

Modular Multi-sensor Payload Design for Unmanned Aerial Vehicle Mapping in Forest Environments

Winnie Kuang, David Russell, Francisco Yandun, David Wettergreen and George Kantor

The Robotics Institute
Carnegie Mellon University
Pittsburgh, PA, USA

CMU PORTUGAL
SUMMIT 2022

NEW FRONTIERS IN TECH

Introduction

- Unmanned Aerial Vehicles (UAVs) can be used to mitigate forest fires by mapping the forest environment and detecting regions that contain flammable vegetation. This information can be relayed over to an Unmanned Ground Vehicle (UGV) which can be used to clear the forest of flammable vegetation.
- We have designed a modular multi-sensor payload in support of our simultaneous localization and mapping (SLAM) and semantic segmentation system to generate a 3D mapping of the forest environment.



Fig. 1: UAV will generate a mapping of the forest environment and relay information such as locations of flammable vegetation and how traversable a region is to a UGV.

Methods

- Our modular multi-sensor payload integrates with our SLAM system using the IMU, stereo cameras, and LiDAR modalities.

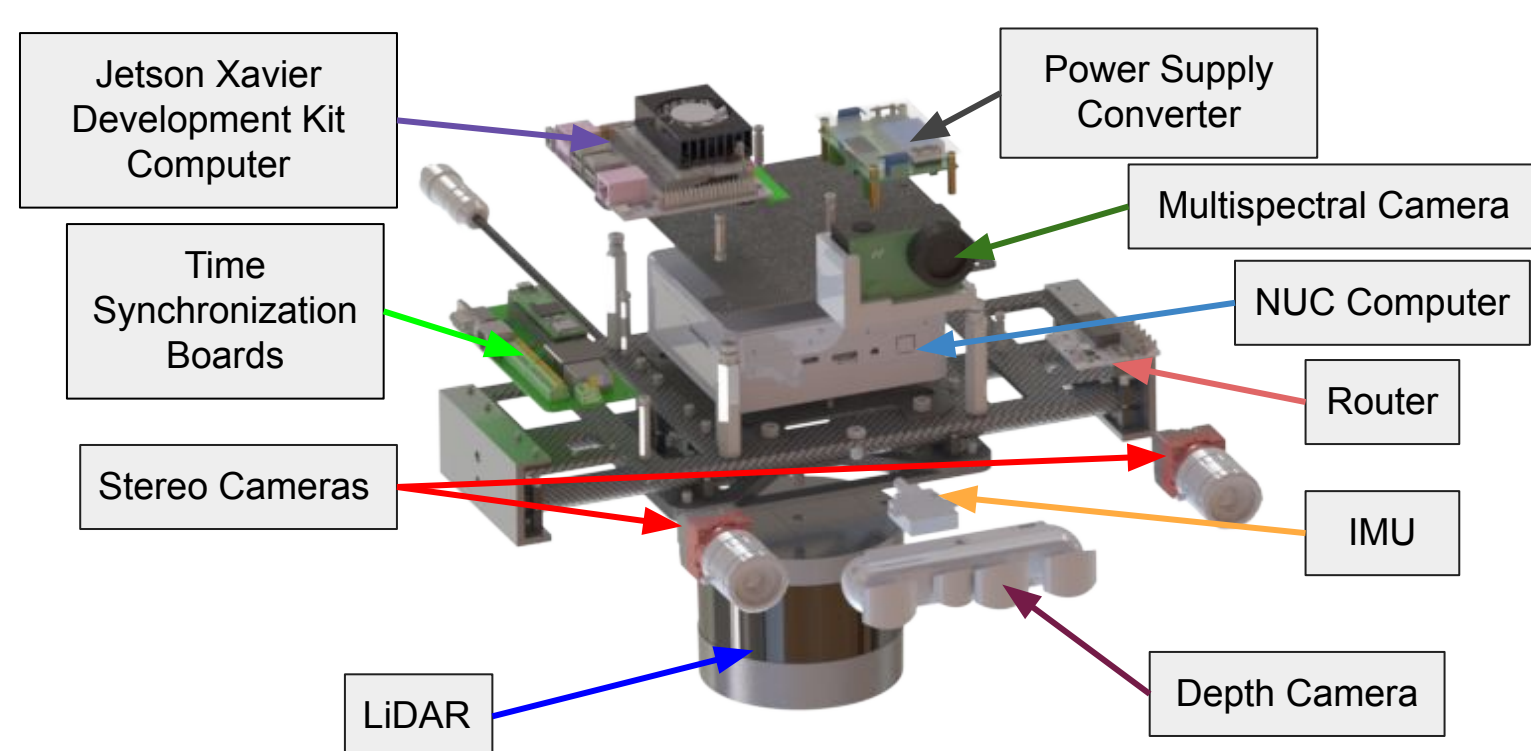


Fig. 2: Modular multi-sensor payload

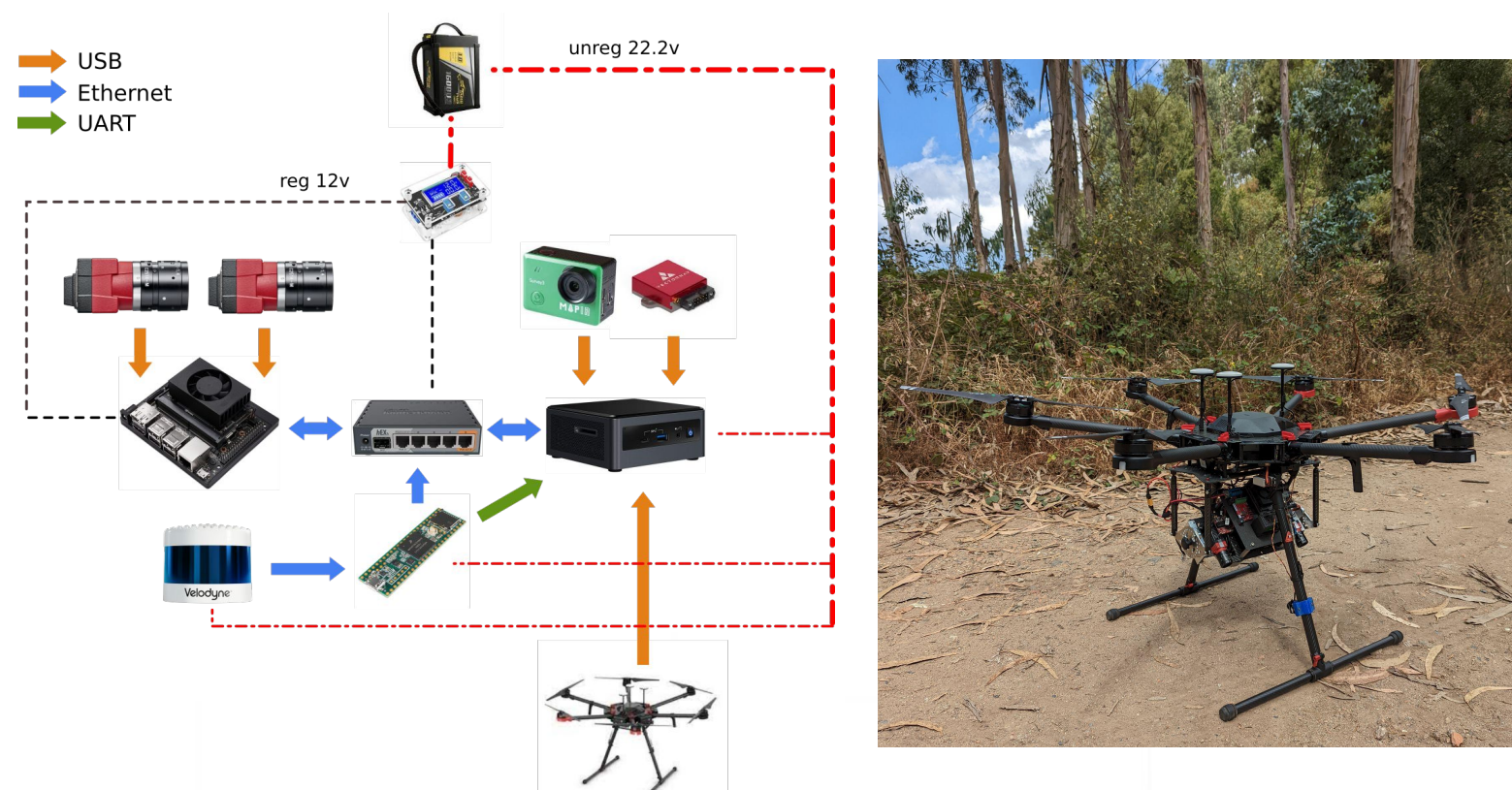


Fig. 3: Connection scheme of payload components with the payload attached onto the DJI M600

Results

- We used our modular multi-sensor payload on the DJI M600 and surveyed a forest environment, over-the-canopy and under-the-canopy.
- After collecting data, the data was processed with our SLAM system to generate 3D mapping of the environment.

