



Swarm Intelligence For Autonomous Uav Control

Sebastian Brünink



Swarm Intelligence For Autonomous Uav Control:

Swarm Intelligence for Autonomous UAV Control, 2005 Unmanned Aerial Vehicles UAVs are becoming vital warfare platforms because they significantly reduce the risk of human life while accomplishing important missions A UAV can be used for example as stand in sensor for the detection of mobile low probability of intercept battlefield surveillance and fire control emitters With many UAVs acting together as a swarm the location and frequency characteristics of each emitter can be accurately determined to continuously provide complete battlefield awareness The swarm should be able to act autonomously while searching for targets and relaying the information to all swarm members In this thesis two methods of autonomous control of a UAV swarm were investigated The first method investigated was the Particle Swarm Optimization PSO algorithm This technique uses a non linear approach to minimize the error between the location of each particle and the target by accelerating particles through the search space until the target is found When applied to a swarm of UAVs the PSO algorithm did not produce the desired performance results The second method used a linear algorithm to determine the correct heading and maneuver the swarm toward the target at a constant velocity This thesis shows that the second approach is more practical to a UAV swarm New results are shown to demonstrate the application of the algorithm to the swarm movement

Swarms and Network Intelligence in Search Yaniv Altshuler, Alex Pentland, Alfred M. Bruckstein, 2017-08-03 This book offers a comprehensive analysis of the theory and tools needed for the development of an efficient and robust infrastructure for the design of collaborative patrolling unmanned aerial vehicle UAV swarms focusing on its applications for tactical intelligence drones It discusses frameworks for robustly and near optimally analyzing flocks of semi autonomous vehicles designed to efficiently perform the ongoing dynamic patrolling and scanning of pre defined search regions It discusses the theoretical limitations of such systems as well as the trade offs between the systems various economic and operational parameters Current UAV systems rely mainly on human operators for the design and adaptation of drones flying routes However recent technological advances have introduced new systems comprised of a small number of self organizing vehicles manually guided at the swarm level by a human operator With the growing complexity of such man supervised architectures it is becoming increasingly harder to guarantee a pre defined level of performance The use of large scale swarms of UAVs as a combat and reconnaissance platform therefore necessitates the development of an efficient optimization mechanism of their utilization specifically in the design and maintenance of their patrolling routes The book is intended for researchers and engineers in the fields of swarms systems and autonomous drones

Intelligent Communication Technologies and Virtual Mobile Networks G. Rajakumar, Ke-Lin Du, Álvaro Rocha, 2023-06-01 The book is a collection of high quality research papers presented at Intelligent Communication Technologies and Virtual Mobile Networks ICICV 2023 held at Francis Xavier Engineering College Tirunelveli Tamil Nadu India during February 16 17 2023 The book shares knowledge and results in theory methodology and applications of communication technology and mobile networks The

book covers innovative and cutting edge work of researchers developers and practitioners from academia and industry working in the area of computer networks network protocols and wireless networks data communication technologies and network security Applications of Machine Learning in UAV Networks Hassan, Jahan,Alsamhi, Saeed,2024-01-17

Applications of Machine Learning in UAV Networks presents a pioneering exploration into the symbiotic relationship between machine learning techniques and UAVs In an age where UAVs are revolutionizing sectors as diverse as agriculture environmental preservation security and disaster response this meticulously crafted volume offers an analysis of the manifold ways machine learning drives advancements in UAV network efficiency and efficacy This book navigates through an expansive array of domains each demarcating a pivotal application of machine learning in UAV networks From the precision realm of agriculture and its dynamic role in yield prediction to the ecological sensitivity of biodiversity monitoring and habitat restoration the contours of each domain are vividly etched These explorations are not limited to the terrestrial sphere rather they extend to the pivotal aerial missions of wildlife conservation forest fire monitoring and security enhancement where UAVs adorned with machine learning algorithms wield an instrumental role Scholars and practitioners from fields as diverse as machine learning UAV technology robotics and IoT networks will find themselves immersed in a confluence of interdisciplinary expertise The book s pages cater equally to professionals entrenched in agriculture environmental studies disaster management and beyond Advanced Research in Technologies, Information, Innovation and Sustainability Teresa Guarda,Filipe Portela,Gustavo Gatica,2025-03-12 This three volume set CCIS 2345 2347 constitutes the revised selected papers from the 4th International Conference on Advanced Research in Technologies Information Innovation and Sustainability 2024 ARTIIS 2024 held in Santiago de Chile Chile during October 21 23 2024 The 83 full papers and 8 short papers included in these proceedings were carefully reviewed and selected from 238 submissions These papers are categorized under the following topical sections Part I Computing Solutions Part II Data Intelligence Part III Sustainability Ethics Security and Privacy **Data Science and Analytics** Usha Batra,Nihar Ranjan Roy,Brajendra Panda,2020-05-27

