technical content, time lines, and milestones for the UGV efforts.

**Learning-based Vision and Its Application to Autonomous Indoor Navigation** Shaoyun Chen (Engineer), 1998

**Visual Navigation** John Aloimonos, 1997

All biological systems with vision move about their environments and successfully perform many tasks. The same capabilities are needed in the world of robots. To that end, recent results in empirical fields that study insects and primates, as well as in theoretical and applied disciplines that design robots, have uncovered a number of the principles of navigation. To offer a unifying approach to the situation, this book brings together ideas from zoology, psychology, neurobiology, mathematics, geometry, computer science, and engineering. It contains theoretical developments that will be essential in future research on the topic, especially new representations of space with less complexity than Euclidean representations possess. These representations allow biological and artificial systems to compute from images in order to successfully deal with their environments. In this book, the barriers between different disciplines have been smoothed, and the workings of vision systems of biological organisms are made clear in computational terms to computer scientists and engineers. At the same time, fundamental principles arising from computational considerations are made clear both to empirical scientists and engineers. Empiricists can generate a number of hypotheses that they could then study through various experiments. Engineers can gain insight for designing robotic systems that perceive aspects of their environment. For the first time, readers will find the insect vision system presented in a way that can be understood by computational scientists working in computer vision and engineering. Three complete working robotic navigation systems are presented, with all the issues related to their design analyzed in detail. The beginning of a computational theory of direct perception, as advocated by Gibson, is presented in detail, with applications for a variety of problems and the idea that vision systems could compute space representations different from perfect metric descriptions and be used in robotic tasks advanced for both artificial and biological systems.

*Computer Vision - ACCV ...*, 1998

**Frames of Reference and Direct Manipulation Based Navigation** Asaf Friedman, 2005

The analysis showed that the lack of realism of these systems means that they do not offer a sense of reality because of the user's inability to interact easily with the computer to navigate among represented objects. The user cannot:

- 1 Plan a course from a given location to a desired one
- 2 Shift the direction of their gaze and focus attention to objects as they move across a path
- 3 Move around an object, keeping track of this change in relation to the surrounding objects
- 4 Turn an object in front of the viewer in

order to examine it This lack of sense of reality cannot be simply improved by adding attributed to the system that are more realistic details shadows and reflections

**Proceedings 2002 IEEE/RSJ International Conference on Intelligent Robots and Systems** ,2002    **Model-based Image Processing** Yeuk Fai Ho,2000    **Ninth IEEE International Conference on Computer Vision** ,2003 ICCV 2003 includes 43 full papers covering the latest research and progress in all areas of vision The proceedings tackles necessary topics such as image representation compression and coding image segmentation object recognition active vision 2D and 3D vision sensing and texture color and motion analysis

**Critical Technologies for the Future of Computing** Sunny Bains,Leo J. Irakliotis,2000    Algebraic Frames for the Perception-action Cycle ,1997    **Proceedings** ,2003    **Autonomous Robotic Systems** Anibal T.de Almeida,1998-05-26

This book constitutes the presentations made at the Advanced Research Workshop on Autonomous Robotic Systems which was held at the University of Coimbra Portugal June 1997 The aim of the meeting was to bring together leading researchers in the area of autonomous systems for mobility and manipulation and the aim of this book is to share the presentations with the reader The book presents the most recent developments in the field Topics include sensors and navigation in mobile robots robot co operation telerobotics legged robots climbing robots and applications Existing and emerging applications of autonomous systems are described in great detail including applications in forestry cleaning mining tertiary buildings assistance to the elderly and handicapped and surgery The chapters are written in a structured and advanced tutorial style by leading specialists from Europe Australia Japan and USA The style will allow the reader to grasp the state of the art and research directions in the area of autonomous systems

**Unmanned Ground Vehicle Technology** ,2005

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