

Multi Uav Cooperative Surveillance With Spatio Temporal

An invaluable addition to the literature on UAV guidance and cooperative control, Cooperative Path Planning of Unmanned Aerial Vehicles is a dedicated, practical guide to computational path planning for UAVs. One of the key issues facing future development of UAVs is path planning: it is vital that swarm UAVs/ MAVs can cooperate together in a coordinated manner, obeying a pre-planned course but able to react to their environment by communicating and cooperating. An optimized path is necessary in order to ensure a UAV completes its mission efficiently, safely, and successfully. Focussing on the path planning of multiple UAVs for simultaneous arrival on target, Cooperative Path Planning of Unmanned Aerial Vehicles also offers coverage of path planners that are applicable to land, sea, or space-borne vehicles. Cooperative Path Planning of Unmanned Aerial Vehicles is authored by leading researchers from Cranfield University and provides an authoritative resource for researchers, academics and engineers working in the area of cooperative systems, cooperative control and optimization particularly in the aerospace industry.

"The ability to fly multiple unmanned aerial vehicles (UAVs) in collaboration has the potential to expand the scope of feasible UAV missions and could become the backbone of future UAV missions. However, despite having garnered significant research interest, there is no indication that systems supporting collaborative operation of multiple UAVs are close to achieving field deployment. The challenge of successfully deploying a quality system is inherently complex, and systems engineering offers an approach to handle the complexities. Effective application of systems engineering requires both knowledge breadth and depth. This thesis presents the results of a consolidation of information intended to support the conduct of systems engineering activities; and describes an experiment to ascertain the sensitivities of some key operational parameters, e.g., acquisition, pointing, and tracking. The experiment was conducted using Automatic Dependent Surveillance Broadcast (ADS-B) and visual tracking equipment employing state-of-the-art technology to understand the operating challenges and requirements of using this equipment to provide situational awareness for a UAV pilot"--Abstract.

Safe Robot Navigation Among Moving and Steady Obstacles is the first book to focus on reactive navigation algorithms in unknown dynamic environments with moving and steady obstacles. The first three chapters provide introduction and background on sliding mode control theory, sensor models, and vehicle kinematics. Chapter 4 deals with the problem of optimal navigation in the presence of obstacles. Chapter 5 discusses the problem of reactively navigating. In Chapter 6, border patrolling algorithms are applied to a more general problem of reactively navigating. A method for guidance of a Dubins-like mobile robot is presented in Chapter 7. Chapter 8 introduces and studies a simple biologically-inspired strategy for navigation a Dubins-car. Chapter 9 deals with a hard scenario where the environment of operation is cluttered with obstacles that may undergo arbitrary motions, including rotations and deformations. Chapter 10 presents a novel reactive algorithm for collision free navigation of a nonholonomic robot in unknown complex dynamic environments with moving obstacles. Chapter 11 introduces and examines a novel purely reactive algorithm to navigate a planar mobile robot in densely cluttered environments with unpredictably moving and deforming obstacles. Chapter 12 considers a multiple robot scenario. For the Control and Automation Engineer, this book offers accessible and precise development of important mathematical models and results. All the presented results have mathematically rigorous proofs. On the other hand, the Engineer in Industry can benefit by the experiments with real robots such as Pioneer robots, autonomous wheelchairs and autonomous mobile hospital. First book on collision free reactive robot navigation in unknown dynamic environments Bridges the gap between mathematical model and practical algorithms Presents implementable and computationally efficient algorithms of robot navigation Includes mathematically rigorous proofs of their convergence A detailed review of existing reactive navigation algorithm for obstacle avoidance Describes fundamentals of sliding mode control

Across the globe, the past several years have seen a tremendous increase in the role of cooperative autonomous systems. The field of cooperative control and optimization has established itself as a part of many different scientific disciplines. The contents of this hugely important volume, which adds much to the debate on the subject, are culled from papers presented at the Seventh Annual International Conference on Cooperative Control and Optimization, held in Gainesville, Florida, in January 2007.

