Design and Autonomous Control of a Flying-Sailing Robot (SailMAV)

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Description

Aquatic environmental monitoring remains challenging due to limited accessibility, large spatial scales, and the need for long-duration deployments. Aerial robots offer fast mobility and flexible deployment, but are constrained by limited endurance. In contrast, aquatic platforms such as sailing robots can operate for long periods but lack fast relocation capabilities.

SailMAV explores a hybrid solution that combines both modalities in a single robotic system. The platform is a micro aerial vehicle capable of flying, landing on water, sailing autonomously, and taking off again. This dual capability enables rapid deployment from shore, efficient transit between distant water bodies, and long-duration sensing missions on water surfaces.

This project focuses on advancing the SailMAV platform through improvements in aerodynamic design, system integration, and autonomous control. The work includes iterative design optimization, autopilot development, and extensive experimental validation in realistic outdoor conditions.

Start date flexible.

Work packages

WP1 Literature review: Review aerial-aquatic robots, hybrid UAV systems, sailing robotics, and autonomous control approaches.

WP2 Design and optimization: Improve the aerodynamic and mechanical design of SailMAV through CAD, prototyping, and iterative testing.

WP3 Autopilot development: Develop and tune autonomous control using PX4 or ArduPilot, including transitions between flight and water modes.

WP4 Simulation and testing: Evaluate performance in simulation and experiments, focusing on stability, efficiency, and robustness across modes.

WP5 Outdoor validation: Conduct field experiments including hovering, fixed-wing flight, water take-off, sailing, and full mission scenarios. “‘

About us

The Laboratory of Sustainability Robotics (LSR) at EPFL and EMPA develops robotic systems for environmental monitoring in aquatic, terrestrial, and aerial environments.

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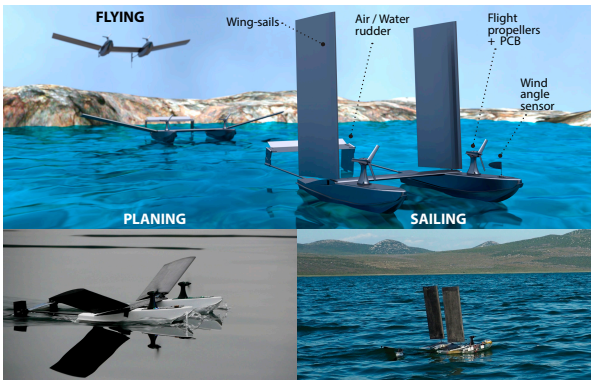

Figure 1: SailMAV: a hybrid robot capable of both aerial flight and autonomous sailing [1,2].

Requirements

- Background in robotics, aerospace, or mechanical engineering.
- Hands-on experience with drones and outdoor flight testing.
- Experience with PX4, ArduPilot, or similar autopilot systems.
- Skills in CAD, control systems, or embedded development are a plus.

Application

- CV and motivation letter.
- Transcript of records.
- Portfolio or project examples (optional).

References

[1] Zufferey et al. ”SailMAV: Design and Implementation of a Novel Multi-Modal Flying Sailing Robot”, IEEE RA-L, 2020 [2] Farinha et Romanello et al. ”SailMAV: Water-surface locomotion and biodiversity monitoring”, IEEE Transactions on Field Robotics, 2025