Process of Implementing Sensors into an Unmanned Aerial System

Caitlin Hedberg, Sydney Zeuli | Faculty Mentor: Dr. Patricia Cleary | Chemistry Department

Abstract

The goal of this project was to integrate multiple sensors onto an unmanned aerial system (UAS) to profile meteorology and composition of the atmosphere. These sensors include a POM, a five-hole probe, and an iMet. These sensors went through a process of calibration, error testing, and field testing before beginning the process of implementation onto the UAS. This collection of sensors will be used to study ozone levels throughout Wisconsin and surrounding states.

Above is a photo of the unmanned aerial system that we will be integrating the following three sensors onto. It is the Typhoon H hexacopter. The challenge will be finding enough space on Typhoon to fit all the sensors and, if need be, their battery packs. The last step of all the timelines is a full flight test. This will entail that all the sensors are on the Typhoon and collection data.

POM

Introduction to the Sensor

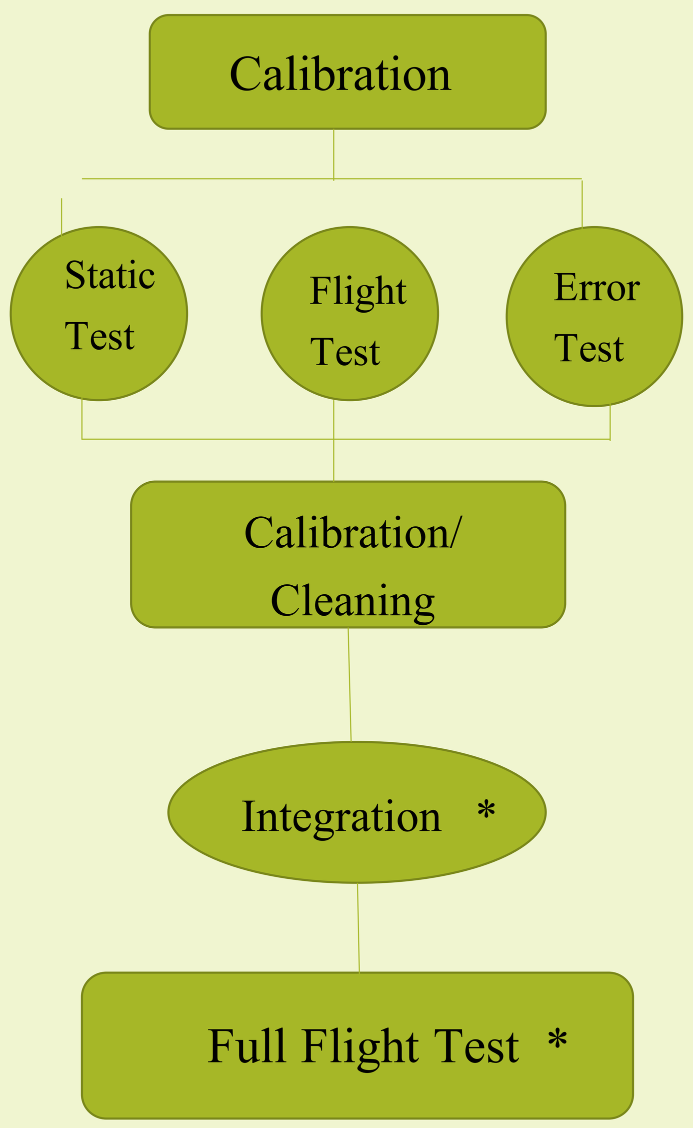
The Pom is an instrument that measures the amount of ozone in the air. The main devise is the gray box in the picture above and the green circle coming off the front is a filter. The POM measures the amount of Ozone in parts per billion (ppb), which means that it counts the number particles of ozone in a billion particles. This number is very small and the filter on the front helps the count be more accurate.