This two volume set CCIS 1229 and CCIS 1230 constitutes the refereed proceedings of the 5th International Conference on Recent Developments in Science Engineering and Technology REDSET 2019 held in Gurugram India in November 2019 The 74 revised full papers presented were carefully reviewed and selected from total 353 submissions The papers are organized in topical sections on data centric programming next generation computing social and web analytics security in data science analytics big data analytics **Advanced Intelligent Computing Technology and Applications** De-Shuang Huang,Wei Chen,Yijie Pan,Haiming Chen,2025-07-25 This 20 volume set LNCS 15842 15861 constitutes in conjunction with the 4 volume set LNAI 15862 15865 and the 4 volume set LNBI 15866 15869 the refereed proceedings of the 21st International Conference on Intelligent Computing ICIC 2025 held in Ningbo China during July 26 29 2025 The total of 1206 regular papers were carefully reviewed and selected from 4032 submissions This year the conference concentrated mainly on the

theories and methodologies as well as the emerging applications of intelligent computing Its aim was to unify the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications Therefore the theme for this conference was Advanced Intelligent Computing Technology and Applications Bio-inspired Computation in Unmanned Aerial Vehicles Haibin

Duan,Pei Li,2014-01-02 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> **UAV Swarming? So what are Those Swarms, what are the Implications, and how Do We Handle Them?**

Bruce T. Clough,2002 Swarming Imagine unmanned aerial vehicles blotting out the sky obliterating anything that moves and injecting terror into every observer s heart Impossible Maybe not The aerospace research community is working hard at developing UAV control technology that requires as little human supervision as possible and concepts using swarms are receiving serious attention Swarming is not just a scare tactic but also a viable control technology for multiple autonomous vehicles that system designers can use Swarming itself is a type of emergent behavior a behavior that isn t explicitly programmed but results as the natural interaction of multiple entities Swarms used correctly could be terribly effective but used the wrong way could be as vulnerable as gnats to Raid Trademark This paper looks at what the author considers swarming to be how you get it what it might be and might not be good for and the questions we need to answer on the way forward to evaluate and implement it Recent Advances in Aerospace Engineering Sanjay Singh,Perumalla Janaki

Ramulu,Sachin Singh Gautam,2024-04-27 The book presents the select proceedings of 2nd International Conference on Modern Research in Aerospace Engineering MRAE 2023 It covers the latest research in the field of aerospace engineering and space technology Various topics covered in this book are aerospace propulsion space research avionics and instrumentation aerodynamics wind tunnel and computational fluid dynamics structural analysis and finite element method aerospace materials and manufacturing system air safety and airworthiness aircraft control system and stability aircraft