DARS is now a well-established conference that gathers every two years the main researchers in Distributed Robotics systems. Even if the field is growing, it has been maintained a one-track conference in order to enforce effective exchanges between the main researchers in the field. It now a well-established tradition to publish the main contributions as a book from Springer.

There are already 5 books entitled "Distributed Autonomous Robotic Systems" 1 to 5.

Covering the design, development, operation and mission profiles of unmanned aircraft systems, this single, comprehensive volume forms a complete, stand-alone reference on the topic. The volume integrates with the online Wiley Encyclopedia of Aerospace Engineering, providing many new and updated articles for existing subscribers to that work.

This book constitutes the refereed proceedings of the 14th Pacific Rim Conference on Artificial Intelligence, PRICAI 2016, held in Phuket, Thailand, in August 2016. The 53 regular papers and 15 short papers presented in this volume were carefully reviewed and selected from 161 submissions. Pricai covers a wide range of topics such as AI foundations; applications of AI; semantic web; information retrieval; constraint satisfaction; multimodal interaction; knowledge representation; social networks; ad-hoc networks; algorithms; software architecture; machine learning; and smart modeling and simulation.

Ad hoc networks, which include a variety of autonomous networks for specific purposes, promise a broad range of civilian, commercial, and military applications. These networks were originally envisioned as collections of autonomous mobile or stationary nodes that dynamically auto-configure themselves into a wireless network without relying on any existing network infrastructure or centralized administration. With the significant advances in the last decade, the concept of ad hoc networks now covers an even broader scope, referring to the many types of autonomous wireless networks designed and deployed for a specific task or function, such as wireless sensor networks, vehicular networks, home networks, and so on. In contrast to the traditional wireless networking paradigm, such networks are all characterized by sporadic connections, highly error-prone communications, distributed autonomous operation, and fragile multi-hop relay paths. The new wireless networking paradigm necessitates reexamination of many established concepts and protocols, and calls for developing a new understanding of fundamental

problems such as interference, mobility, connectivity, capacity, and security, among others. While it is essential to advance theoretical research on fundamental and practical research on efficient policies, algorithms and protocols, it is also critical to develop useful applications, experimental prototypes, and real-world deployments to achieve an immediate impact on society for the success of this wireless networking paradigm.

This two volume set constitutes the refereed post-conference proceedings of the Second International Conference on Machine Learning and Intelligent Communications, MLICOM 2017, held in Weihai, China, in August 2017. The 143 revised full papers were carefully selected from 225 submissions. The papers are organized thematically in machine learning, intelligent positioning and navigation, intelligent multimedia processing and security, intelligent wireless mobile network and security, cognitive radio and intelligent networking, intelligent internet of things, intelligent satellite communications and networking, intelligent remote sensing, visual computing and three-dimensional modeling, green communication and intelligent networking, intelligent ad-hoc and sensor networks, intelligent resource allocation in wireless and cloud networks, intelligent signal processing in wireless and optical communications, intelligent radar signal processing, intelligent cooperative communications and networking.

Explore foundational and advanced issues in UAV cellular communications with this cutting-edge and timely new resource UAV Communications for 5G and Beyond delivers a comprehensive overview of the potential applications, networking architectures, research findings, enabling technologies, experimental measurement results, and industry standardizations for UAV communications in cellular systems. The book covers both existing LTE infrastructure, as well as future 5G-and-beyond systems. UAV Communications covers a range of topics that will be of interest to students and professionals alike. Issues of UAV detection and identification are discussed, as is the positioning of autonomous aerial vehicles. More fundamental subjects, like the necessary tradeoffs involved in UAV communication are examined in detail. The distinguished editors offer readers an opportunity to improve their ability to plan and design for the near-future, explosive growth in the number of UAVs, as well as the correspondingly demanding systems that come with them. Readers will learn about a wide variety of timely and practical UAV topics, like: Performance measurement for aerial vehicles over cellular networks, particularly with respect to existing LTE performance Inter-cell interference coordination with drones Massive multiple-input and multiple-output (MIMO) for Cellular UAV communications, including beamforming, null-steering, and the performance of forward-link C&C channels 3GPP standardization for cellular-supported UAVs, including UAV traffic requirements, channel modeling, and interference challenges Trajectory optimization for UAV communications Perfect for professional engineers and researchers working in the field of unmanned aerial vehicles, UAV Communications for 5G and Beyond also belongs on the bookshelves of students in masters and PhD programs studying the integration of UAVs into cellular communication systems.

