QUADSAT SWARM

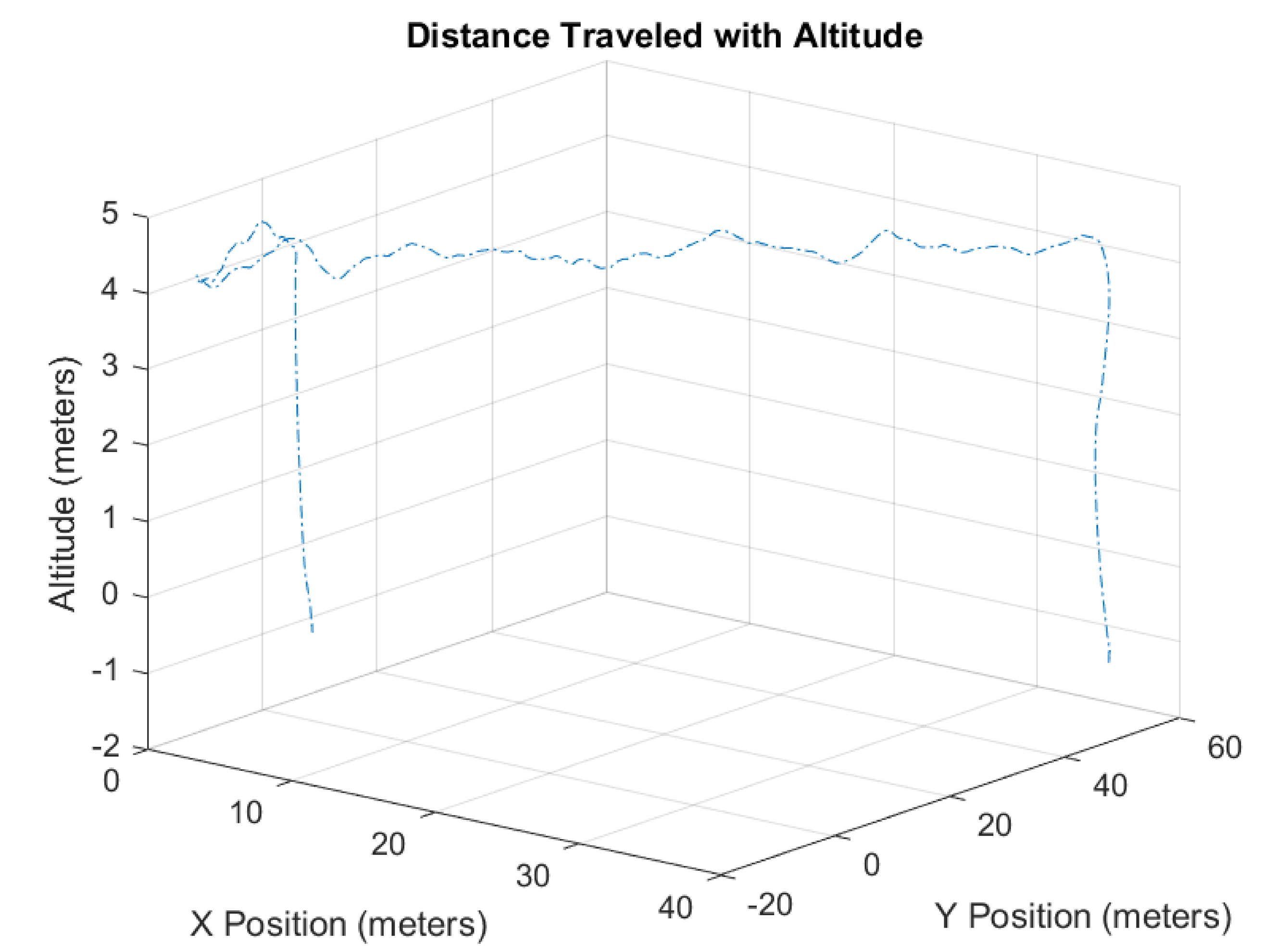
ME: Tyler Blish, Brian McAnally, Zachary Shelby, Austin Snell

