IMAV 2024

DRAFT PROCEEDINGS

15th annual International Micro Air Vehicle Conference and Competition

September 16-20, 2024

Bristol, United Kingdom

www.imavs.org

Contents

Preface

On behalf of the Local Organizing Committee, it is our pleasure to present the proceedings of the 15th annual International Micro Air Vehicle Conference and Competition, which was held in Bristol, United Kingdom from September 16-20, 2024. For the first time, the IMAV was organized by the University of Bristol in the United Kingdom.

These proceedings are available to the public as open-access publications, seeking to promote and contribute to the advancement of the state-of-the-art in the area of small flying robots and their applications for the benefit of society.

The IMAV is a pioneering scientific-technological event in the field of aerial robotics and has been established as the primary event for the communities of researchers dedicated to the study, development, and research of Micro Air Vehicles. By participating in authentic competition scenarios, encompassing indoor and outdoor environments, as well as presenting innovative solutions via conference papers, the boundaries of research in the field of Micro Air Vehicles (MAVs) are continuously pushed forward.

These proceedings contain thirty-nine peer-reviewed scientific papers by one hundred and forty-four authors organized in seven sessions presented at the IMAV in 2024. The topics of these papers contain a nice mix ranging from aerial vehicle design and energy sources to control, navigation and perception. Together, the papers give an overview of the current state-of-the-art in the field of Micro Air Vehicles. Based on the quality of the scientific and technical contributions, papers were selected to be published in two scientific journals: the International Journal of Micro Air Vehicles (Sage), and Unmanned Systems (World Scientific).

We would like to express our sincere gratitude for the guidance and support of the members of the seventeen members of the International Committee from thirteen institutes who guide IMAV overall, and the eighteen reviewers from seven institutes, who played an important role in assuring the quality of all the papers. In addition to the presentation of the scientific papers, keynote talks were delivered by experts in the field whom we want to thank for their valuable contributions. We also want to thank all members of the Local Organizing Committee for their invaluable support in the organization of this IMAV-2024.

Bristol, United Kingdom. September 2024

T. Richardson
University of Bristol, United Kingdom

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Call for Papers

The International Micro Air Vehicles (IMAV) Conference is an annual event that brings together researchers, engineers, and enthusiasts from around the world to discuss and share the latest advances in the field of Micro Air Vehicles (MAVs). A key attraction of this event is the combination of a practical student competition with academic exchange of the latest research within a conference setting.

At the IMAV conference, attendees have the opportunity to present their research papers and attend keynote lectures from leading experts. The conference covers a wide range of topics, including the design, modeling, and control of MAVs, sensing and perception for MAVs, and applications of MAVs in various fields.

In addition to the technical presentations, the IMAV conference also features a highly anticipated flight competition, where participants compete with their autonomous MAVs in a range of tasks, such as obstacle avoidance, target detection, and delivery. The competition provides an opportunity for participants to put their research into practice and to showcase the capabilities of their MAVs in a real-world setting.

Call for papers

The call for papers for IMAV 2024 welcomed contributions to all aspects of MAVs, including, but not limited to:

- Sensing and perception for MAVs
- Multi-MAV systems and swarm intelligence
- Low Reynolds number aerodynamics
- Design of novel drone types Design of novel MAV types Design of novel MAV types (hybrids, propulsion, silent drones)
- MAVs that interact robustly with their environment
- New control methods
- Reconfiguration of MAVs in unpredicted events
- Autonomous navigation in GPS-denied environments
- Integration of MAVs in airspace Integration of MAVs in airspace (sense-and-avoid, UTM, . . .)
- Application of MAVs in industry, agriculture, environmental monitoring, conservation, search and rescue operations

Venue

- Location: Bristol, United Kingdom
- Event dates: September 16 – 20, 2024. Web site: http://www.imavs.org/2024

