

Unmanned Ground Vehicle Navigation Using Aerial Ladar Data

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.

This monograph is devoted to the theory and development of autonomous navigation of mobile robots using computer vision based sensing mechanism. The conventional robot navigation systems, utilizing traditional sensors like ultrasonic, IR, GPS, laser sensors etc., suffer several drawbacks related to either the physical limitations of the sensor or incur high cost. Vision sensing has emerged as a popular alternative where cameras can be used to reduce the overall cost, maintaining high degree of intelligence, flexibility and robustness. This book includes a detailed description of several new approaches for real life vision based autonomous navigation algorithms and SLAM. It presents the concept of how subgoal based goal-driven navigation can be carried out using vision sensing. The development concept of vision based robots for path/line tracking using fuzzy logic is presented, as well as how a low-cost robot can be indigenously developed in the laboratory with microcontroller based sensor systems. The book describes successful implementation of integration of low-cost, external peripherals, with off-the-shelf procured robots. An important highlight of the book is that it presents a detailed, step-by-step sample demonstration of how vision-based navigation modules can be actually implemented in real life, under 32-bit Windows environment. The book also discusses the concept of implementing vision based SLAM employing a two camera based system.

Localization and mapping are the essence of successful navigation in mobile platform technology. Localization is a fundamental task in order to achieve high levels of autonomy in robot navigation and robustness in vehicle positioning. Robot localization and mapping is commonly related to cartography, combining science, technique and computation to build a trajectory map that reality can be modelled in ways that communicate spatial information effectively. This book describes comprehensive introduction, theories and applications related to localization, positioning and map building in mobile robot and autonomous vehicle platforms. It is organized in twenty seven chapters. Each chapter is rich with different degrees of details and approaches, supported by unique and actual resources that make it possible for readers

to explore and learn the up to date knowledge in robot navigation technology. Understanding the theory and principles described in this book requires a multidisciplinary background of robotics, nonlinear system, sensor network, network engineering, computer science, physics, etc.

This edited volume presents the proceedings of the AMAA 2015 conference, Berlin, Germany. The topical focus of the 2015 conference lies on smart systems for green and automated driving. The automobile of the future has to respond to two major trends, the electrification of the drivetrain, and the automation of the transportation system. These trends will not only lead to greener and safer driving but re-define the concept of the car completely, particularly if they interact with each other in a synergetic way as for autonomous parking and charging, self-driving shuttles or mobile robots. Key functionalities like environment perception are enabled by electronic components and systems, sensors and actuators, communication nodes, cognitive systems and smart systems integration. The book will be a valuable read for research experts and professionals in the automotive industry but the book may also be beneficial for graduate students.

Intelligent Unmanned Ground Vehicles Autonomous Navigation Research at Carnegie Mellon Springer Science & Business Media

This book constitutes the thoroughly refereed post-conference proceedings of the 13th International Conference on Principles and Practice of Multi-Agent Systems, PRIMA 2010, held in Kolkata, India, in November 2010. The 18 full papers presented together with 15 early innovation papers were carefully reviewed and selected from over 63 submissions. They focus on practical aspects of multiagent systems and cover topics such as agent communication, agent cooperation and negotiation, agent reasoning, agent-based simulation, mobile and semantic agents, agent technologies for service computing, agent-based system development, ServAgents workshop, IAHC workshop, and PRACSYS workshop.

This book provides state-of-the-art scientific and engineering research findings and developments in the area of mobile robotics and associated support technologies. It contains peer-reviewed articles presented at the CLAWAR 2008 conference. Robots are no longer confined to industrial manufacturing environments; rather, a great deal of interest is invested in the use of robots outside the factory environment. The CLAWAR conference series, established as a high-profile international event, acts as a platform for dissemination of research and development findings to address the current interest in mobile robotics in meeting the needs of mankind in various sectors of the society. These include personal care, public health, and services in the domestic, public and industrial environments. The editors of the book have extensive research experience and publications in the area of robotics in general, and in mobile robotics specifically.

