Editorial

Special Issue on Advancing Micro Air Vehicle Technologies: Selected Papers from IMAV 2022

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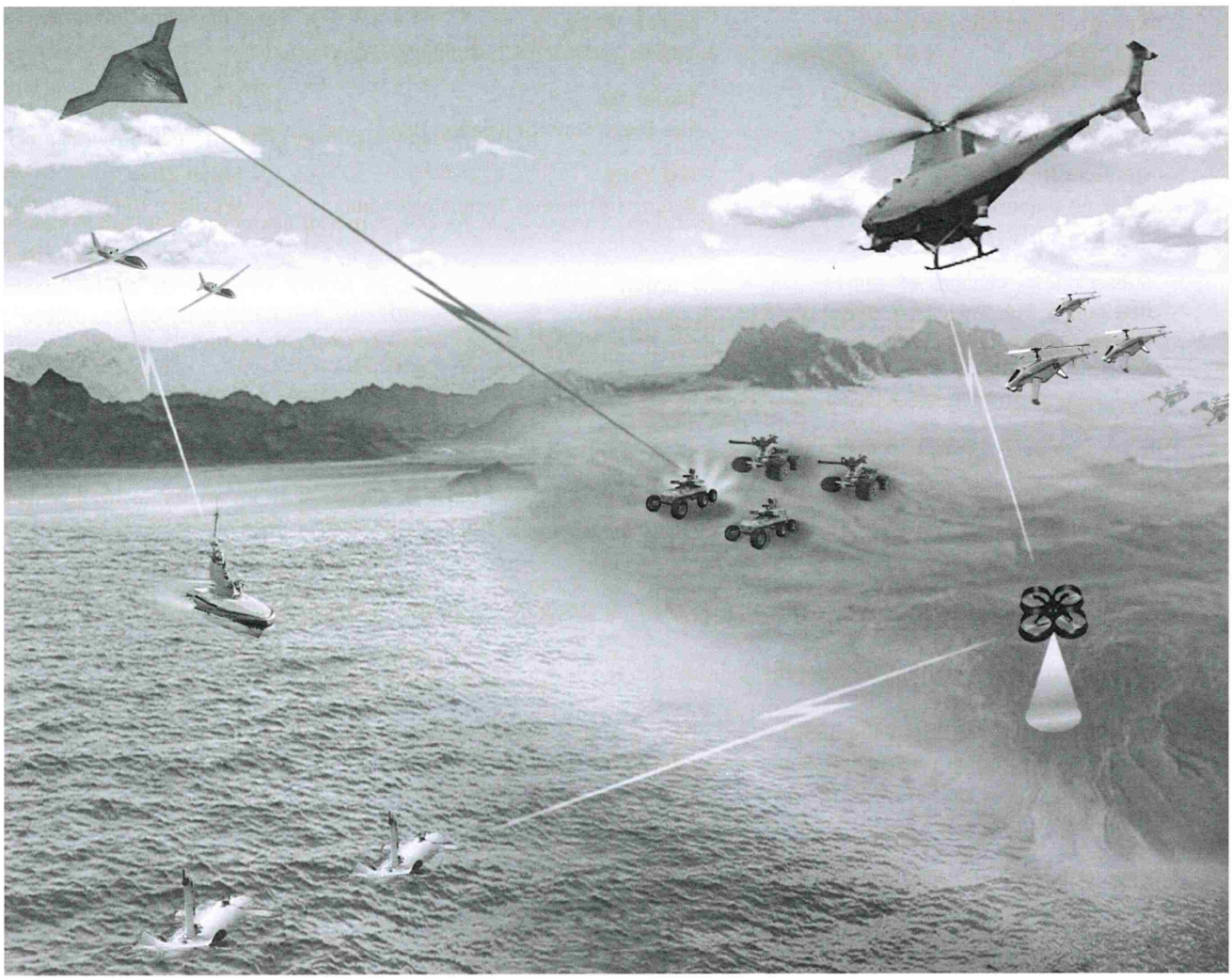

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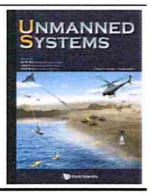

Editorial: Special Issue on Advancing Micro Air Vehicle Technologies
Selected Papers from IMAV 2022

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From September 12 to 16, 2022, the Micro Air Vehicle Lab of the Delft University of Technology in the Netherlands organized the 13th edition of the International Micro Air Vehicle (IMAV) competition. Drawing researchers, students, engineers, and enthusiasts from across the globe, IMAV2022 organized a conference combined with three challenging competitions set to advance the status of micro air vehicle (MAV) technologies, with a special emphasis on the relevant fields of package delivery, greenhouse monitoring and miniaturization of Artificial Intelligence.

The IMAV conference has long been recognized as a motivating environment for the exchange of cutting-edge research and practical applications in MAVs, spanning disciplines from aerodynamics and design to control systems and artificial intelligence. Combining academic inquiry with real-world challenges, the conference serves as a great testbed where theory meets practice, where innovation is driven and where the boundaries of what is possible in the realm of small unmanned aerial systems are pushed.

Among the many submissions received, the program committee identified five standout papers that encapsulated the spirit of innovation and addressed key challenges in Micro Air Vehicle technologies. These papers represent a diverse array of topics, each offering unique insights and solutions to propel the field forward.

In the realm of autonomy, the first paper by Hattenberger *et al.* [1] presents a novel approach to micro-drone autopilot architectures, which includes the safe optimized static scheduling of autopilot tasks to mitigate risks when running time-critical control software on limited hardware. This work lays the groundwork for safer and more reliable autonomous flight, essential for the widespread adoption of MAVs in package delivery and beyond.

The paper by Schröter *et al.* [2], introduces a novel concept: a conjoined biplane and quadrotor hybrid with the ability to split mid-flight, thereby unlocking enhanced long-range capabilities while retaining the agility needed to navigate complex urban environments and enter buildings when arriving at the distant location. This ability to split holds the promise of dramatically increasing the range that small quadcopters can cover while still being small enough to perform tasks like entering a building upon reaching their destination.

The third paper by Bahnam *et al.* [3], tackles a critical aspect of MAV navigation: computational efficiency of vision-based navigation. By optimizing state-of-the-art visual inertial odometry to run on low-power low-memory hardware, researchers have made important steps towards enabling very small MAVs to perform complex indoor navigation tasks, a crucial prerequisite for the scalability and real-world deployment of MAV.

Meanwhile, the fourth paper by Müller and Moorman [4] explores the design space of miniature tilt-wing concepts, combining vertical landing capabilities with efficient forward flight. With applications ranging from urban delivery to reconnaissance missions, these compact yet versatile MAVs promise to unlock new possibilities in aerial logistics and beyond.

Last but not least, the fifth paper by Fernandez *et al.* [5] underscores the importance of multidisciplinary design optimization in realizing the full potential of small drones. By introducing a mission-tailored tail-sitter capable of carrying payloads exceeding 27% of its own mass while still maintaining vertical takeoff and landing capabilities, researchers have demonstrated the power of holistic design approaches in maximizing MAV performance and versatility. This concept became the winning entry in the outdoor package delivery competition.

Besides the conference, IMAV2022 brought three challenging competitions in the areas of outdoor flight for package delivery, indoor flight for greenhouse monitoring and artificial intelligence for nano-copters. The innovations presented, ranging from transformative hybrid designs to autonomy algorithms, offer a glimpse into a future where MAVs seamlessly navigate both urban landscapes and confined indoor spaces with unprecedented precision and reliability.