The use of unmanned aerial vehicles (UAVs) plays an important role in supporting human activities. Man is concentrating more and more on intellectual work, and trying to automate practical activities as much as possible in order to increase their efficiency. In this regard, the use of drones is increasingly becoming a key aspect of this automation process, offering many advantages, including agility, efficiency and reduced risk, especially in dangerous missions. Hence, this Special Issue focuses on applications, platforms and services where UAVs can be used as facilitators for the task at hand, also keeping in mind that security should be addressed from its different perspectives, ranking from communications security to operational security, and furthermore considering privacy issues.

The two-volume set of LNCS 10941 and 10942 constitutes the proceedings of the 9th International Conference on Advances in Swarm Intelligence, ICSI 2018, held in Shanghai, China, in June 2018. The total of 113 papers presented in these volumes was carefully reviewed and selected from 197 submissions. The papers were organized in topical sections namely: multi-agent systems; swarm robotics; fuzzy logic approaches; planning and routing problems; recommendation in social media; predication; classification; finding patterns; image enhancement; deep learning; theories and models of swarm intelligence; ant colony optimization; particle swarm optimization; artificial bee colony algorithms; genetic algorithms; differential evolution; fireworks algorithm; bacterial foraging optimization; artificial immune system; hydrologic cycle optimization; other swarm-based optimization algorithms; hybrid optimization algorithms; multi-objective optimization; large-scale global optimization.

This book constitutes the proceedings of the Third International Conference on Interactive Collaborative Robotics, ICR 2018, held in Leipzig, Germany, in September 2018, as a satellite event of the 20th International Conference on Speech and Computer, SPECOM 2018. The 30 papers presented in this volume were carefully reviewed and selected from 51 submissions. The papers presents challenges of human-robot interaction, robot control and behavior in social robotics and collaborative robotics, as well as applied robotic and cyberphysical systems.

This book includes the proceedings of the Intelligent and Fuzzy Techniques INFUS 2019 Conference, held in Istanbul, Turkey, on July 23–25, 2019. Big data analytics refers to the strategy of analyzing large volumes of data, or big data, gathered from a wide variety of sources, including social networks, videos, digital images, sensors, and sales transaction records. Big data analytics allows data scientists and various other users to evaluate large volumes of transaction data and other data sources that traditional business systems would be unable to tackle. Data-driven and knowledge-driven approaches and techniques have been widely used in intelligent decision-making, and they are increasingly attracting attention due to their importance and effectiveness in addressing uncertainty and incompleteness. INFUS 2019 focused on intelligent and fuzzy systems with applications in big data analytics and decision-making, providing an international forum that brought together those actively involved in areas of interest to data science and knowledge engineering. These proceeding feature about 150 peer-reviewed papers from countries such as China, Iran, Turkey, Malaysia, India, USA, Spain, France, Poland,

Mexico, Bulgaria, Algeria, Pakistan, Australia, Lebanon, and Czech Republic.

This book captures the latest results and techniques for cooperative localization and navigation drawn from a broad array of disciplines. It provides the reader with a generic and comprehensive view of modeling, strategies, and state estimation methodologies in that fields. It discusses the most recent research and novel advances in that direction, exploring the design of algorithms and architectures, benefits, and challenging aspects, as well as a potential broad array of disciplines, including wireless communication, indoor localization, robotics, emergency rescue, motion analysis, etc.

Multi-robot systems are a major research topic in robotics. Designing, testing, and deploying aerial robots in the real world is a possibility due to recent technological advances. This book explores different aspects of cooperation in multiagent systems. It covers the team approach as well as deterministic decision-making. It also presents distributed receding horizon control, as well as conflict resolution, artificial potentials, and symbolic planning. The book also covers association with limited communications, as well as genetic algorithms and game theory reasoning. Multiagent decision-making and algorithms for optimal planning are also covered along with case studies. Key features: Provides a comprehensive introduction to multi-robot systems planning and task allocation Explores multi-robot aerial planning; flight planning; orienteering and coverage; and deployment, patrolling, and foraging Includes real-world case studies Treats different aspects of cooperation in multiagent systems Both scientists and practitioners in the field of robotics will find this text valuable.