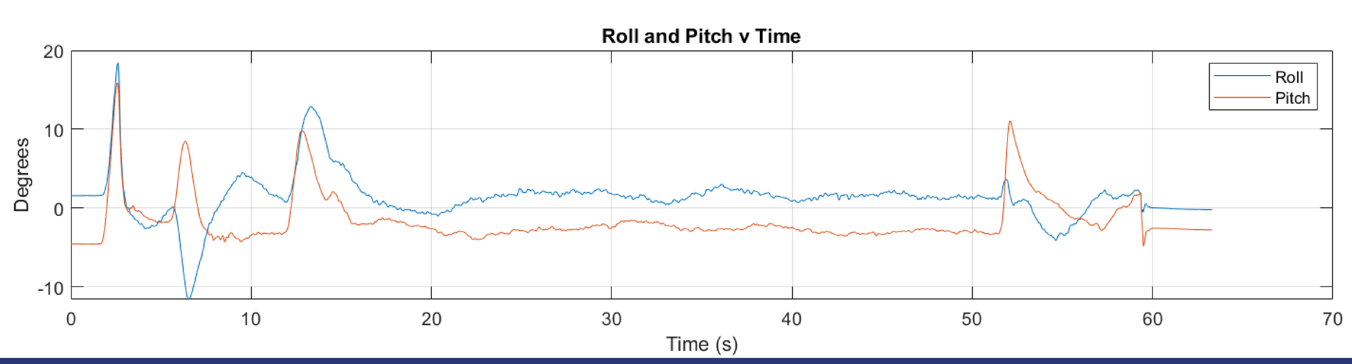
ECE: Jason Bortolussi, Kaitlyn Laliberte, Stephanie Lo

