IMAV 2025

16th International Micro Air Vehicle Conference and Competition

November 3-7, 2025

San Andrés Cholula, Puebla, Mexico

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16TH INTERNATIONAL MICRO AIR VEHICLE CONFERENCE AND COMPETITION

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Preface

On behalf of the Local Organizing Committee, it is our pleasure to present the proceedings of the 16th International Micro Air Vehicle Conference and Competition, which was held in San Andrés Cholula, Puebla, Mexico from November 3-7, 2025. For the first time, the IMAV had a physical event in Mexico.

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 twenty-one peer-reviewed scientific papers by seventy authors organized in four sessions presented at the IMAV in 2025. 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-2025.

Last but not least, we extend our deepest gratitude to Christophe De Wagter for his invaluable support each year in the edition and production of the IMAV proceedings.

San Andrés Cholula, Puebla, Mexico. November 2025

Jose Martinez-Carranza
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email: carranza@inaoep.mx

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Call for Papers

16TH INTERNATIONAL MICRO AIR VEHICLE CONFERENCE AND COMPETITION

The International Micro Air Vehicle Conference and Competitions (IMAV) is a yearly event that aims at fostering key technologies for the development of micro-air vehicles. Since early editions, the IMAV has offered a pioneer event format where competitions are carried out alongside a two-day conference. Highly recognized members of the community are invited to deliver keynotes, while academics are invited to submit research and technical papers. After a peer-reviewed process, accepted papers are presented during the conference.

This edition of the IMAV will be held in the Universidad de las Américas Puebla (UDLAP) located in the city of San Andres Cholula, in the State of Puebla, México. The conference will take place from the 3rd to 7th of November, 2025.

Call for papers

The call for papers for IMAV 2025 welcomed contributions to all aspects of MAVs, including, but not limited to:

Topics for scientific and technical papers include, but are not limited to:

- Low Reynolds number aerodynamics
- Unsteady aerodynamics
- Smart morphing materials
- Propulsion set and new energy sources
- Autonomous navigation
- Autonomous Drone Racing
- Cooperation and formation flight
- Control theory and state estimation
- Computer vision for MAVs
- Sense & avoid Integration of UAVs in airspace
- Reconfiguration in unpredicted events
- New MAV architectures
- Characterization of noise emission for MAVs
- Low noise and noise mitigation

Dedicated applicative sessions will be set up for the following topics:

- Atmospheric research
- Archaeological research
- Search and rescue operations
- Industrial inspection
- Agriculture & environment
- Artificial Intelligence for MAVs
- Ethics & Regulations
- Societal impact of MAVs

Based on the quality of the papers and after a thorough evaluation by the IMAV's international committee, selected papers and finalist to the "Best Conference Paper Award" will be offered to be published in one of the following two Journals: International Journal of Micro Air Vehicles and in the Unmanned Systems.

Venue

- Location: San Andrés Cholula, Puebla, Mexico
- This year, the IMAV 2025 conference will be hosted at UDLAP's Auditorium Guillermo and Sofia Jenkinns.
- Event dates: 3-7 November 2025.
- Web site: http://www.imavs.org/2025

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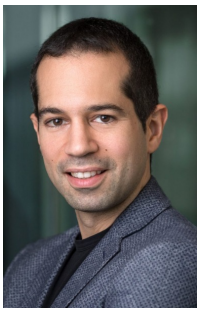
Keynote Speakers

Agile Vision-based Flight

Prof. Davide Scaramuzza - Prof. of Robotics and Perception at the University of Zurich

Abstract

Autonomous drones play a crucial role in inspection, agriculture, logistics, and search-and-rescue missions and promise to increase productivity by a factor of 10. However, they still lag behind human pilots in speed, versatility, and robustness. What does it take to fly autonomous drones as agile as or even better than human pilots? Autonomous, agile navigation through unknown, GPS-denied environments poses several challenges for robotics research regarding perception, learning, planning, and control. In this talk, I will show how the combination of model-based and machine-learning methods, united with the power of new, low-latency sensors, such as event cameras, can allow drones to achieve unprecedented speed and robustness by relying solely on onboard computing. This can result in better productivity and safety of future autonomous aircraft.