This book compiles some of the latest research in cooperation between robots and sensor networks. Structured in twelve chapters, this book addresses fundamental, theoretical, implementation and experimentation issues. The chapters are organized into four parts namely multi-robots systems, data fusion and localization, security and dependability, and mobility.

Complete with online files and updates, this cutting-edge text looks at the next generation of unmanned flying machines. Aerial robots can be considered as an evolution of the Unmanned Aerial Vehicles (UAVs). This book provides a complete overview of all the issues related to aerial robotics, addressing problems ranging from flight control to terrain perception and mission planning and execution. The major challenges and potentials of heterogeneous UAVs are comprehensively explored.

This book constitutes the thoroughly refereed post-workshop proceedings of the 5th International Workshop on Modelling and Simulation for Autonomous Systems, MESAS 2018, held in Prague, Czech Republic, in October 2018. The 46 revised full papers included in the volume were carefully reviewed and selected from 66 submissions. They are organized in the following topical sections: Future Challenges of Advanced M&S Technology; Swarming - R&D and Application; M&S of Intelligent Systems - AI, R&D and Application; AxS in Context of Future Warfare and Security Environment (Concepts, Applications, Training, Interoperability, etc.).

Bio-inspired Computation in Unmanned Aerial Vehicles focuses on the aspects of path planning, formation control, heterogeneous cooperative control and vision-based surveillance and navigation in Unmanned Aerial Vehicles (UAVs) from the perspective of bio-inspired computation. It helps readers to gain a comprehensive understanding of control-related problems in UAVs, presenting the latest advances in bio-inspired computation. By combining bio-inspired computation and UAV control problems, key questions are explored in depth, and each piece is content-rich while remaining accessible. With abundant illustrations of simulation work, this book links theory, algorithms and implementation procedures, demonstrating the simulation results with graphics that are intuitive without sacrificing academic rigor. Further, it pays due attention to both the conceptual framework and the implementation procedures. The book offers a valuable resource for scientists, researchers and graduate students in the field of Control, Aerospace Technology and Astronautics, especially those interested in artificial intelligence and Unmanned Aerial Vehicles. Professor Haibin Duan and Dr. Pei Li, both work at Beihang University (formerly Beijing University of Aeronautics & Astronautics, BUAA). Prof Duan's academic website is: <http://hbduan.buaa.edu.cn>

This book constitutes the refereed proceedings of the First International Symposium on Mobile Internet Security, MobiSec 2017, held in Jeju Island, Republic of Korea, in October 2017. The 13 revised full papers along with a short paper presented were carefully reviewed and selected from 44 submissions. They are closely related to various theories and practical applications in mobility management to highlight the state-of-the-art research.

UAVs are becoming a reality and attract increasing attention. They can be remotely controlled or completely autonomous and be used alone or as a fleet and in a large set of applications. They are constrained by hardware since they cannot be too heavy and rely on batteries. Their use still raises a large set of exciting new challenges in terms of trajectory optimization and positioning when they are used alone or in cooperation, and communication when they evolve in swarm, to name but a few examples. This book presents some new original contributions regarding UAV or UAV swarm optimization and communication aspects.

Optimization and Communication in UAV NetworksMdpi AG

This three-volume set LNCS 10361, LNCS 10362, and LNAI 10363 constitutes the refereed proceedings of the 13th International Conference on Intelligent Computing, ICIC 2017, held in Liverpool, UK, in August 2017. The 212 full papers and 20 short papers of the three proceedings volumes were carefully reviewed and selected from 612 submissions. This first volume of the set comprises 71 papers. The papers are organized in topical sections such as Evolutionary Computation and Learning; Neural Networks; Nature Inspired Computing and Optimization; Signal Processing; Pattern Recognition; Biometrics Recognition; Image Processing; Information Security; Virtual Reality and Human-Computer Interaction; Business Intelligence and Multimedia Technology; Genetic Algorithms; Biomedical Informatics Theory and Methods; Particle Swarm Optimization

and Niche Technology; Swarm Intelligence and Optimization; Independent Component Analysis; Compressed Sensing and Sparse Coding; Natural Computing; Intelligent Computing in Computer Vision; Computational Intelligence and Security for Image Applications in Social Network; Neural Networks: Theory and Application.