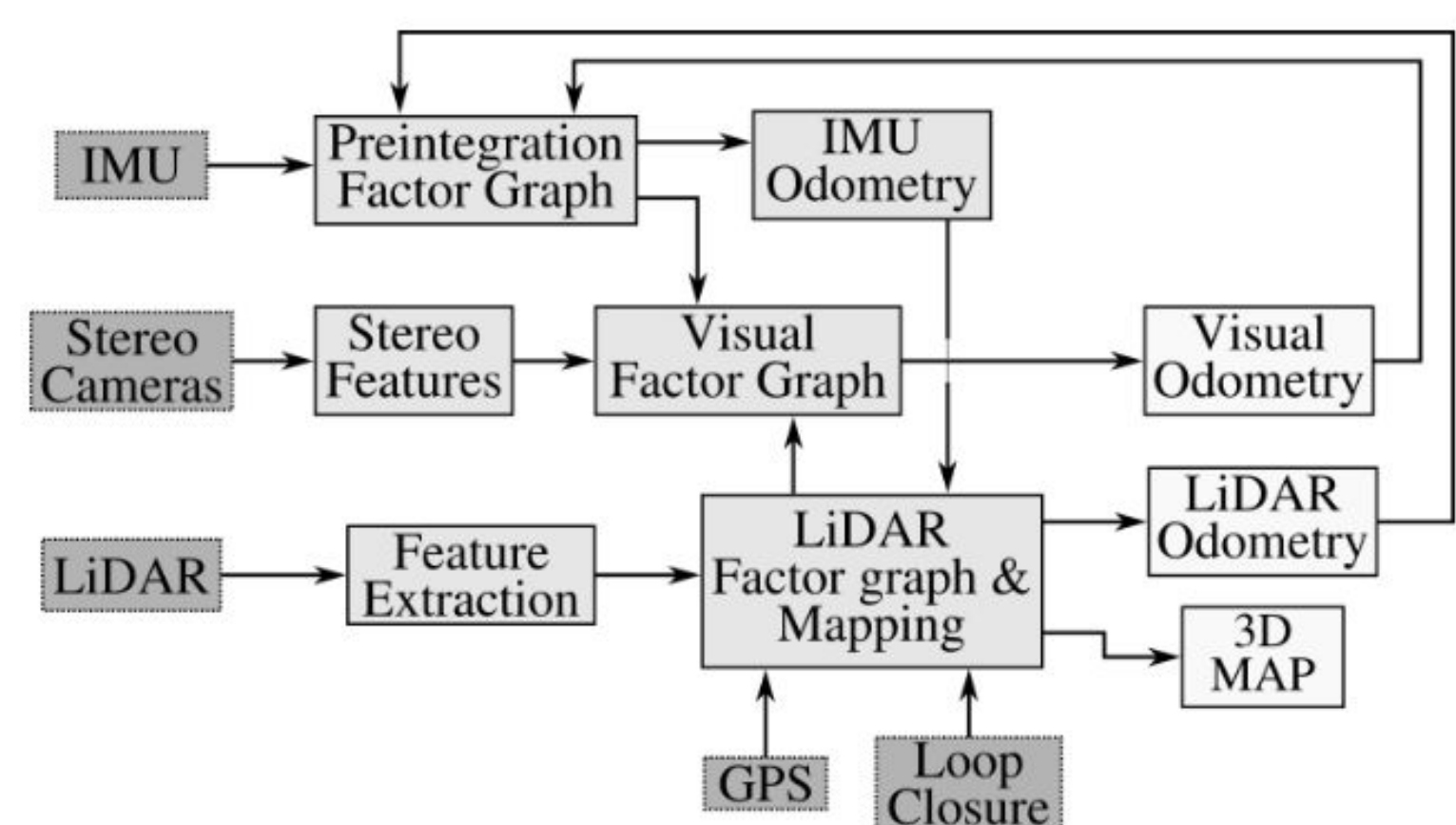


Fig. 4: Overview of multi-sensor SLAM system

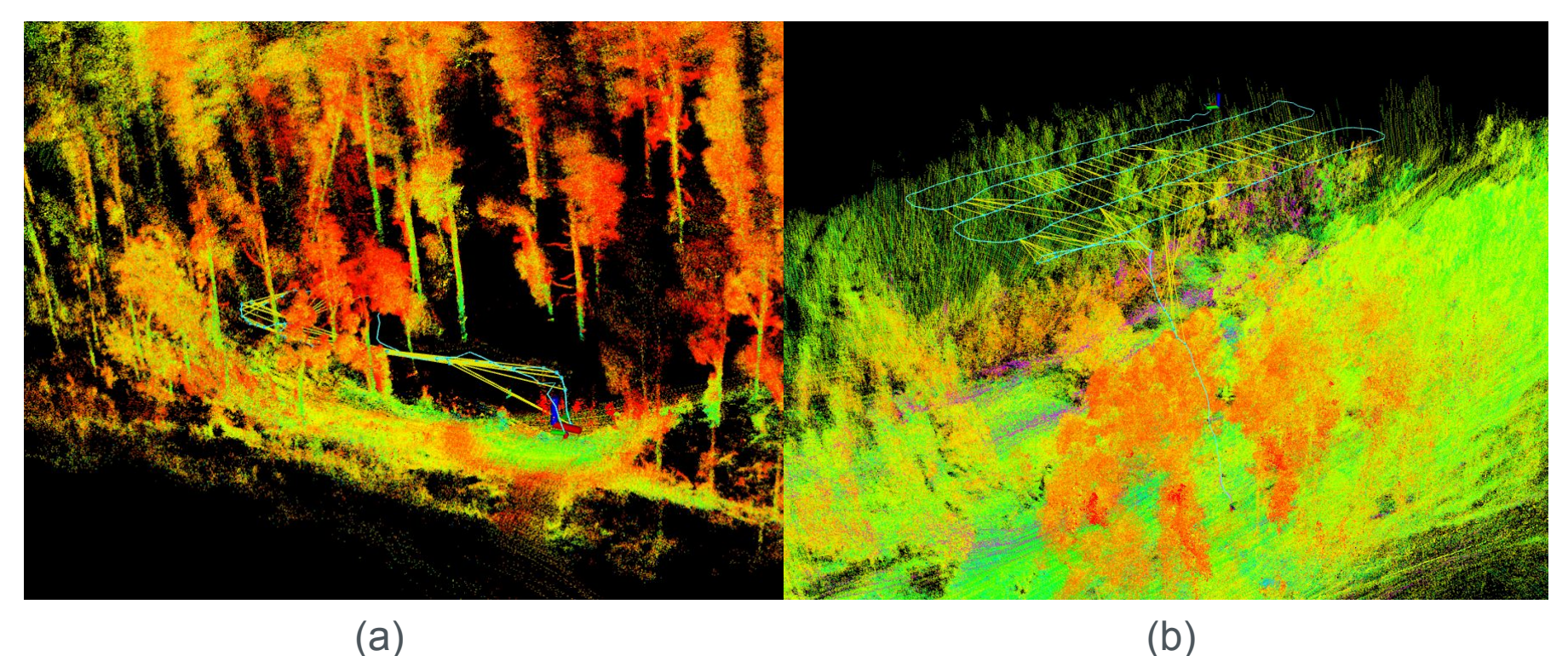


Fig. 5: Field data was processed to generate mapping of forest environment: (a) under-the-canopy, (b) over-the-canopy

Conclusion

- We have designed and tested our modular multi-sensor payload in a forest environment and have successfully generated a 3D mapping of the environment.

References

[1] Russell, David J., Tito Arevalo-Ramirez, Chinmay Garg, Winnie Kuang, Francisco Yandun, David Wettergreen, and George Kantor. 2022. "UAV Mapping with Semantic and Traversability Metrics for Forest Fire Mitigation." IEEE International Conference on Robotics and Automation (ICRA): Workshop in Innovation in Forestry Robotics: Research and Industry Adoption (IFRRIA).