Biography

Davide Scaramuzza is a Professor of Robotics and Perception at the University of Zurich. He did his Ph.D. at ETH Zurich, a postdoc at the University of Pennsylvania, and was a visiting professor at Stanford University. His research focuses on autonomous, agile microdrone navigation using standard and event-based cameras. He pioneered autonomous, vision-based navigation of drones, which inspired the navigation algorithm of the NASA Mars helicopter and many drone companies. He contributed significantly to visual-inertial state estimation, vision-based agile navigation of microdrones, and low-latency, robust perception with event cameras, which were transferred to many products, from drones to automobiles, cameras, AR/VR headsets, and mobile devices. In 2022, his team demonstrated that an AI-powered drone could outperform the world champions of drone racing, a result published in Nature and considered the first time an AI defeated a human in the physical world. He is a consultant for the United Nations on disaster response and disarmament. He has won many awards, including an IEEE Technical Field Award, the levation to IEEE Fellow, the IEEE Robotics and Automation Society Early Career Award, a European Research Council Consolidator Grant, a Google Research Award, two NASA TechBrief Awards, and many paper awards. In 2015, he co-founded Zurich-Eye, today Meta Zurich, which developed the world-leading virtual-reality headset Meta Quest. In 2020, he co-founded SUIND, which builds autonomous drones for precision agriculture. Many aspects of his research have been featured in the media, such as The New York Times, The Economist, and Forbes.

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Neuromorphic Artificial Intelligence for small, autonomous drones

Prof. Guido De Croon - Prof. in Bio-inspired Micro Air Vehicles Delft University of Technology

Abstract

Small, autonomous drones are promising for many applications, such as search-and-rescue, greenhouse monitoring, or keeping track of stock in warehouses. Since they are small, they can fly in narrow areas. Moreover, their light weight makes them very safe for flight around humans. However, making small drones fly completely by themselves is an enormous challenge. Most approaches to Artificial Intelligence for robotics have been designed with self-driving cars or other large robots in mind – and these are able to carry many sensors and ample processing. In my talk, I will argue that a different approach is necessary for achieving autonomous flight with small drones. In particular, I will discuss how we can draw inspiration from flying insects and endow our drones with similar intelligence. Examples include flapping-wing drones that can deal with collisions, and swarms of CrazyFlie quadrotors of 30 grams able to explore unknown environments and find gas leaks. The intelligence of these small drones will be further enhanced by novel neuromorphic sensing and processing technologies. I will discuss recent experiments we performed on neuromorphic AI in our lab – from ego-motion estimation to agile flight. Finally, I will present our research in the context of the European SPEAR project: that it is possible to evolve drone bodies for specific tasks, outcompeting traditional drone designs in tasks such as drone racing.

Biography

Received his M.Sc. and Ph.D. in the field of Artificial Intelligence (AI) at Maastricht University, the Netherlands. His research interest lies in computationally efficient and often bio-inspired algorithms for robot autonomy, with an emphasis on computer vision. Since 2008, he has worked on algorithms for achieving autonomous flight with small and light-weight flying robots, such as the DelFly flapping wing MAV. In 2011-2012, he was a research fellow in the Advanced Concepts Team of the European Space Agency, where he studied topics such as optical flow-based control algorithms for extraterrestrial landing scenarios. Currently, he is an associate professor at TU Delft and scientific lead of the Micro Air Vehicle lab (MAV-lab) of Delft University of Technology.

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A Quest for Autonomously Exploring Drones

Prof. Hyunchul Shim - Prof. in the Department of Aerospace Engineering at Korea Advanced Institute of Science and Technology

Abstract

Towards the end of the 20th century, a Japanese TV show featured electric helicopters flying through complex mazes, hand-controlled by human pilots for a big prize. Watching it, I wondered: what if UAVs could do this autonomously? At that time, drones were bulky—typical drones in those days were the size of a motorbike—and onboard SLAM or lightweight perception was still far in the future. By the mid-2010s, the landscape had shifted: small multirotors had emerged, and GPUs became compact enough to fly. In 2016, I co-founded what is recognized as the first autonomous drone racing competition, held at IROS in Daejeon. Since then, we have witnessed a surge of autonomous drone challenges, from the DARPA Subterranean Challenge to Lockheed Martin's AlphaPilot and, most recently, the UAE's A2RL DCL. In this talk, I will reflect on this trajectory—from the point when quadrotors came to symbolize drones, through the breakthroughs enabled by global competitions, to the lessons learned from my own first-hand experiences. I will also discuss the challenges ahead in building more capable, trustworthy, and socially beneficial drone technologies.