The Cognitive Approach in Cloud Computing and Internet of Things Technologies for Surveillance Tracking Systems discusses the recent, rapid development of Internet of things (IoT) and its focus on research in smart cities, especially on surveillance tracking systems in which computing devices are widely distributed and huge amounts of dynamic real-time data are collected and processed. Efficient surveillance tracking systems in the Big Data era require the capability of quickly abstracting useful information from the increasing amounts of data. Real-time information fusion is imperative and part of the challenge to mission critical surveillance tasks for various applications. This book presents all of these concepts, with a goal of creating automated IT systems that are capable of resolving problems without demanding human aid. Examines the current state of surveillance tracking systems, cognitive cloud architecture for resolving critical issues in surveillance tracking systems, and research opportunities in cognitive computing for surveillance tracking systems Discusses topics including cognitive computing architectures and approaches, cognitive computing and neural networks, complex analytics and machine learning, design of a symbiotic agent for recognizing real space in ubiquitous environments, and more Covers supervised regression and classification methods, clustering and dimensionality reduction methods, model development for machine learning applications, intelligent machines and deep learning networks includes coverage of cognitive computing models for scalable environments, privacy and security aspects of surveillance tracking systems, strategies and experiences in cloud architecture and service platform design

This book constitutes the refereed proceedings of the 5th International Conference on Industrial Applications of Holonic and Multi-Agent Systems, HoloMAS 2011, held in Toulouse, France, August 29-31, 2011. The 25 revised full papers presented were carefully reviewed and selected from 36 submissions. The papers are organized in topical sections on industrial agents, simulation and modelling, planning and scheduling, smart technical systems, and MAS for unmanned aerial vehicles.

"The past few years witnessed a major revolution in the area of unmanned aerial vehicles (UAVs), commonly known as drones, due to significant technological advances across various drone-related fields ranging from embedded systems to autonomy, control, security, and communications. These unprecedented recent advances in UAV technology have made it possible to widely deploy drones across a plethora of application domains ranging from delivery of goods to surveillance, environmental monitoring, track control, remote sensing, and search and rescue. In fact, recent reports from the Federal Aviation Administration (FAA) anticipate that sales of UAVs may exceed 7 million in 2020 and many industries are currently investing in innovative drone-centric applications and research. To enable all such applications, it is imperative to address a plethora of research challenges pertaining to drone systems, ranging from navigation to autonomy, control, sensing, navigation, and communications. In particular, the deployment of UAVs in tomorrow's smart cities, is largely contingent upon equipping them with effective means for communications and networking. To this end, in this book, we provide a comprehensive treatment of the wireless communications and networking research challenges and opportunities associated with UAV technology. This treatment begins in this chapter which provides an introduction to UAV technology and an in-depth discussion on the wireless communication and networking challenges associated with the introduction of UAVs"--

Discover what lies beyond the bleeding-edge of autonomous airborne networks with this authoritative new resource Autonomous Airborne Wireless Networks delivers an insightful exploration of recent advances in the theory and practice of using airborne wireless networks to provide emergency communications, coverage and capacity expansion, information dissemination, and more. The distinguished engineers and editors have selected resources that cover the fundamentals of airborne networks, including channel models, recent regulation developments, self-organized networking, AI-enabled flying networks, and notable applications in a variety of industries. The book evaluates advances in the cutting-edge of unmanned aerial vehicle wireless network technology while offering readers new ideas on how airborne wireless networks can support various applications expected of future networks. The rapidly developing field is examined from a fresh perspective, one not just concerned with ideas of control, trajectory optimization, and navigation. Autonomous Airborne Wireless Networks considers several potential use cases for the technology and demonstrates how it can be integrated with concepts from self-organized network technology and artificial intelligence to deliver results in those cases. Readers will also enjoy: A thorough discussion of distributed drone base station positioning for emergency cellular networks using reinforcement learning (AI-enabled trajectory optimization) An exploration of unmanned aerial vehicle-to-wearables (UAV2W) indoor radio propagation channel measurements and modelling An up-to-date treatment of energy minimization in UAV trajectory design for delay tolerant emergency communication Examinations of cache-enabled UAVs, 3D MIMO for airborne networks, and airborne networks for Internet of Things communications Perfect for telecom engineers and industry professionals working on identifying practical and efficient concepts tailored to overcome challenges facing unmanned aerial vehicles providing wireless communications, Autonomous Airborne Wireless Networks also has a place on the bookshelves of stakeholders, regulators, and research agencies working on the latest developments in UAV communications.

