Progress Review 04

Team FireFly | April 06, 2022

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Progress

Mechanical Design

Mechanical changes are generally finalized other than connecting the PCB:

- Completed installing helicoils
- Rotated the Xavier
  - Better access to ports
  - Mount is more stable
- Created new mount for the thermal camera
- Installed thermal camera and mount onto baseplate
- Put in tapped holes for the PCB
  - PCB currently unmounted because of delay in component delivery

Flight Test (finally)

We were able to perform one flight test to Hawkins since the last PR

Fire Segmentation

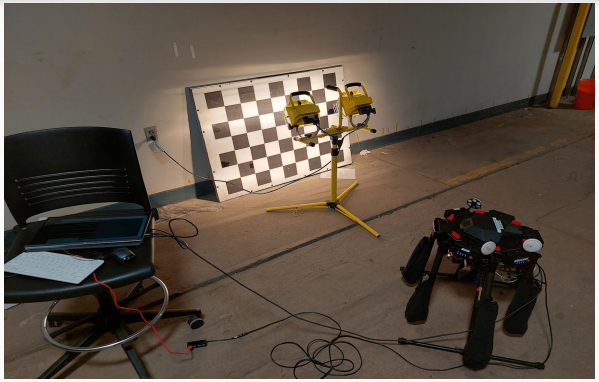
Tested our fire segmentation algorithm on video taken mid-flight of a camping heater/stove

Calibration - Intrinsic and Extrinsic

- Completed internal camera calibration successfully using 200 images
- Intrinsic - RMS reprojection error of 1.4 pixels

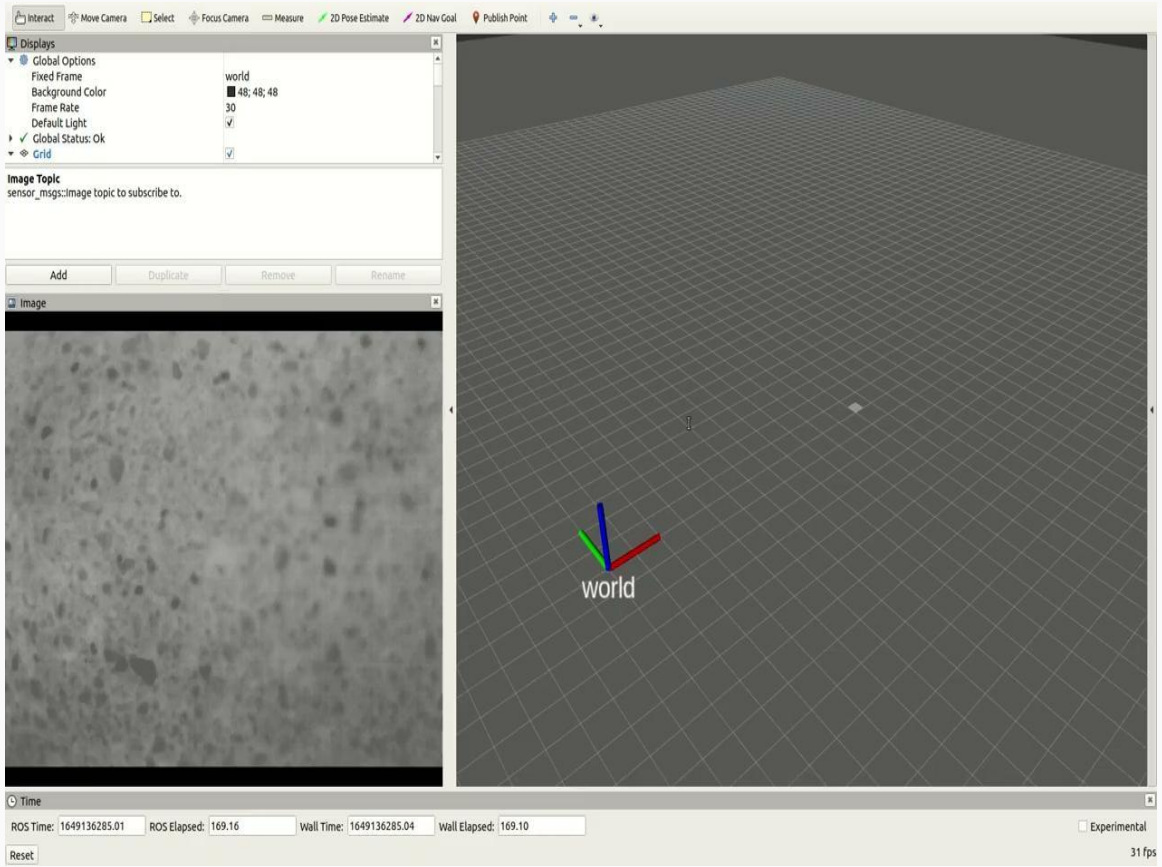
- Completed external camera calibration using Kalibr
- Mean reprojection error of 0.84 pixels
- Standard deviation of 0.42 pixels