In 1986, B.K.P. Horn published a book entitled *Robot Vision*, which actually discussed a wider field of subjects, basically addressing the field of computer vision, but introducing “robot vision” as a technical term. Since then, the interaction between computer vision and research on mobile systems (often called “robots”, e.g., in an industrial context, but also including vehicles, such as cars, wheelchairs, tower cranes, and so forth) established a diverse area of research, today known as robot vision. Robot vision (or, more general, robotics) is a fast-growing discipline, already taught as a dedicated teaching program at university level. The term “robot vision” addresses any autonomous behavior of a technical system supported by visual sensoric information. While robot vision focusses on the vision process, visual robotics is more directed toward control and automatization. In practice, however, both fields strongly interact. *Robot Vision 2008* was the second international workshop, counting a 2001 workshop with identical name as the first in this series. Both workshops were organized in close cooperation between researchers from New Zealand and Germany, and took place at The University of Auckland, New Zealand. Participants of the 2008 workshop came from Europe, USA, South America, the Middle East, the Far East, Australia, and of course from New Zealand.

In this book, new results or developments from different research backgrounds and application fields are put together to provide a wide and useful viewpoint on these headed research problems mentioned above, focused on the motion planning problem of mobile robots. These results cover a large range of the problems that are frequently encountered in the motion planning of mobile robots both in theoretical methods and practical applications including obstacle avoidance methods, navigation and localization techniques, environmental modelling or map building methods, and vision signal processing etc. Different methods such as potential fields, reactive behaviours, neural-fuzzy based methods, motion control methods and so on are studied. Through this book and its references, the reader will definitely be able to get a thorough overview on the current research results for this specific topic in robotics. The book is intended for the readers who are interested and active in the field of robotics and especially for those who want to study and develop their own methods in motion/path planning or control for an intelligent robotic system.

This book is a printed edition of the Special Issue "UAV or Drones for Remote Sensing Applications" that was published in *Sensors*. The International Symposium of Robotics Research (ISRR) continues to be the premiere meeting of the International Foundation of Robotics Research (IFRR). The 13th International Symposium of Robotics Research took place November 26-29, 2007, in Hiroshima, Japan, and was organized by the two editors of this book. This volume brings a collection of a broad range of topics in robotics. The content of these 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 novel areas of applications. Historically, the proceedings of the ISRR have featured ground-breaking work of the highest caliber, which influenced generations to come. The present volume promises to be no exception. The collection of scientific articles in this volume provides new insights to important problems in robotics, written by some of the leaders in the field.

In the past decade a critical mass of work that uses fuzzy logic for autonomous vehicle navigation has been reported. Unfortunately, reports of this work are scattered among conference, workshop, and journal publications that belong to different research communities (fuzzy logic,

robotics, artificial intelligence, intelligent control) and it is therefore not easily accessible either to the new comer or to the specialist. As a result, researchers in this area may end up reinventing things while being unaware of important existing work. We believe that research and applications based on fuzzy logic in the field of autonomous vehicle navigation have now reached a sufficient level of maturity, and that it should be suitably reported to the largest possible group of interested practitioners, researches, and students. On these grounds, we have endeavored to collect some of the most representative pieces of work in one volume to be used as a reference. Our aim was to provide a volume which is more than "yet another random collection of papers," and gives the reader some added value with respect to the individual papers. In order to achieve this goal we have aimed at: • Selecting contributions which are representative of a wide range of problems and solutions and which have been validated on real robots; and • Setting the individual contributions in a clear framework, that identifies the main problems of autonomous robotics for which solutions based on fuzzy logic have been proposed.