CS: Ryan Contois, Luke McIntire, Justin Moore, Timothy Strauss | EP: Thomas Hall

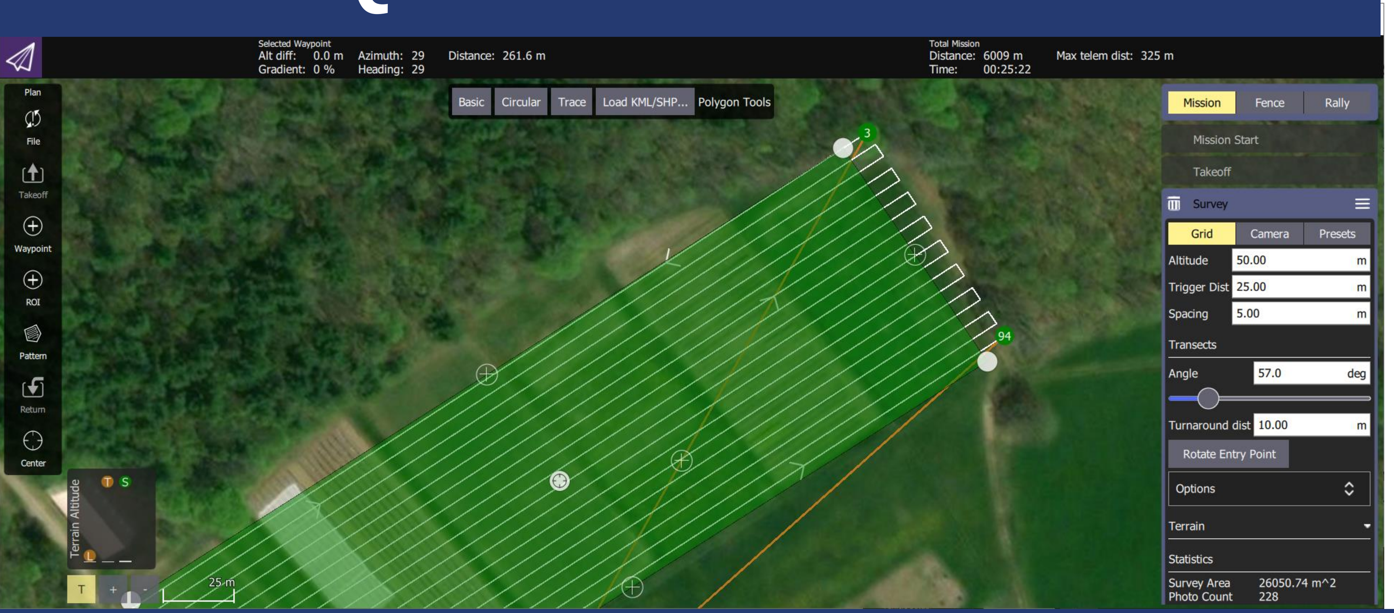
Faculty Advisor: Dr. May-Win Thein

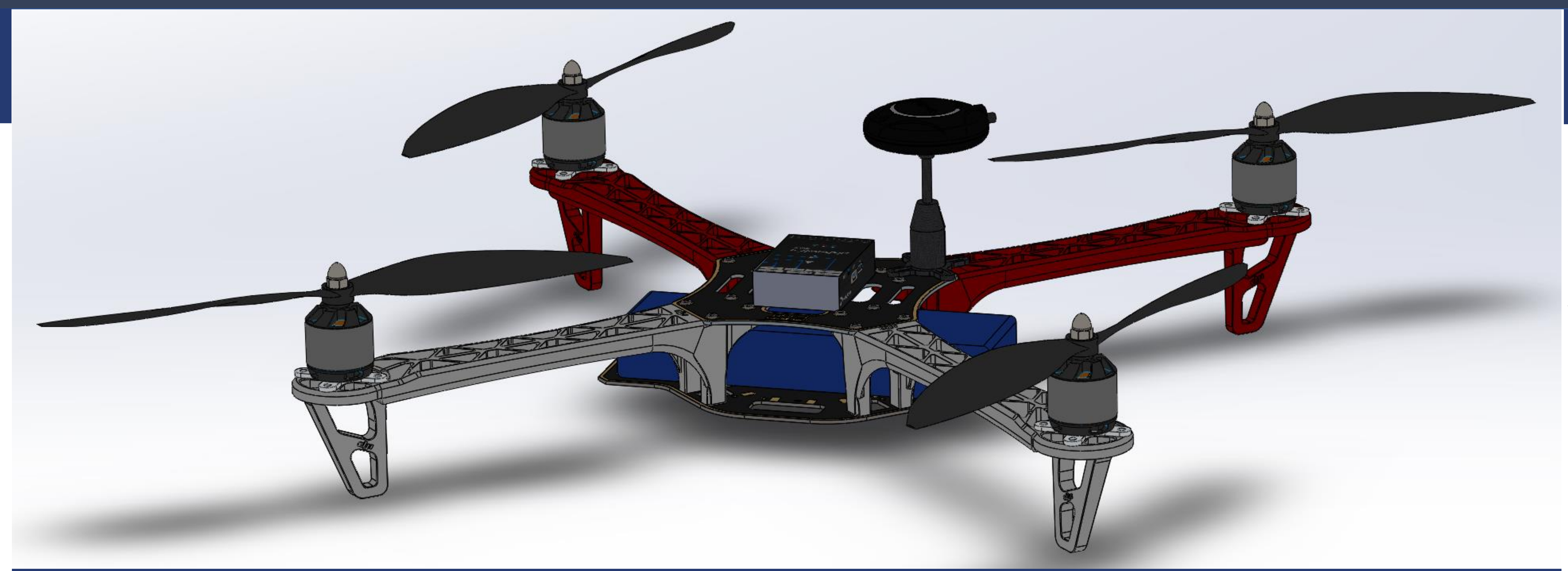
Data Logging





QGroundControl





Pixhawk PX4

User Friendly

Open Source Quadcopter Control

Auto Calibration

Flight Safety Features

Automatic Sensor Fusion

Compatible with ROS and Pi

Project Overview

Mission

QuadSat Swarm is a multi-year interdisciplinary project advised Dr. May-Win Thein, which attempts to create a swarm of autonomous quadcopters to be used as a test platform in satellite modeling and dynamics. By using quadcopters to model these dynamics, a cost-efficient method is being produced to see how satellites would act in a set constellation around Earth.

The goal of this year's years project is to design, build and test a rugged autonomous quadcopter that is:

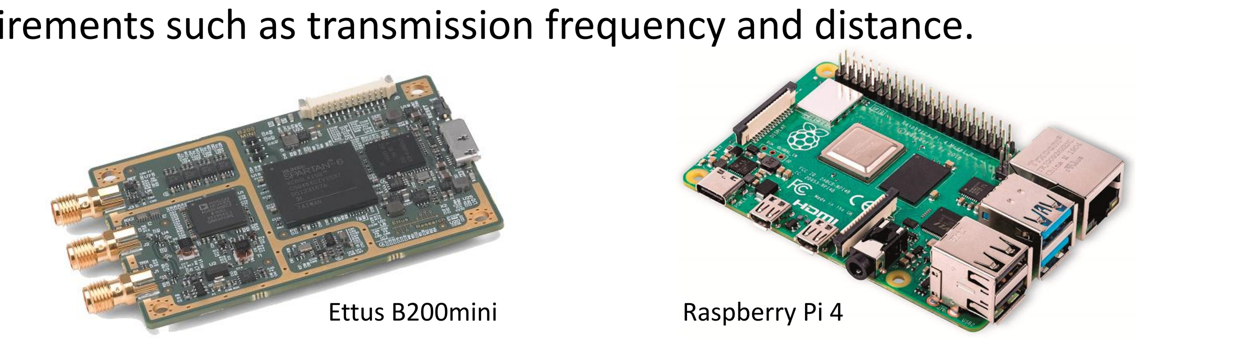
- Duplicatable: for swarm purposes
- Cost efficient: $400 maximum per-base-quad
- Stable: for safety purposes