maintenance overhauling NDT and other technical tests autonomous airborne systems airborne defence systems AI and ML applications in aerospace engineering unmanned aerial vehicles and flight mechanics The book will be useful for researchers and professionals in aerospace engineering and space science and technology Proceedings of 2023 7th Chinese Conference on Swarm Intelligence and Cooperative Control Xiaoduo Li,Xun Song,Yingjiang Zhou,2024-06-14 This book includes original peer reviewed research papers from the 2023 7th Chinese Conference on Swarm Intelligence and Cooperative Control CCSICC2023 held in Nanjing China on November 17 19 2023 The topics covered include but are not limited to reviews and discussions of swarm intelligence basic theories on swarm intelligence swarm communication and networking swarm perception awareness and location swarm decision and planning cooperative control cooperative guidance swarm simulation and assessment The papers showcased here share the latest findings on theories algorithms and applications in swarm intelligence and cooperative control making the book a valuable asset for researchers engineers and university students alike **Intelligent Coordination of UAV Swarm Systems** Xiwang Dong,Mou Chen,Xiangke Wang,2023-09-19 The reprint delves into the fascinating world of unmanned aerial vehicle UAV swarm systems and their intelligent coordination This comprehensive collection of research papers explores advancements in UAV swarm systems such as intelligent perception and cognition swarm navigation and localization autonomous decision and planning cooperative guidance and control and swarm intelligence UAV swarm systems have gained significant attention in recent years due to their potential for revolutionizing various domains including surveillance search and rescue environmental monitoring and disaster response Intelligent perception and cognition play a crucial role in enabling UAV swarm systems to perceive and understand their environment Swarm navigation and localization techniques ensure precise positioning and effective movement coordination within the swarm Autonomous decision and planning algorithms empower UAV swarm systems to make intelligent choices in real time Cooperative guidance and control strategies facilitate seamless collaboration among individual UAVs within the swarm Swarm intelligence inspired by the collective behavior of social insects offers valuable insights into designing robust and scalable UAV swarm systems **Proceedings of the ... American Control Conference** ,2005 *Shepherding UxVs for Human-Swarm Teaming* Hussein A. Abbass,Robert A. Hunjet,2021-03-19 This book draws inspiration from natural herding whereby a farmer utilizes sheepdogs to herd sheep to inspire a scalable and inherently human friendly approach to swarm control The book discusses advanced artificial intelligence AI approaches needed to design smart robotic herding agents capable of controlling biological swarms or robotic swarms of unmanned vehicles These smart herding agents are described with the techniques applicable to the control of Unmanned X Vehicles UxVs including air unmanned aerial vehicles or UAVs ground unmanned ground vehicles or UGVs underwater unmanned underwater vehicles or UUVs and on the surface of water unmanned surface vehicles or USVs This book proposes how smart herders could be designed and used to guide a swarm of UxVs to achieve a goal while ameliorating typical