Complications

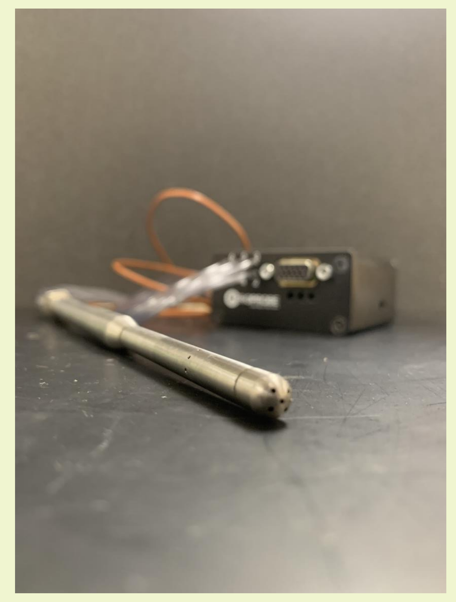
One of the main complications that we faced was seeing if the noise from our drone, the unmanned aerial system that the POM will be attached to, would affect the data collected by the POM.

Current Stage in Research

Below is the timeline we have followed to ready the POM for flight. We are currently cleaning the drone from the fire and recalibrating it. We are also working on coding programs for annualizing the data we receive. After those are done the POM will be integrated onto our drone and a test flight will be done.



5-Hole Probe



Introduction to the Sensor

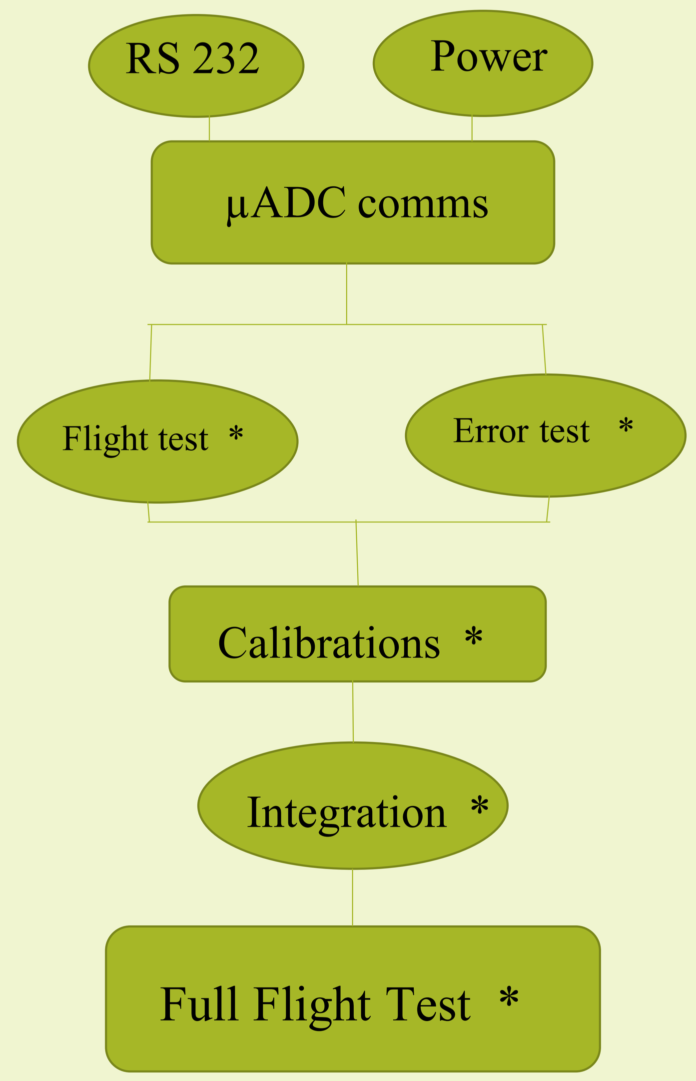
The 5-Hole Probe is an instrument made up of two parts the multi-hole Air Data Probe (ADP), and the micro Air Data Computer (µADC). The ADP collects the data and transfers it to the µADC where it is stored until it can be transferred onto a computer. The probe is used to measure angle of attack, angle of sideslip, airspeed, and altitude.

