IMAV 2023

14th annual International Micro Air Vehicle Conference and Competition

September 11-15, 2023

Aachen, Germany

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Preface

On behalf of the Local Organizing Committee, it is our pleasure to present the proceedings of the 14th annual International Micro Air Vehicle Conference and Competition, which was held in Aachen, Germany from September 11-15, 2023. For the second time, the IMAV was organized by the Institut of Flight System Dynamics of the RWTH Aachen University in Germany.

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-two peer-reviewed scientific papers by ninety-one authors organized in eight sessions presented at the IMAV in 2023. 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. Six articles were nominated for the best paper award, out of which one was granted the "Best Paper Award" at the award ceremony. Based on the quality of the scientific and technical contribution, six 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 fourteen members of the International Committee from ten institutes who guide IMAV overall, and the twenty reviewers from twelve 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-2023.

Aachen, Germany. September 2023

D. Moormann
RWTH, Aachen

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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 peculiarity of this event is the combination of a practical student competition as well as an 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.

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Call for papers

We are now inviting authors to submit papers for presentation at the conference. We welcome contributions to all aspects of MAVs, including, but not limited to:

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

Submission Guidelines

During the conference, scientific and technical papers can be presented. Authors will have an allotted time slot of 20 minutes to present their work. Technical and scientific papers can be submitted as draft papers. Full papers should be submitted until September 1, 2023. Papers should have a minimum of 6 pages and a maximum of 8 pages.

All papers must be original and not simultaneously submitted to another journal or conference. File sizes should be minimized (max 5MB) while graphical quality should be maximized by using vector graphics whenever possible.

Venue

- Location: Aachen, Germany
- Event dates: September 11 -15, 2023. Web site: http://www.imavs.org/2023

Conference Oral Presentations

Flapping Wings

High-speed camera measurement of insect-like flapping wing deformation using a speckle pattern wing... p.12
Design and Path Following Flight Test of a Flapping-Wing Air Vehicle p.20
Integrated Simulation Program for Initial Design of Bird-Inspired Ornithopter p.26

Sensing and perception 1

3D Human Pose reconstruction Single-pixel imaging p.33
Hierarchical Continual Learning for Single Image Aerial Localisation p.40
Determining the moment of inertia tensor of a UAV using a motion capture system p.49
Why do I need to speak to my drone? p.57

Sensing and perception 2

A Lightweight Learning-based Visual-Inertial Odometry p.65
Frustumbug: a 3D mapless stereo-vision-based bug algorithm for Micro Air Vehicles p.73
Improved Moving Horizon Estimation for Ultra-Wideband Localization on Small Drones p.86
Efficient Model-Aided Visual-Inertial Ego-Motion Estimation for Multirotor MAVs p.93

New control methods 1

Analysis of admittance control for a fully-actuated, tactile UAV p.101
Autopilot framework with INDI RPM control, real-time actuator feedback, and stability control on... p.109
Cascaded Indoor Flight Controller Design for a Miniaturized Tiltwing Aircraft p.117
Performance Comparisons on Fully-Actuated Multirotors with Different Actuation Modes p.127

New control methods 2

Distributed Nonlinear Model Predictive Control for a Quadrotor UAV p.135
Adaptive frequency control strategy for the propulsion management of a long-endurance drone using... p.143
Model Predictive Control on a Fully-actuated Octocopter for Wind Disturbance Rejection p.149

Design of novel MAV types

Assessing the Agility of a Variable-Tilt UAV p.157
Analysis of the Transient Response of UAV Rotors p.165
Multi-Vehicle Simulation Framework for Heterogeneous Unconventional MAVs p.171
Experimentally Validated Simulator of Flight Dynamics: for a Magnus Effect-based Quadcopter System p.179
Numerical Investigation on Flow Control of Leading-Edge Reinforced Flexible Membrane Wing p.187
Measuring Disturbance Response of a Fully-Actuated UAV using Surging Flow Wind Tunnel Experiments p.193

Guidance and path planning

Multi Method Local Path Planning Considering Flight Dynamics Constraints for Collision Avoidance p.200
Autonomous Landing, Obstacle Avoidance and Block Recovery for a Quadrotor Drone p.208
Automating Fixed Wing Forced Landings with Offline Reinforcement Learning p.216
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Multi-UAV systems and swarm intelligence

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Best Paper Awards and Special issues

IMAV 2023 awarded the best paper award to a relevant, well-written, and well-presented publication. It also selected a shortlist of 6 papers to be published in a Special Issue of the International Journal of Micro Air Vehicles (Sage). The papers are [1] [10] [17] [18] [19] [28]

Best Conference Paper

High-speed camera measurement of insect-like flapping wing deformation using a speckle pattern wing membrane.
Thomas Roelandt, Thijs Willems, Frank Naets and Dirk Vandepitte. [1] on page 12.

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