Unmanned aerial vehicles (UAVs) are increasingly used in military missions because they have the advantages of not placing human life at risk and of lowering operation costs via decreased vehicle weight. These benefits can be fully realized only if UAVs work cooperatively in groups with an efficient exchange of information. This book provides an authoritative reference on cooperative decision and control of UAVs and the means available to solve problems involving them.

U.S. Air Force (USAF) planners have envisioned that uninhabited air vehicles (UAVs), working in concert with inhabited vehicles, will become an integral part of the future force structure. Current plans are based on the premise that UAVs have the potential to augment, or even replace, inhabited aircraft in a variety of missions. However, UAV technologies must be better understood before they will be accepted as an alternative to inhabited aircraft on the battlefield. The U.S. Air Force Office of Scientific Research (AFOSR) requested that the National Research Council, through the National Materials Advisory Board and the Aeronautics and Space Engineering Board, identify long-term research opportunities for supporting the development of technologies for UAVs. The objectives of the study were to identify technological developments that would improve the performance and reliability of "generation-after-next" UAVs at lower cost and to recommend areas of fundamental research in materials, structures, and aeronautical technologies. The study focused on innovations in technology that would "leapfrog" current technology development and would be ready for scaling-up in the post-2010 time frame (i.e., ready for use on aircraft by 2025).

Intelligent Autonomy of UAVs: Advanced Missions and Future Use provides an approach to the formulation of the fundamental task typical to any mission and provides guidelines of how this task can be solved by different generic robotic problems. As such, this book aims to provide a systems engineering approach to UAV projects, discovering the real problems that need to be resolved independently of the application. After an introduction to the rapidly evolving field of aerial robotics, the book presents topics such as autonomy, mission analysis, human-UAV teams, homogeneous and heterogeneous UAV teams, and finally, UAV-UGV teams. It then covers generic robotic problems such as orienteering and coverage. The book next introduces deployment, patrolling, and foraging, while the last part of the book tackles an important application: aerial search, tracking, and surveillance. This book is meant for both scientists and practitioners. For practitioners, it presents existing solutions that are categorized according to various missions: surveillance and reconnaissance, 3D mapping, urban monitoring, precision agriculture, forestry, disaster assessment and monitoring, security, industrial plant inspection, etc. For scientists, it provides an overview of generic robotic problems such as coverage and orienteering; deployment, patrolling and foraging; search, tracking, and surveillance. The design and analysis of algorithms raise a unique combination of questions from many fields, including robotics, operational research, control theory, and computer science.

This book is a printed edition of the Special Issue "UAV Sensors for Environmental Monitoring" that was published in Sensors

Unmanned Aerial Systems: Theoretical Foundation and Applications presents some of the latest innovative approaches to drones from the point-of-view of dynamic modeling, system analysis, optimization, control, communications, 3D-mapping, search and rescue, surveillance, farmland and construction monitoring, and more. With the emergence of low-cost UAS, a vast array of research works in academia and products in the industrial sectors have evolved. The book covers the safe operation of UAS, including, but not limited to, fundamental design, mission and path planning, control theory, computer vision, artificial intelligence, applications requirements, and more. This book provides a unique reference of the state-of-the-art research and development of unmanned aerial systems, making it an essential resource for researchers, instructors and practitioners. Covers some of the most innovative approaches to drones Provides the latest state-of-the-art research and development surrounding unmanned aerial systems Presents a comprehensive reference on unmanned aerial systems, with a focus on cutting-edge technologies and recent research trends in the area

