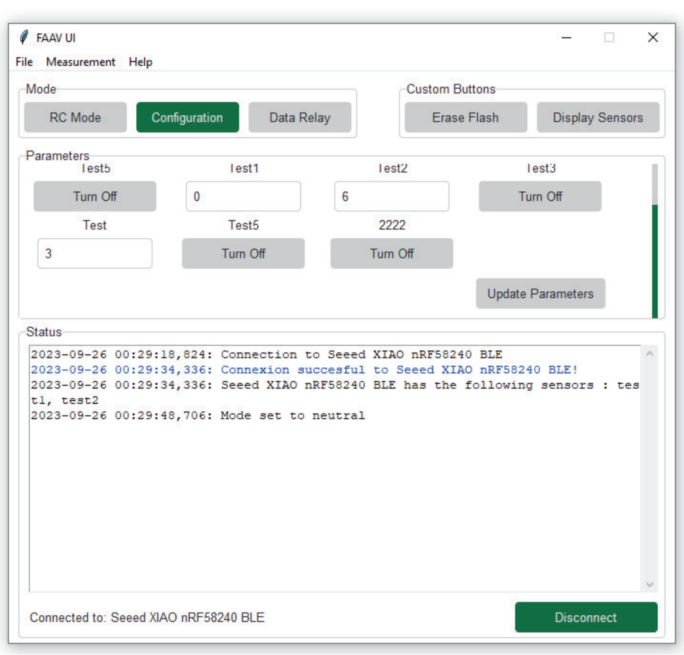
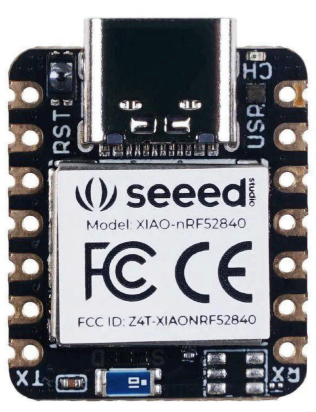
# Flapping-Wing Aerial-Aquatic-Vehicles (FAAV) RC Software & Electronics

The Laboratory of Intelligent Systems at EPFL is currently developing Flapping-Wing Aerial-Aquatic-Vehicles (FAAV), which takes inspiration from nature to create a robot capable of both flying and swimming seamlessly. By emulating bird wing morphology, this innovative robot aims to facilitate data collection for oceanography and climate research.


*A neat controller to command your bot!*



*The FAAV UI receives the command through the usb and sends it over BLE*




*The microcontroller processes the commands and sends them to the wings and tail motors!*

## Introduction

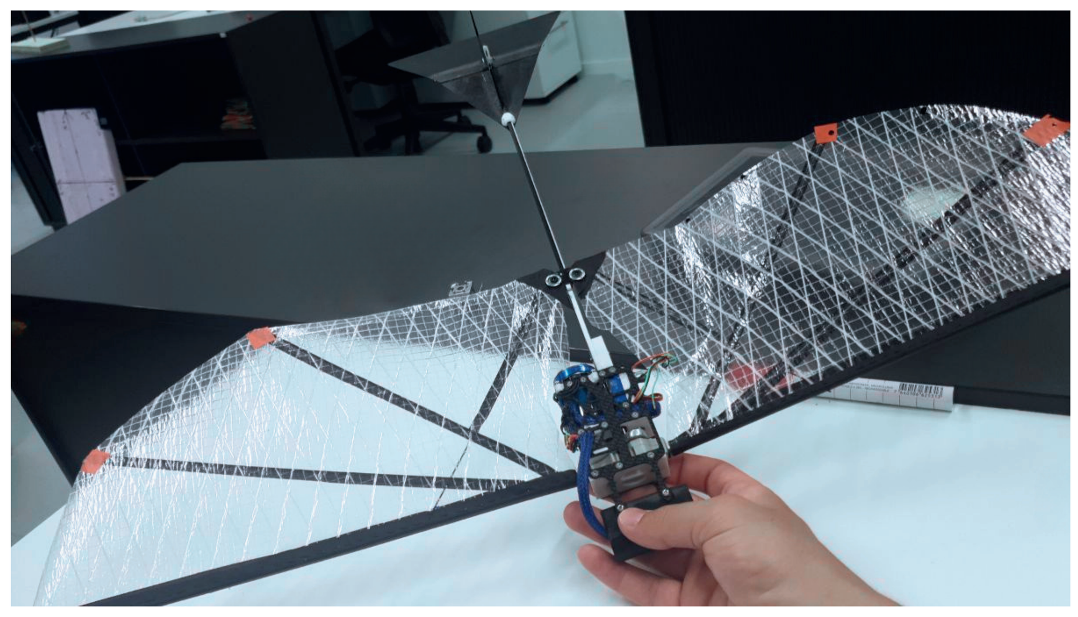
Despite the considerable advancements in flapping wing and aerial aquatic robotics, the fusion of these two concepts has been largely unexplored. Several significant challenges lie ahead. One such challenge is striking the right balance in the design to enable efficient performance in both swimming and flying modes without overburdening the robot. Additionally, achieving autonomy in the robot's operations is crucial, ensuring it can autonomously handle transitions between air and water without relying heavily on user input.