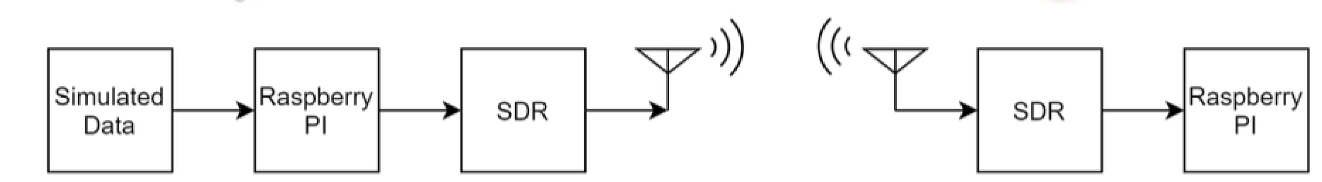
Design Criteria

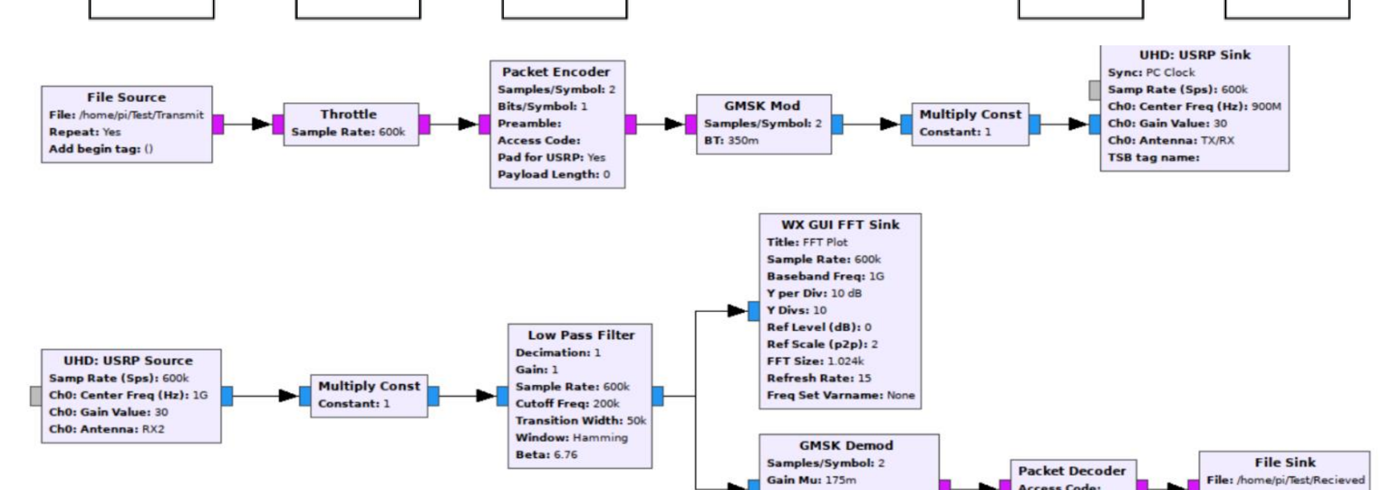
I. Fly autonomously way point to way point within 5 meters.
II. Aesthetic design, non-hindering of operation.
III. Must be able to fly with multiple quads connecting to one ground station.
IV. All sensors must have sampling frequencies that do not limit flight capabilities or create instabilities
V. Be able to fly both indoors and outdoors (in clear weather).
VI. Withstand small impacts and rough landings without damaging sensors.

Communications

Software-defined radio (SDR) is an extremely flexible piece of hardware that allows for a wide range of testing on multiple different design requirements such as transmission frequency and distance.







Final Transceiver Signal Flow Diagram

Swarm Software

- We are implementing a two node ROS system to allow for bidirectional communication with the quadcopters.
- We pull telemetry data off the Pixhawk and it works its way to an algorithm that calculates a new location for that Pixhawk.

Autonomous Cohesive Motion

Hardware and Electrical Design
- Construction and assembly of multiple quads
- Introducing hardware & sensors

Autonomy Development
- Implementing linear and non-linear controls
- Attitude and position feedback

Swarm Communication
- Implemented Artificial Potential Fields with attractive and repulsive force.
- Sliding mode control used to determine appropriate next location for quads.

PIXHAWK

↓ Node Information

ROS NODE ON Pi

↑ New Location of Node | ↓ Node Information

ROS CORE ON BASE STATION

↑ New Location of Node | ↓ Node Information

ROS NODE ON BASE STATION

Obstacle Avoidance

- Built into PX4 Pixhawk Firmware
- Companion Computer – Raspberry Pi 4
- Uses Intel RealSense® D435 Camera
- 3D Printed bracket to attach camera
- Localized Mapping
- Global Mapping