In the event of large crises (earthquakes, typhoons, floods, ...), a primordial task of the fire and rescue services is the search for human survivors on the incident site. This is a complex and dangerous task, which - too often - leads to loss of lives among the human crisis managers themselves. This book explains how unmanned search can be added to the toolkit of the search and rescue workers, offering a valuable tool to save human lives and to speed up the search and rescue process. The introduction of robotic tools in the world of search and rescue is not straightforward, due to the fact that the search and rescue context is extremely technology-unfriendly, meaning that very robust solutions, which can be deployed extremely quickly, are required. Multiple research projects across the world are tackling this problem and in this book, a special focus is placed on showcasing the results of the European Union ICARUS project on this subject. The ICARUS project proposes to equip first responders with a comprehensive and integrated set of unmanned search and rescue tools, to increase the situational awareness of human crisis managers, so that more work can be done in a shorter amount of time. The ICARUS tools consist of assistive unmanned air, ground, and sea vehicles, equipped with victim-detection sensors. The unmanned vehicles collaborate as a coordinated team, communicating via ad hoc cognitive radio networking. To ensure optimal human-robot collaboration, these tools are seamlessly integrated into the command and control equipment of the human crisis managers and a set of training and support tools is provided to them in order to learn to use the ICARUS system. The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement number 285417. The publishing of this book was funded by the EC FP7 Post-Grant Open Access Pilot programme.

Mobile robots require the ability to make decisions such as "go through the hedges" or "go around the brick wall." Mobile Robot Navigation with Intelligent Infrared Image Interpretation describes in detail an alternative to GPS navigation: a physics-based adaptive Bayesian pattern classification model that uses a passive thermal infrared imaging system to automatically characterize non-heat generating objects in unstructured outdoor environments for mobile robots. The resulting classification model complements an autonomous robot's situational awareness by providing the ability to classify smaller structures commonly found in the immediate operational environment.

Passivity-based Model Predictive Control for Mobile Vehicle Navigation represents a complete theoretical approach to the adoption of passivity-based model predictive control (MPC) for autonomous vehicle navigation in both indoor and outdoor environments. The brief also introduces analysis of the worst-case scenario that might occur during the task execution. Some of the questions answered in the text include: • how to use an MPC optimization framework for the mobile vehicle navigation approach; • how to guarantee safe task completion even in complex environments including obstacle avoidance and sideslip and rollover avoidance; and • what to expect in the worst-case

scenario in which the roughness of the terrain leads the algorithm to generate the longest possible path to the goal. The passivity-based MPC approach provides a framework in which a wide range of complex vehicles can be accommodated to obtain a safer and more realizable tool during the path-planning stage. During task execution, the optimization step is continuously repeated to take into account new local sensor measurements. These ongoing changes make the path generated rather robust in comparison with techniques that fix the entire path prior to task execution. In addition to researchers working in MPC, engineers interested in vehicle path planning for a number of purposes: rescued mission in hazardous environments; humanitarian demining; agriculture; and even planetary exploration, will find this SpringerBrief to be instructive and helpful.

The authors present a method for estimating the position and orientation of a ground vehicle in an environment with landmarks. From the geometric relationships, a set of linear equations is derived with a quadratic constraint, which forms the basis for an optimisation problem. The problem is also extended to associating two sets of measurements taken at two successive locations to improve the navigation accuracy. This method is efficient and the performance is robust against large measurement errors.

"This cutting-edge resource offers you a thorough understanding of the application of GPS and GPS/INS (inertial navigation system) for vehicle navigation and control. Written by highly-regarded authorities in the field, this unique reference covers a wide range of key topics, including ground vehicles models, psuedolites, highway vehicle control, unmanned ground vehicles, farm tractors, and construction equipment. The book is supported with over 150 illustrations and more than 180 equations."--Editor.

This edited volume includes thoroughly collected on sensing and control for autonomous vehicles. Guidance, navigation and motion control systems for autonomous vehicles are increasingly important in land-based, marine and aerial operations. Autonomous underwater vehicles may be used for pipeline inspection, light intervention work, underwater survey and collection of oceanographic/biological data. Autonomous unmanned aerial systems can be used in a large number of applications such as inspection, monitoring, data collection, surveillance, etc. At present, vehicles operate with limited autonomy and a minimum of intelligence. There is a growing interest for cooperative and coordinated multi-vehicle systems, real-time re-planning, robust autonomous navigation systems and robust autonomous control of vehicles. Unmanned vehicles with high levels of autonomy may be used for safe and efficient collection of environmental data, for assimilation of climate and environmental models and to complement global satellite systems. The target audience primarily comprises research experts in the field of control theory, but the book may also be beneficial for graduate students.