Conference Oral Presentations

Session 1: Bioinspiration and Flight Operations I

Session 2: Machine Learning

Session 3: Platform Design

Session 4: Sensing

Session 5: Bioinspiration and Flight Operations II

Session 6: Control

Session 7: Aircraft Performance and Conservation

Keynote Speakers

WildDrone

Professor Ulrik Pagh Schultz Lundquist, University of Southern Denmark

Abstract

The WildDrone project aims to revolutionize wildlife conservation practices by using autonomous drone technology as a unifying platform to monitor wildlife populations, track their movements, and manage human-wildlife conflicts. In this talk, Professor Pagh Schultz Lundquist will give an overview of the WildDrone network, research and training activities, the interdisciplinary methodology, and the specific drone-related research currently taking place in the project.

Biography

Professor Ulrik Pagh Schultz Lundquist is Professor and Head of Center for SDU UAS, the drone center at University of Southern Denmark. He is currently coordinator of the WildDrone Marie Curie Network and is interested in the design and implementation of aerial, mobile, and self-organizing robotic systems with a focus on the use of high-level software abstractions to achieve safety, reliability, and robustness.

Enabling UAVs to use tools in complex dynamic environments

Richard Green – University of Canterbury

Abstract

Close-proximity operation of UAVs using tools in outdoor environments requires a level of control precision (sub centimetre) and position estimation robustness/accuracy beyond what is currently possible. We will discuss our approaches to solve this by improving multirotor UAV position control precision, especially in windy conditions – and by significantly increasing the robustness/accuracy of visual-inertial position/orientation estimation in difficult environments. Our progress is evidenced by a fully autonomous UAV using tools to prune pine trees, prune branches near power lines, harvest catkins, test power-line joints – and working towards using tools (e.g. screwdriver) in construction applications.

Biography

Richard Green has been lecturing in computer science at the University of Canterbury since 2014 after running his own successful software startup in Sydney. With over 200 refereed publications, Richard heads the Computer Vision Research Lab with an emphasis on autonomous robot vision/deep learning (robots/UAVs/underwater robots). Richard has led numerous successful MBIE-funded projects, including an autonomous robot-vine-pruner project and an autonomous forest-pruning-drone project, and currently leads a $10m MBIE project for drones using precision tools along with a $6m MBIE project automating vineyard robots.

MIMRee: Multi-Robot Inspection and Maintenance of Offshore Wind Turbine Blades

Simon Watson – University of Manchester

Abstract

The inspection and maintenance of offshore wind turbine blades is critical to long-term operations, however their location makes human interventions hazardous and costly. UAVs have been used for remote visual inspections, however interventions are much more difficult. This presentation will showcase work on the remote deployment of ground-based robots for intervention missions by UAVs.

Biography

Dr Simon Watson is a Reader in Robotic Systems at the University of Manchester. His research is focused on the development of robotic platforms for the inspection of critical infrastructure assets in the net zero energy and urban infrastructure domains. He has developed aerial, aquatic and ground platforms for the nuclear, offshore wind and transportation sectors and was the co-founder of the spin-out company Ice9.

Bio-informed Guidance and Control: From Birds to Morphing Air Vehicles

Graham Taylor – University of Oxford

Abstract

Birds achieve manoeuvrability far exceeding that of fixed-wing vehicles by morphing their wings and tail to vary flight performance and exert fine control. Presenting data from many birds and thousands of flights recorded in a state-of-the-art motion capture lab, this talk will explore how birds optimize and control visually-guided behaviours like perching and collision avoidance. The problems that birds have adapted to solve are the same as faced by aerial robots in natural and built environments, so insights from birds have much to offer the design of uncrewed air systems – especially in the era of environmental robotics.

Biography

Professor Graham Taylor is Deputy Head of the Mathematical, Physical and Life Sciences Division at the University of Oxford, where he leads the Oxford Flight Group. His research focusses on the guidance, navigation and control of animal flight and its applications to autonomous systems, spanning lab, field and computational studies.

Papers

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