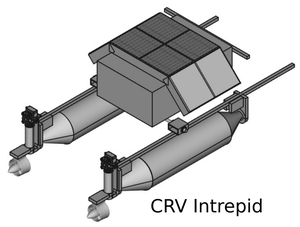
Invasive Species

by the Goofy Guppies

In Maryland, invasive fish species like blue catfish and northern snakeheads cause significant ecological and economic harm by disrupting food webs, competing with native species, and impacting fisheries, potentially leading to declines in native fish populations

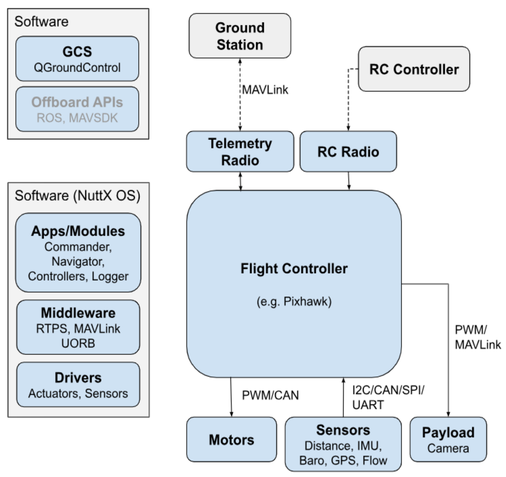
The total problem in Maryland covers 100 lakes, none of which are natural, 3 major rivers and lots of smaller streams totaling more than 16,000 miles of waterways. Not all of these waterways are navigable.

This much water would be very difficult to search manually, so we are proposing a small fleet of autonomous vehicles with probes to perform the data gathering.



CRV Intrepid

A major problem in real world activities is data collection. Your vehicles have to report back to a central location so the data can be analyzed. We have been experimenting with three systems: one is static logging, where data and video are recorded on board the vehicle and offloaded when the vehicle returns to its base, the second is WiFi, where access points are set up to receive data from the vehicles in a mesh, the third is direct transmission over a serial link on the 915 MHz experimenter's band (it would be 433 MHz in Europe). The Ground Control System is QGroundControl, which is also used to plan and execute the research missions.



The base station requires power to operate and systems to support the necessary antennas and processing equipment. In remote areas this requires some sort of generator. In our test systems this function is performed by a camping solar generator and battery.

There is a measure called permittivity which roughly correlates with how well a material can propagate radio waves. The vacuum of space has a permittivity of 1, air is approximately 1.0006, and wather is roughly 80. This means that you have to use extremely low frequency (ELF) radio to send data to submarines.

We will be conducting a set of experiments to determine just how far we can reach underwater with the resources available to us. The choice is between store and forward models, making a tethered probe, and using some form of electromagnetic radiation. A store and forward system would imply the use of an autonomous probe, which could operate independently of the drone, only returning to the drone for recharging.

Store & Forward

WiFi

Tethered Probe

Autonomous Probe

Store and forward is represented by Olymbros, which takes video as it is towed behind a boat, usually connected to the fish line. After the mission, the SDHC card would be unloaded and the video matched with the GPS data from the drone. The WiFi link is represented by a little canister we built with an ESP32-CAM attached. We should be able to verify the difficulties transmitting through water fairly easily. The cable connection will be represented by a device called the FishCAM. We would start with one on the drone and just capture a stream from sightly below the surface. The system would be added to a probe once we learn how to control the probe remotely. The autonomous vehicle would be a modified Seaglide.

Potential analysis:
- Environmental DNA (eDNA)
- Audio samles
- Video samples
- Water Chemistry
- Water Temperature

Once we have data and can reliably find the invasive fishes, we have to work out how to catch them and deliver them to shore for composting.