Biography

Hyunchul Shim received the B.S. and M.S. degrees in mechanical design and production engineering from Seoul National University, Seoul, Korea, in 1991 and 1993, respectively, and the Ph.D. degree in mechanical engineering from the University of California Berkeley, Berkeley, USA in 2000. From 1993 to 1994, he was with Hyundai Motor Company, Korea. From 2001 to 2005, he was with Maxtor Corporation, Milpitas, CA, USA as Staff Engineer. From 2005 to 2007, he was with the University of California Berkeley as Principal Engineer, in charge of Berkeley Aerobot Team. In 2007, he joined the Department of Aerospace Engineering, KAIST, South Korea, as an Assistant Professor. He is now Professor in School of Electrical Engineering. During his career at KAIST, he has led a number of efforts as Director of KI Robotics Institute at KAIST from '19-'22, advisor for RPAS panel at ICAO, and Director of Korea Civil RPAS Research Center. He is also very active in a number of world's premier competitions such as DARPA SubT, Lockheed Martin AlphaPilot, Indy Autonomous Challenges. He has received a number of major awards from Korean government and global events. His interests center on the combination of robotics and AI with aerial and ground vehicles for highly intelligent vehicles.

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Detection and Classification of Small UAVs

Capt. Rafael Cruz Gómez and Lt. Gustavo Guerrero Clavel - Captain Rafael Alberto Cruz Gómez and Lieutenant Gustavo Guerrero Clavel of the Secretariat of the Navy (SEMAR)

Abstract

Small Unmanned Aerial Vehicles (UAV) or drones are providing big amounts of data. Often, new classes of drones are deployed on a regular basis to help in different tasks. The purpose of this talk is to present a technique of drone detection using acoustic means. Although there are several techniques of drone detection, such as electromagnetic signal detection, radar location, electro-optic, and infrared visual detection. It is feasible to detect the unique acoustic signature of a drone class using modern techniques of signal processing. Using acoustic sensors, a drone can be detected, and with machine learning techniques, its path can be tracked. Furthermore, there are several other data that can be extracted using deep learning techniques based on neural networks such as the class of the drone, which can help in the decision process of the main function of the drone. At the end of the talk is presented a small routine used to detect and classify drones using its acoustic signature.

Biography

Captain Gómez graduated as an electrical engineer from the Escuela de Ingenieros of the Mexican Navy. He has a dual master's degree in Master of Sciences of Electrical Engineering and Master of Sciences in Engineering Acoustics from the United States Naval Postgraduate School. He has held several appointments in the Mexican Navy such as the Embedded Systems designer for UAV SPARTAAMv44, SPARTAAMv88 and, SPARTAAMv200. LCDR Gómez has been awarded with several distinctions, including Medals of Perseverance, Mexican Navy Research, and Development distinctive, and Honorable Mention for the excellence in the design of UAV. Currently, LCDR Gómez is the head of the Embedded Systems Lab in the SPARTAAM UAS Program at the Mexican Navy.

Lieutenant Guerrero, Electronics and Naval Communications Engineer, graduated from the Naval Engineers School of Mexico (2006–2011) and completed a specialisation in Operational Logistics at CESNAV in 2021. He has received technical training from Microchip, a PCB Design Course for military, aerospace, and extreme environments, and IPC/WHMA-A-620 certification from the Institute of Printed Circuits. He has served in various positions at INIDETAM and UNINDETEC, and is currently Head of the Integration and Technical Support Laboratory for Unmanned Aircraft. His work includes avionics engineering in the design, construction, and testing of avionics subsystems, simulation models, UAV prototype integration, as well as operation and technical support for UAV systems such as SPARTAAM-44, SPARTAAM-88, SPARTAAM-VTOL, and SPARTAAM-Satellite. For his contributions, he was awarded the Technological Research and Development Distinction.

