Swarm UAVs for Area Mapping in GPS-Denied Locations

Team Lead: Daniel Golan
Advisors: Dr. Sergey Drakunov
Student Team: Bryan Gonzalez, Patrick Kennedy, Ryan Taylor, Ethan Thomas, Joseph Perry, Ryan Ebrahimi, Kyle Fox

Introduction

- Creates a high accuracy point cloud through photogrammetry with post flight fusion.
- Nearly autonomous control in GPS-denied areas using SLAM and extended Kalman filter for sensor suite.
- Creates a point cloud during a flight and localizes within its generated world frame.
- Communicates via MAVlink from companion computer to Flight controller but uses Wifi with ROS nodes for swarm communication.

Figure 1: UAS with camera and companion computer

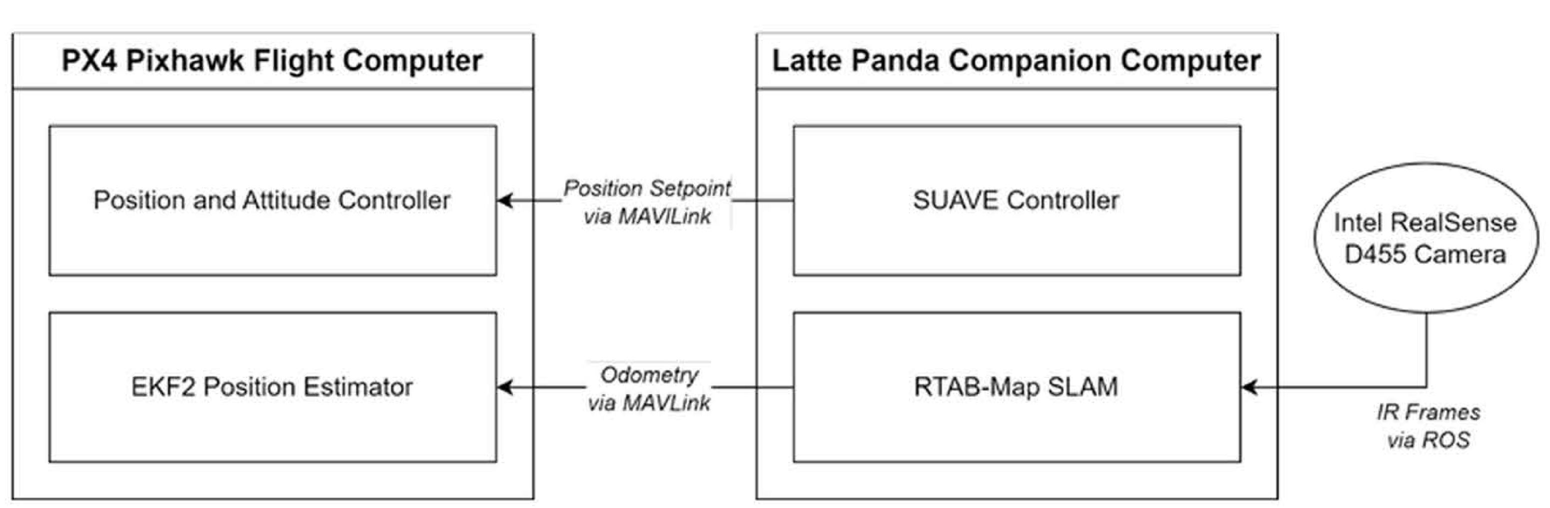

Figure 2: System architecture for autonomous drones utilizing VIO for postionestimation

Methods

- FC finds original position with EKF and then RTAB-Map publishes a ROS topic with the drone's real-time odometry for local positioning.
- RTAB-Map and VIO run through the onboard Latte Panda 3 Delta with ROS and OpenCV and uses an Intel Realsense to collect RGB-D values.
- A Transformation is applied to the incoming RTAB-Map data so the frame aligns with the local VIO frame.
- The post flight point cloud data is uploaded onto CloudCompare then modified and fused with all UAS's points of views.