First used in military applications, unmanned aerial vehicles are becoming an integral aspect of modern society and are expanding into the commercial, scientific, recreational, agricultural, and surveillance sectors. With the increasing use of these drones by government officials, business professionals, and civilians, more research is needed to understand their complexity both in design and function. Unmanned Aerial Vehicles: Breakthroughs in Research and Practice is a critical source of academic knowledge on the design, construction, and maintenance of drones, as well as their applications across all aspects of society. Highlighting a range of pertinent topics such as intelligent systems, artificial intelligence, and situation awareness, this publication is an ideal reference source for military consultants, military personnel, business professionals, operation managers, surveillance companies, agriculturalists, policymakers, government officials, law enforcement, IT professionals, academicians, researchers, and graduate-level students.

Climate change is a serious threat to field crop production and food security. It has negative effects on food, water, and energy security due to change in weather patterns and extreme events such as floods, droughts, and heat waves, all of which reduce crop productivity. Over six

chapters, this book presents a comprehensive picture of the importance of agronomy as it relates to the United Nations' Sustainable Development Goals. With an emphasis on the goals of Zero Hunger and Climate Change, this volume examines sustainable agronomic practices to increase crop productivity and improve environmental health.

This pioneering book describes the development of a robot mapping and navigation system inspired by models of the neural mechanisms underlying spatial navigation in the rodent hippocampus. Computational models of animal navigation systems have traditionally had limited performance when implemented on robots. This is the first research to test existing models of rodent spatial mapping and navigation on robots in large, challenging, real world environments.

This book provides state-of-the-art scientific and engineering research findings and developments in the area of mobile robotics and associated support technologies around the theme of cooperative robotics. The book contains peer reviewed articles presented at the CLAWAR 2016 conference. The book contains a strong stream of papers on multi-legged locomotion and cooperative robotics. There is also a strong collection of papers on human assistive devices, notably wearable exoskeletal and prosthetic devices, and personal care robots and mobility assistance devices designed to meet the growing challenges due to the global ageing society. Robot designs based on biological inspirations and ethical concerns and issues related to the design, development and deployment of robots are also strongly featured.

This is the first book on the topic of all source positioning, navigation and timing (PNT) and how to solve the problem of PNT when the most widely-used measurement source available today, the GPS system, may be come unavailable, jammed or spoofed. Readers learn how to define the system architecture as well as the algorithms for GPS-denied and GPS-challenged PNT systems. In addition, the book provides comprehensive coverage of the individual technologies used, such as celestial navigation, vision-based navigation, terrain referenced navigation, gravity anomaly referenced navigation, signal of opportunity (SOO) based PNT, and collaborative PNT. Celestial Navigation is discussed, with stars and satellite used as reference, and star-tracker technology also included. Propagation based timing solutions are explored and the basic principles of oscillators and clocks presented. Initial alignment of strap-down navigation systems is explored, including initial alignment as a Kalman filter problem. Velocimeter/Dead reckoning based navigation and its impact on visual odometry is also explained. Covering both theoretical and practical issues, and packed with equations and models, this book is useful for both the engineering student as well as the advanced practitioner.

This volume contains the proceedings of the KKA 2017 – the 19th Polish Control Conference, organized by the Department of Automatics and Biomedical Engineering, AGH University of Science and Technology in Kraków, Poland on June 18–21, 2017, under the auspices of the Committee on Automatic Control and Robotics of the Polish Academy of Sciences, and the Commission for Engineering Sciences of the Polish Academy of Arts and Sciences. Part 1 deals with general issues of modeling and control, notably flow modeling and control, sliding mode, predictive, dual, etc. control. In turn, Part 2 focuses on optimization, estimation and prediction for control. Part 3 is concerned with autonomous vehicles, while Part 4 addresses applications. Part 5 discusses computer methods in control, and Part 6 examines fractional order calculus in the modeling and control of dynamic systems. Part 7 focuses on modern robotics. Part 8 deals with modeling and identification, while Part 9 deals with problems related to security, fault detection and diagnostics. Part 10 explores intelligent systems in automatic control, and Part 11 discusses the use of control tools and techniques in biomedical engineering. Lastly, Part 12 considers engineering education and teaching with regard to automatic control and robotics.