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MACE: Development of a Medium-Altitude Fixed-Wing Drone for Environmental Monitoring

Prof. Tom Richardson Professor Tom Richardson, Faculty of Engineering, University of Bristol, UK.

Abstract

Natural events, particularly volcanic eruptions, release tiny particles (aerosols) into the atmosphere and offer invaluable real-world opportunities to study processes relevant to climate science. However, safely and rapidly collecting data from these events is challenging. The MACE project is developing advanced, automated drone technology specifically designed for observing and analysing emissions from active volcanoes. These drones will operate at altitudes up to 10km above sea level and will be flown over regularly erupting volcanoes ,including Volcán de Fuego (Guatemala), Soufrière Hills (Montserrat), and Lascar (Chile). By analysing these natural volcanic emissions in situ, the research will investigate how tiny cloud droplets form and how natural aerosol layers affect radiation. A key goal is to develop a rapid-response capability using these drones, enabling the scientific community to safely gather crucial data from future significant volcanic eruptions, thereby improving our understanding of natural climate processes.

Biography

Tom Richardson is Professor of Aerial Robotics at the University of Bristol in the UK and specializes in the application of modern control theory and novel sensors to UAS/Drones. He has been granted permission for BVLOS (Beyond Visual Line of Sight) operations in multiple countries and was the International Drone Safety Lead for the Multinational Deep Carbon Observatory (DCO) funded ABOVE field campaign to Papua New Guinea in 2019. Tom is a founding partner of Perceptual Robotics, has held an NPPL (pilots license) for over 15 years and has worked with a range of industrial partners including DSTL, BAE Systems and Thales. Recent projects include MIMRee on the robotic inspection and maintenance of wind turbines and Prometheus on the use of drones for underground inspection.

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The history of a drone show company

Xavier Páez Casanovas, WG Drones Company

Abstract

WG Drones is a company specializing in the design, manufacture, and sale of drones specifically for light shows and aerial displays. The company was founded in 2019 and is based in Puebla, Mexico, with an operational base in Spain. Its core business revolves around creating drones equipped with bright 2200 Lumens RGBW LEDs that are compatible with professional drone show software, catering to the growing market for dynamic aerial entertainment.

The company serves a global clientele, providing not only the hardware but also essential equipment and training for drone show providers. WG Drones has successfully sold its products and established a presence in a diverse range of countries across multiple continents, including Argentina, Australia, Chile, Colombia, the Dominican Republic, India, Italy, Qatar, the Maldives, Mexico, New Zealand, South Korea, Spain, and the United States. Notable projects include the use of their DR-001 model by Citelum Mexico for a Valentine's Day show in Puebla, and the deployment of 1,000 WG Drones by Flock Drone Art for the opening ceremony of the America's Cup 2024 in Barcelona, Spain.

In 2024, in a significant move to strengthen its position in the European market, WG Drones has expanded its operations in Spain. This expansion aims to meet the increasing demand for advanced drone show technology throughout Europe. While specific details regarding a large-scale manufacturing facility are not explicitly public, the establishment of the Spanish entity suggests a focused effort to provide local support, sales, and potentially service options for its European clientele.

Biography

Xavier Páez is the founder and current CEO of WG Drones, a company that blends creativity, engineering, and cutting-edge technology to design and execute aerial light shows and multimedia experiences. With over 14 years of experience in water feature design and technological innovation, Xavier has led international projects that integrate art, engineering, and immersive technology. He began his entrepreneurial journey as the founder of WG Water Gush, a company recognized for pioneering the concept of the "Social Media Fountain", combining interactive lighting and fountain systems for public and private spaces. In 2023, Xavier expanded his vision by creating WG Drones, taking visual experiences beyond the water and into the sky through advanced drone light show technology. In 2024, WG Drones established a new base in Girona, Spain, continuing its mission to redefine outdoor entertainment through synchronized drone performances and large-scale multimedia events. Xavier's leadership is guided by a strong belief in technological development, strategic innovation, and creative excellence, driving WG Drones to the forefront of international event technology.

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