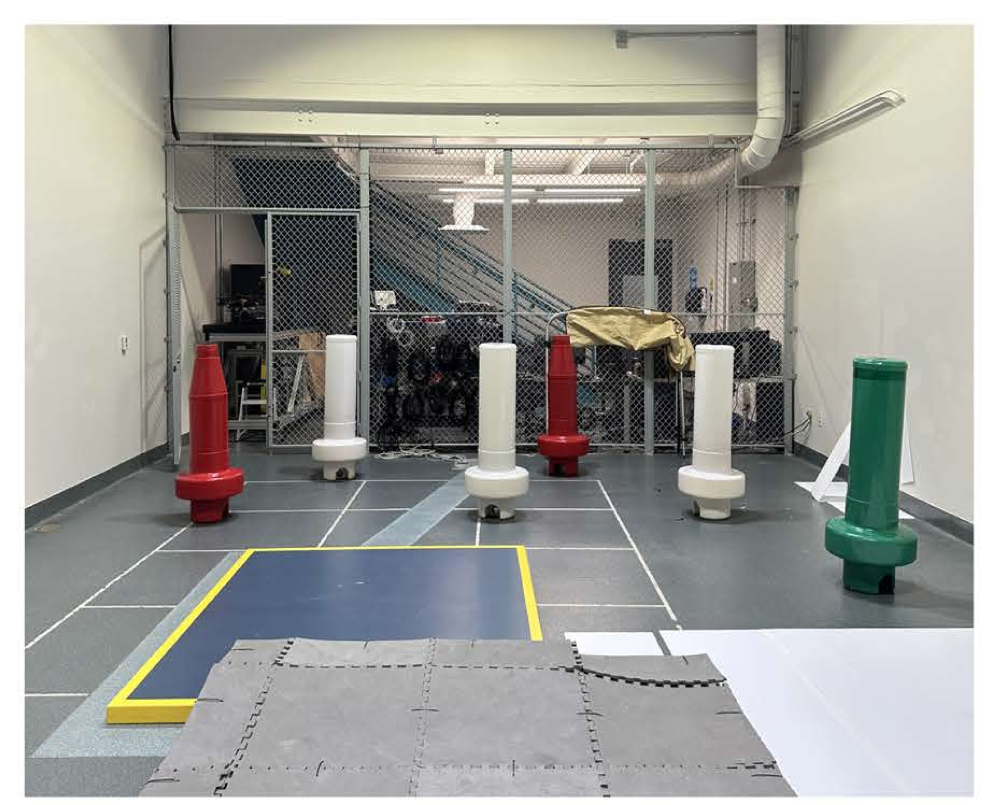

Figure 3: Testing Facility

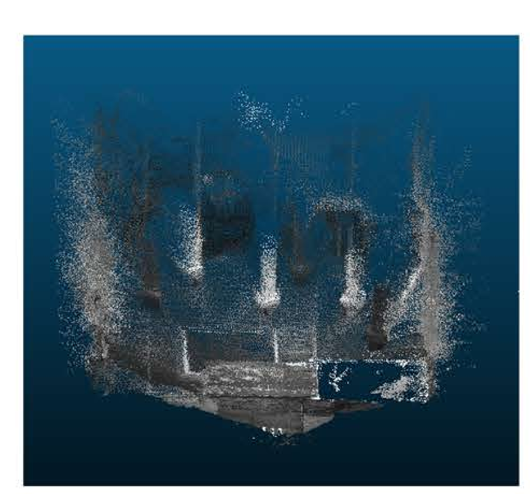

Figure 4: 1 Point Cloud

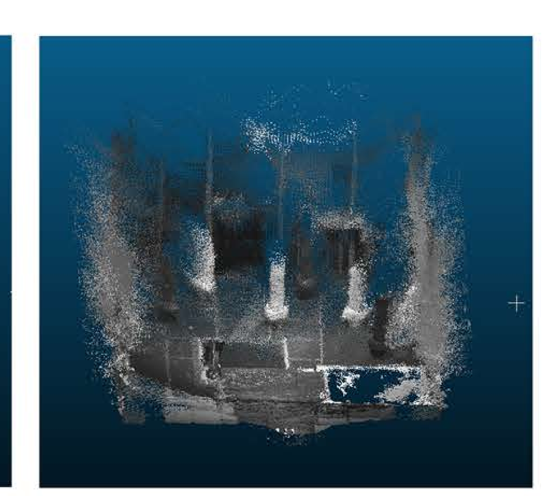

Figure 5: 3 Fused Point Clouds

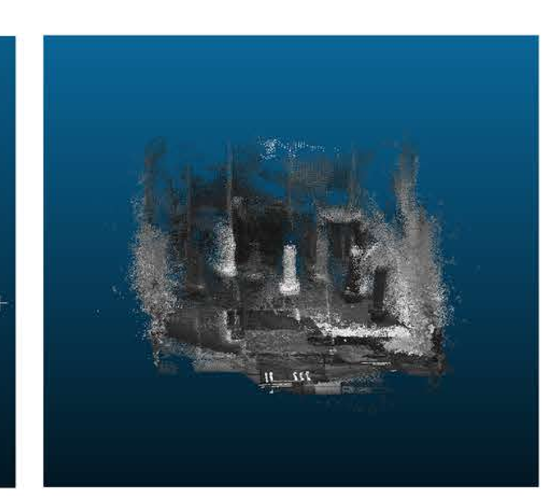

Figure 6: 5 Fused Point Clouds

Results

- The drone can autonomously move in its +X axis, corresponding to pitch, while accounting for initial IMU drift.
- There is a window for the appropriate amount of point clouds to be fused so that it is not too sparse or oversaturated with information.
- The SLAM algorithm is suitable for predicting actual odometry with a high enough fidelity to account for errors during takeoff and landing.

Figure 7: Pitch Translational Flight

Conclusion & Future Work

- During testing, it was found that the drone converges accurately on its target setpoint with some expected drift. To solve the stability issues, a new frame will be used, as well as post flight PID tuning. The next steps are to fly a full swarm while collecting point cloud data using a dual quaternion controller.