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.

The automotive industry appears close to substantial change engendered by "self-driving" technologies. This technology offers the possibility of significant benefits to social welfare—saving lives; reducing crashes, congestion, fuel consumption, and pollution; increasing mobility for the disabled; and ultimately improving land use. This report is intended as a guide for state and federal policymakers on the many issues that this technology raises.

Detecting mud hazards is a significant challenge to UGV autonomous off-road navigation. A military UGV stuck in a mud body during a mission may need to be sacrificed or rescued, both unattractive options. JPL is currently developing a daytime mud detection capability under the RCTA program using UGV mounted sensors. To perform robust mud detection under all conditions, we expect multiple sensors will be necessary. A passive mud detection solution is desirable to meet the FCS-ANS requirements. To characterize the advantages and disadvantages of candidate passive sensors, data collections have been performed on wet and dry soil using visible, multi-spectral (including near-infrared), shortwave infrared, mid-wave infrared, long-wave infrared, polarization, and stereo sensors. In this paper, we examine the cues for mud detection each of these sensors provide, along with their deficiencies, and we illustrate localizing detected mud in a world model that can be used by a UGV to plan safe paths.

Autonomous vehicles (AVs) have been used in military operations for more than 60 years, with torpedoes, cruise missiles, satellites, and target drones being early examples.¹ They have also been widely used in the civilian sector—for example, in the disposal of explosives, for work and measurement in radioactive environments, by various offshore industries for both creating and maintaining undersea facilities, for atmospheric and undersea research, and by industry in automated and robotic manufacturing. Recent military experiences with AVs have consistently demonstrated their value in a wide range of missions, and anticipated developments of AVs hold promise for increasingly significant roles in future naval operations. Advances in AV capabilities are enabled (and limited) by progress in the technologies of computing and robotics, navigation, communications and networking, power sources and propulsion, and materials. *Autonomous Vehicles in Support of Naval Operations* is a forward-looking discussion of the naval operational environment and vision for the Navy and Marine Corps and of naval mission needs and potential applications and limitations of AVs. This report considers the potential of AVs for naval operations, operational needs and technology issues, and opportunities for improved operations.

This book discusses all the major nature-inspired algorithms with a focus on their application in the context of solving navigation

and routing problems. It also reviews the approximation methods and recent nature-inspired approaches for practical navigation, and compares these methods with traditional algorithms to validate the approach for the case studies discussed. Further, it examines the design of alternative solutions using nature-inspired techniques, and explores the challenges of navigation and routing problems and nature-inspired metaheuristic approaches.

Accurate knowledge of the pose (position and orientation) is essential to the unmanned ground vehicle's (UGV) ability to follow a prescribed path and to reach a specified location, which is the essence of autonomous mobility. An essential element of an autonomous UGV's sensor suite is the navigation sensor. Given appropriate processing, other UGV terrain sensors can also provide independent estimates of vehicle pose or derivatives thereof that can be fused with the navigation data to provide a more robust knowledge of pose and implicitly, of registration between the two sensors. Improved accuracy of UGV pose in turn enables improved accuracy of terrain geometry estimates. In this report, we describe a precursor to fusion, which is juxtaposition of consistent entities (apples to apples). Trajectories of pose estimates are recorded as a surrogate UGV traverses rough terrain, one trajectory from an inertial UGV navigation sensor, and its counterpart from egomotion extracted in post-processing from a forward looking video camera. The sensors and the relevant aspects of the data collection methodology are described, as are the streams of pose estimates. We explain the procedure adopted for temporally aligning the data streams and the assumptions concerning registration under which the streams are juxtaposed. A notation is developed to relate the myriad coordinate frames implicit in the application. The juxtaposition is presented graphically, with recommendations for subsequent studies with the intent of achieving fusion. A small related study evaluating the possibility of calculating the registration from pose trajectories is reported.