Complications

Some issues that we have come across with the probe is finding a cord to transfer data from the µADC to the computer, finding a program on the computer that the µADC will respond to, finding a way to communicate with the µADC from the program on the computer, and the probe needs a constant supply of power to collect data.

Current Stage in Research

Below is a diagram of the timeline we intend to follow to prepared this probe to be integrated onto an unmanned aerial system. We are currently on the µADC comms step, trying to get the probe to respond to commands made on a computer program.



iMet

Introduction to the Sensor

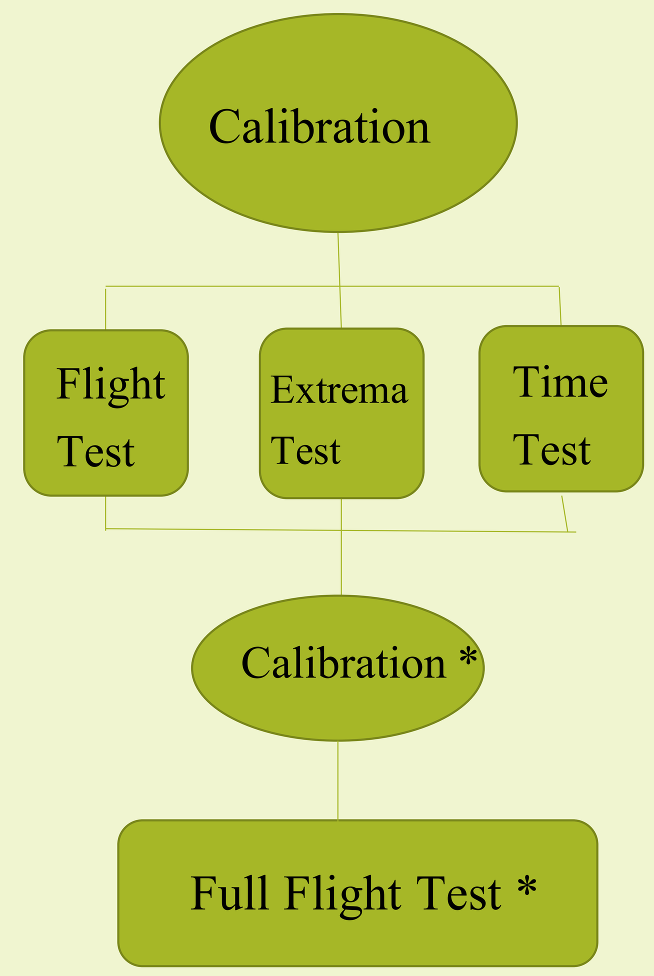
The Intermet XQ2, aka the iMet. One of the key elements of this project is the effect of the sea breeze on ozone. Thus, the iMet is an integral part of our setup, as it measures temperature, pressure, and relative humidity.

Complications

All sensors must go through a testing process to understand data drifts, percent errors, and how the sensor adapts to different climates. As this sensor's main task is to collect sea breeze data, the core testing around this sensor came from recreating a sea breeze to assess the probe's adaptability. However, recreating this breeze is uniquely difficult without the presence of a large body of water and/or a large amount of fans and a way to change the humidity. Mock sea breezes were creating using a combination of a refrigerator, a portable cooler, and the outdoor wind.

Current Stage in Research

Below is a diagram of the timeline we have been following to prepared the iMet to be integrated onto an unmanned aerial system. We are currently on the testing arm of our diagram



Project Timeline:

The fire in the timeline represents a fire that occurred on the second floor of our building. Ash from that fire went through the vents to our labs and the POM had to be sent away to be cleaned. The Coronavirus has slowed our process since we are told to work from home now and do not have access to the sensors to continue testing and calibration but are still analyzing data from calibrations and planning for the future.

* Indicates future events

Acknowledgments:

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