- With our calibrations, we are able to achieve our desired 5 meter mapping accuracy



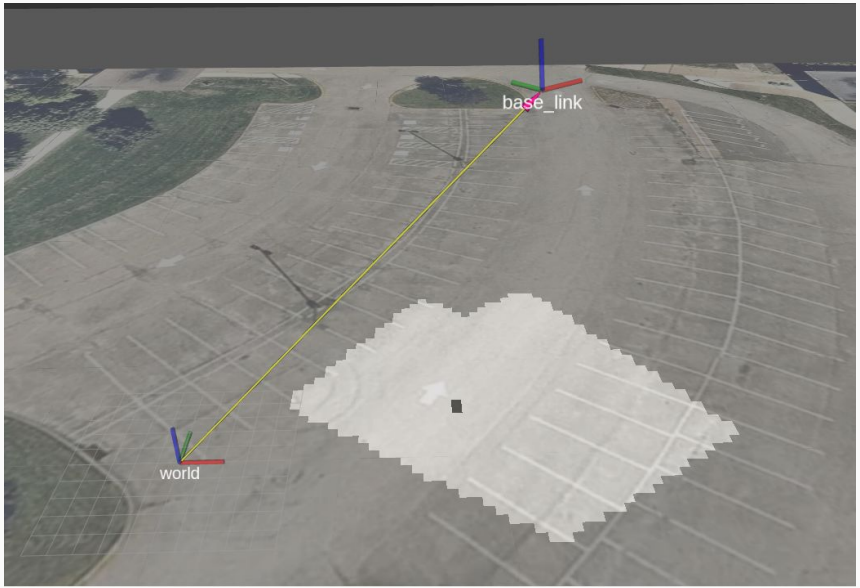
Mapping

Testing projection in real-time
Grey pixel - ground truth
Black pixel - projection



Visualization

- Investigated different satellite tile servers
  - Switched to using MapBox
- Added basic GUI as an RVIZ plugin

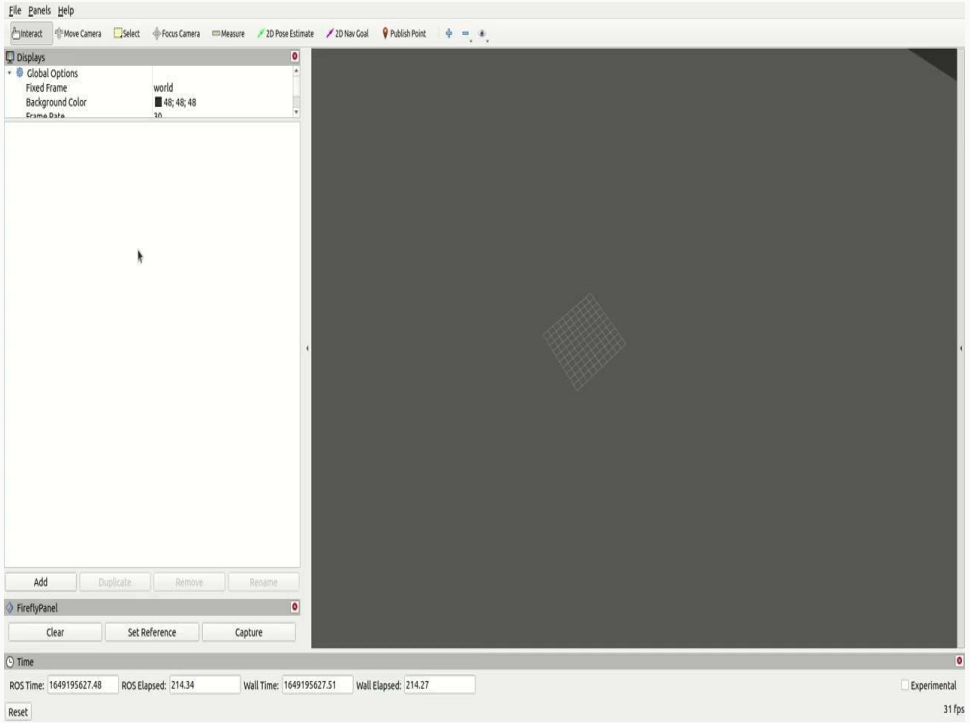


Telemetry

Added the following features to the telemetry software

- Heartbeat
- Command from the ground station to the drone to set the local mapping reference frame
- Command from the ground station to the drone to take a picture and process it