Unmanned Aerial Vehicle (UAV) technology holds great promise for various civilian and military applications. Cooperative control of a network of autonomous UAVs poses novel challenges because of the inherent constraints like non-holonomic motion, limited range communication, etc. In this dissertation, we present some recently-developed tools and strategies for motion coordination of UAVs. In particular, the focus is on algorithms for various coordination tasks such as vehicle routing to meet service demands, deployment over a region for surveillance and flying in flock-like formations.

This book is used at the graduate or advanced undergraduate level and many others. Manned and unmanned ground, aerial and marine vehicles enable many promising and revolutionary civilian and military applications that will change our life in the near future. These applications include, but are not limited to, surveillance, search and rescue, environment monitoring, infrastructure monitoring, self-driving cars, contactless last-mile delivery vehicles, autonomous ships, precision agriculture and transmission line inspection to name just a few. These vehicles will benefit from advances of deep learning as a subfield of machine learning able to endow these vehicles with different capability such as perception, situation awareness, planning and intelligent control. Deep learning models also have the ability to generate actionable insights into the complex structures of large data sets. In recent years, deep learning research has received an increasing amount of attention from researchers in academia, government laboratories and industry. These research activities have borne some fruit in tackling some of the challenging problems of manned and unmanned ground, aerial and marine vehicles that are still open. Moreover, deep learning methods have been recently actively developed in other areas of machine learning, including reinforcement training and transfer/meta-learning, whereas standard, deep learning methods such as recent neural network (RNN) and coevolutionary neural networks (CNN). The book is primarily meant for researchers from academia and industry, who are working on in the research areas such as engineering, control engineering, robotics, mechatronics, biomedical engineering, mechanical engineering and computer science. The book chapters deal with the recent research problems in the areas of reinforcement learning-based control of UAVs and deep learning for unmanned aerial systems (UAS) The book chapters present various techniques of deep learning for robotic applications. The book chapters contain a good literature survey with a long list of references. The book chapters are well written with a good exposition of the research problem, methodology, block diagrams and mathematical techniques. The book chapters are lucidly illustrated with numerical examples and simulations. The book chapters discuss details of applications and future research areas.

A comprehensive review of the state of the art in the control of multi-agent systems theory and applications The superiority of multi-agent systems over single agents for the control of unmanned air, water and ground vehicles has been clearly demonstrated in a wide range of application areas. Their large-scale spatial distribution, robustness, high scalability and low cost enable multi-agent systems to achieve tasks that could not successfully be performed by even the most sophisticated single agent systems. Cooperative Control of Multi-Agent Systems:

Theory and Applications provides a wide-ranging review of the latest developments in the cooperative control of multi-agent systems theory and applications. The applications described are mainly in the areas of unmanned aerial vehicles (UAVs) and unmanned ground vehicles (UGVs). Throughout, the authors link basic theory to multi-agent cooperative control practice — illustrated within the context of highly-realistic scenarios of high-level missions — without losing sight of the mathematical background needed to provide performance guarantees under general working conditions. Many of the problems and solutions considered involve combinations of both types of vehicles. Topics explored include target assignment, target tracking, consensus, stochastic game theory-based framework, event-triggered control, topology design and identification, coordination under uncertainty and coverage control. Establishes a bridge between fundamental cooperative control theory and specific problems of interest in a wide range of applications areas Includes example applications from the fields of space exploration, radiation shielding, site clearance, tracking/classification, surveillance, search-and-rescue and more Features detailed presentations of specific algorithms and application frameworks with relevant commercial and military applications Provides a comprehensive look at the latest developments in this rapidly evolving field, while offering informed speculation on future directions for collective control systems The use of multi-agent system technologies in both everyday commercial use and national defense is certain to increase tremendously in the years ahead, making this book a valuable resource for researchers, engineers, and applied mathematicians working in systems and controls, as well as advanced undergraduates and graduate students interested in those areas.

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.

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