The International Conference on Intelligent Unmanned Systems 2011 was organized by the International Society of Intelligent Unmanned Systems and locally by the Center for Bio-Micro Robotics Research at Chiba University, Japan. The event was the 7th conference continuing from previous conferences held in Seoul, Korea (2005, 2006), Bali, Indonesia (2007), Nanjing, China (2008), Jeju, Korea (2009), and Bali, Indonesia (2010). ICIUS 2011 focused on both theory and application, primarily covering the topics of robotics, autonomous vehicles, intelligent unmanned technologies, and biomimetics. We invited seven keynote speakers who dealt with related state-of-the-art technologies including unmanned aerial vehicles (UAVs) and micro air vehicles (MAVs), flapping wings (FWs), unmanned ground vehicles (UGVs), underwater vehicles (UVs), bio-inspired robotics, advanced control, and intelligent systems, among others. This book is a collection of excellent papers that were updated after presentation at ICIUS2011. All papers that form the chapters of this book were reviewed and revised from the perspective of advanced relevant technologies in the field. The aim of this book is to stimulate interactions among researchers active in the areas pertinent to intelligent unmanned systems.

Poland, - mania, Singapore, Slovakia, Spain, Sweden, Switzerland, Taiwan, UK, and USA.

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 and agricultural machines. 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.

This book comprises select proceedings of the International Conference on Recent Innovations and Developments in Mechanical Engineering (IC-RIDME 2018). The book contains peer reviewed articles covering thematic areas such as fluid mechanics, renewable energy, materials and manufacturing, thermal engineering, vibration and acoustics, experimental aerodynamics, turbo machinery, and robotics and mechatronics. Algorithms and methodologies of real-time problems are described in this book. The contents of this book will be useful for both academics and industry professionals.

The purpose of this paper is to provide a brief survey of a number of different threads of development that have brought the Unmanned Ground Vehicle (UGV) field to its current state, together with references to allow the interested reader to probe more deeply. In the broadest "dictionary" sense, a UGV is any piece of mechanized equipment that moves across the surface of the ground and serves as a means of carrying or transporting something, but explicitly does NOT carry a human being. A discussion of such a broad universe of possible UGV systems needs some organizing principle, and in fact a taxonomy of UGV systems could be based upon any of a number of characteristics of each system. To reasonably limit its scope, this survey will focus principally on the large number of systems in which the "long pole" technological challenge is or has been in the area of navigation and control. Within that context, a teleoperated vehicle system is one in which navigational guidance is transmitted to the vehicle from an externally situated human operator; an autonomous vehicle is one that determines its own course using onboard sensor and processing resources; the term "supervisory control" is often given to the myriad of control schemes that combine inputs from both an external human operator and onboard sensors to determine the UGV's path. (53 refs.).

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 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, 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.

This book presents a variety of perspectives on vision-based applications. These contributions are focused on optoelectronic sensors, 3D & 2D machine vision technologies, robot navigation, control schemes, motion controllers, intelligent algorithms and vision systems. The authors focus on applications of unmanned aerial vehicles, autonomous and mobile robots, industrial inspection applications and structural health monitoring. Recent advanced research in measurement and others areas where 3D & 2D machine vision and machine control play an important role, as well as surveys and reviews about vision-based applications. These topics are of interest to readers from diverse areas, including electrical, electronics and computer engineering, technologists, students and non-specialist readers.

- Presents current research in image and signal sensors, methods, and 3D & 2D technologies in vision-based theories and applications;
- Discusses applications such as daily use devices including robotics, detection, tracking and stereoscopic vision systems, pose estimation, avoidance of objects, control and data exchange for navigation, and aerial imagery processing;
- Includes research contributions in scientific, industrial, and civil applications.

Robotics began as a science fiction creation which has become quite real, first in assembly line operations such as automobile manufacturing, aeroplane construction etc. They have now reached such areas as the Internet, ever-multiplying-medical uses and sophisticated military applications. Control of today's robots is often remote which requires even more advanced computer vision capabilities as well as sensors and interface techniques. Learning has become crucial for modern robotic systems as well. This new book brings together leading research in this exciting field.

[Copyright: 35f2754e5f095078fad0203d913b0d4e](#)