## Objective

The primary objectives of this internship are the development of software and electronics in order to achieve autonomous motion for the robot in both air and water.

## Software

The wireless graphical user interface enables users to change the behaviour of the robots, such as the wing frequency. Considering that these parameters might change depending on the experiment, the GUI will change based on the setup on the robot, thus allowing for easy and flexible use. Additionally, the user interface will be in charge of gathering data from the various sensors installed on the FAAV, allowing for both real-time display and storage on the flash. To ensure seamless communication, I implemented mechanisms to maintain a stable BLE connection (a low power consumption version of the original Bluetooth) between the FAAV and the master computer. In case of any interruptions, the robot will seek reconnection to the master with as little delay as possible.



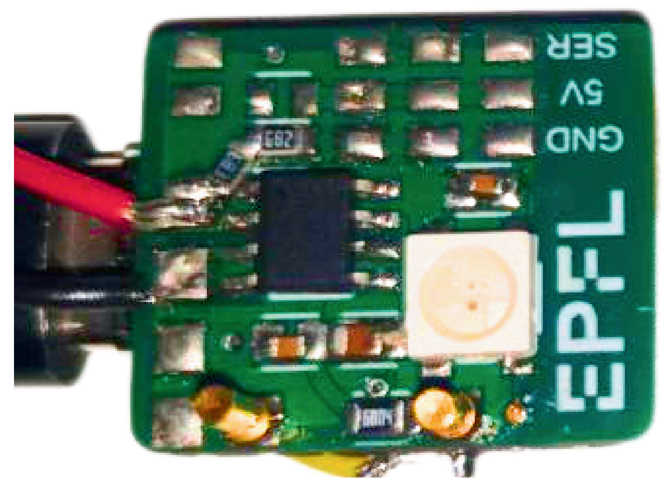
A FAAV prototype (credits to my supervisor Raphael Zufferey)

## Hardware

Regarding electronics, my task was to connect the microcontroller on the robot to all its peripherals: such as sensors and motors, making sure that the circuit is waterproof and quite robust. This setup will work thanks to a printed circuit board that I have designed specifically for this project. Besides the three servos (specialized motors) controlling the wings and the tail which allowed the bot move , it needed a way to respond to its environment!


The printed circuit board

Therefore, we add sensors! For now, the robot includes a water sensor (two golden pins), a current and voltage sensor to keep track of the power consumption.



A printed circuit board with the components soldered on!

## Final Thoughts

Conducting research in water bodies has always been challenging for scientists, but this robot offers a game-changing advantage. It can collect data from hazardous areas such as turbulent waters or locations affected by oil spills, greatly enhancing current research efforts.

In conclusion, the combination of aerial and aquatic capabilities in a single robot presents an exciting opportunity to amass crucial data, thus enabling us to tackle the climate crisis more efficiently.

Created by Cristian Fortuna during the Laidlaw Scholars Leadership and Research Program under the guidance of Dr. Raphael Zufferey