communication bandwidth issues that arise in the control of multi agent systems The book covers a wide range of topics ranging from the design of deep reinforcement learning models for shepherding a swarm transparency in swarm guidance and ontology guided learning to the design of smart swarm guidance methods for shepherding with UGVs and UAVs The book extends the discussion to human swarm teaming by looking into the real time analysis of human data during human swarm interaction the concept of trust for human swarm teaming and the design of activity recognition systems for shepherding Presents a comprehensive look at human swarm teaming Tackles artificial intelligence techniques for swarm guidance Provides artificial intelligence techniques for real time human performance analysis **Over 40 Publications / Studies Combined: UAS / UAV / Drone Swarm Technology Research** , Over 3 800 total pages Just a sample of the studies publications included Drone Swarms Terrorist and Insurgent Unmanned Aerial Vehicles Use Potentials and Military Implications Countering A2 AD with Swarming Stunning Swarms An Airpower Alternative to Collateral Damage Ideal Directed Energy System To Defeat Small Unmanned Aircraft System Swarms Break the Kill Chain not the Budget How to Avoid U S Strategic Retrenchment Gyges Effect An Ethical Critique of Lethal Remotely Piloted Aircraft Human Robotic Swarm Interaction Using an Artificial Physics Approach Swarming UAS II Swarming Unmanned Aircraft Systems Communication Free Robot Swarming UAV Swarm Attack Protection System Alternatives for Destroyers Confidential and Authenticated Communications in a Large Fixed Wing UAV Swarm UAV Swarm Behavior Modeling for Early Exposure of Failure Modes Optimized Landing of Autonomous Unmanned Aerial Vehicle Swarms Mini Micro and Swarming Unmanned Aerial Vehicles A Baseline Study UAV Swarm Operational Risk Assessment System SmartSwarms Distributed UAVs that Think Command and Control Autonomous UxV s UAV Swarm Tactics An Agent Based Simulation and Markov Process Analysis A Novel Communications Protocol Using Geographic Routing for Swarming UAVs Performing a Search Mission Accelerating the Kill Chain via Future Unmanned Aircraft Evolution of Control Programs for a Swarm of Autonomous Unmanned Aerial Vehicles AFIT UAV Swarm Mission Planning and Simulation System A Genetic Algorithm for UAV Routing Integrated with a Parallel Swarm Simulation Applying Cooperative Localization to Swarm UAVS Using an Extended Kalman Filter A Secure Group Communication Architecture for a Swarm of Autonomous Unmanned Aerial Vehicles Braving the Swarm Lowering Anticipated Group Bias in Integrated Fire Police Units Facing Paramilitary Terrorism Distributed Beamforming in a Swarm UAV Network Integrating UAS Flocking Operations with Formation Drag Reduction Tracking with a Cooperatively Controlled Swarm of GMTI Equipped UAVS Using Agent Based Modeling to Evaluate UAS Behaviors in a Target Rich Environment Experimental Analysis of Integration of Tactical Unmanned Aerial Vehicles and Naval Special Warfare Operations Forces Target Acquisition Involving Multiple Unmanned Air Vehicles Interfaces for Small Unmanned Air Systems ISUS Program Tools for the Conceptual Design and Engineering Analysis of Micro Air Vehicles Architectural Considerations for Single Operator Management of Multiple Unmanned Aerial Vehicles Proceedings of the 2004

International Symposium on Collaborative Technologies and Systems, CTS 2004 ,2003 *Flying Ad Hoc Networks* Jingjing Wang, Chunxiao Jiang, 2022-02-10 Relying on unmanned autonomous flight control programs unmanned aerial vehicles UAVs equipped with radio communication devices have been actively developed around the world Given their low cost flexible maneuvering and unmanned operation UAVs have been widely used in both civilian operations and military missions including environmental monitoring emergency communications express distribution even military surveillance and attacks for example Given that a range of standards and protocols used in terrestrial wireless networks are not applicable to UAV networks and that some practical constraints such as battery power and no fly zone hinder the maneuverability capability of a single UAV we need to explore advanced communication and networking theories and methods for the sake of supporting future ultra reliable and low latency applications Typically the full potential of UAV network s functionalities can be tapped with the aid of the cooperation of multiple drones relying on their ad hoc networking in network communications and coordinated control Furthermore some swarm intelligence models and algorithms conceived for dynamic negotiation path programming formation flight and task assignment of multiple cooperative drones are also beneficial in terms of extending UAV s functionalities and coverage as well as of increasing their efficiency We call the networking and cooperation of multiple drones as the terminology flying ad hoc network FANET and there indeed are numerous new challenges to be overcome before the idespread of so called heterogeneous FANETs In this book we examine a range of technical issues in FANETs from physical layer channel modeling to MAC layer resource allocation while also introducing readers to UAV aided mobile edge computing techniques **Controlled Mobility for Performance Enhancements in Wireless Sensor Networks** Jayanthi Rao, 2009 *Journal of Guidance, Control, and Dynamics* ,2007 **Intelligent Autonomous Systems 8** Frans Groen, 2004 Intelligent Autonomous systems are beginning to enter our daily life in ambient intelligence applications These systems can directly sense and act in their own environment without demanding detailed supervision form humans Many new challenges are emerging to create systems that can operate and interact in human inhabited environments The goal of IAS 8 is to exchange and stimulate research ideas about how to bring active intelligent systems into our daily lives This publications contains an excellent selection of papers that shows the research of autonomous systems today Subjects discussed are the designing of autonomous agents Artificial Emotional Creatures and Multi Robot Coordination in Highly Dynamic Environments

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