GUI can currently do satellite overlay (0:07), projecting a captured image (2:18), and clearing the current map (2:29)



Benchmarking Telemetry

- We tested how fast we could stream the onboard map to the ground station
- Could reliably send up to 1152 bytes per second

- 25 m x 25 m area with 0.5 m resolution -> 2500 bins
- 42 bins per tunnel message -> 60 tunnel messages
- 1 tunnel message is 145 bytes @ **1152 bytes/s** -> 126 ms
- 60 tunnel messages -> 7.55 seconds

- This achieves our performance requirements for sending this size of map update in less than 10 seconds

Challenges

Challenges

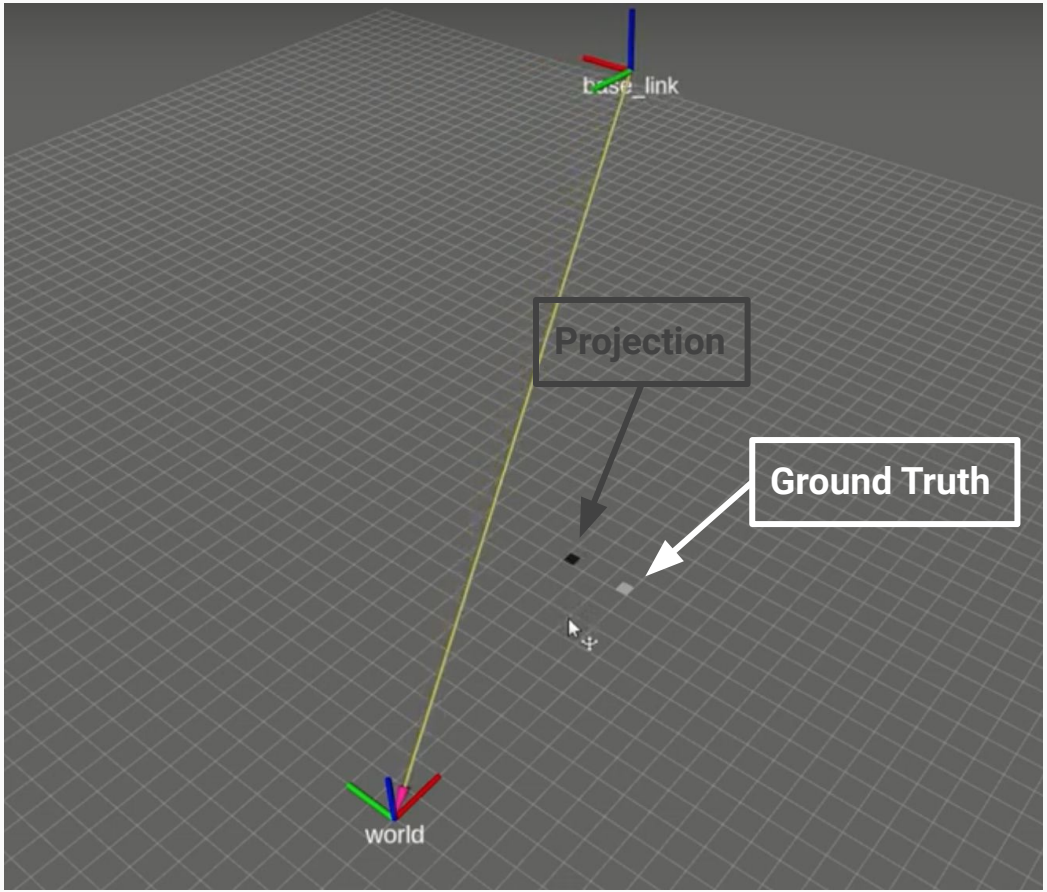
- Test flight bottlenecks
  - Difficulty with bad weather and limited permission to test on campus
  - Got permission to test on the Mall
    - We will perform our SVD here
- Software Version Conflicts
  - Python 2 vs Python 3 - Added shebangs to explicitly use Python 2 on onboard computer and Python 3 on ground station
  - OpenCV - We explicitly set the version of OpenCV in our CMakeLists.txt file

Future Work

Future Work

- Complete PCB integration
  - PCB Assembly
  - Interface Software
- Mapping ground truth validation script
- Error Handling for Disconnections
- GUI - Show field of view of drone camera
- Test mapping on more flight tests and with multiple fires

Questions?


base_link
Projection
Ground Truth
world