Hazard Detection and Avoidance for Asteroid Landing

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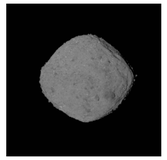


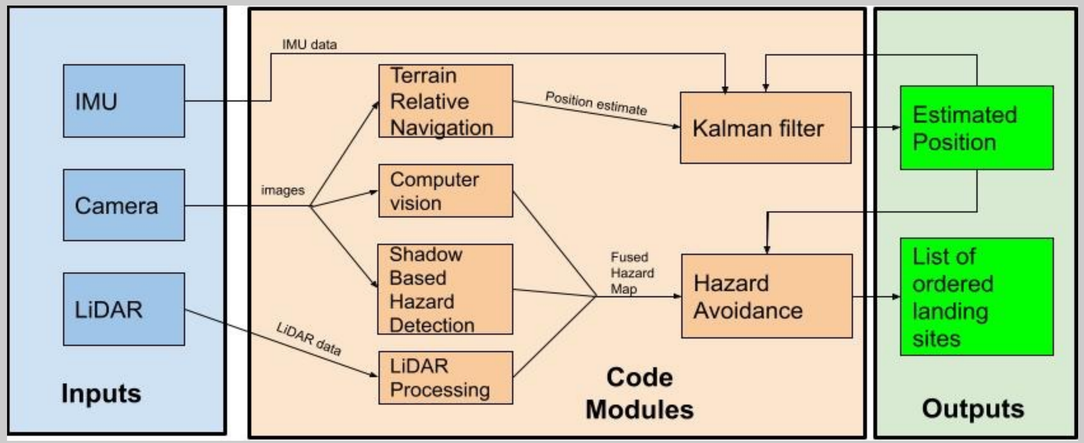
Problem

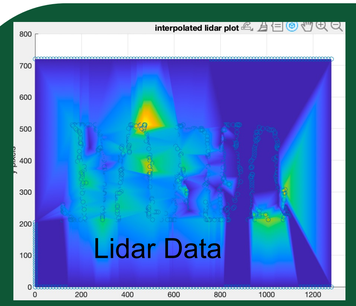
Landing on an asteroid is hazardous for the rover due to the possibility of collision with a large boulder or sharp rock. A hazard detection system is needed to detect inadequate landing sites on the asteroid and protect the rover and potentially any humans on board.

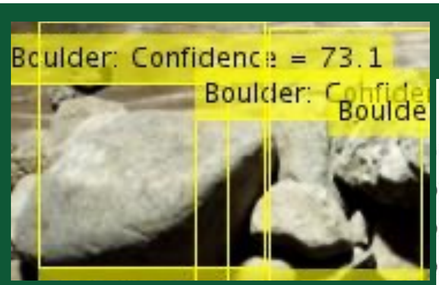
Project Overview

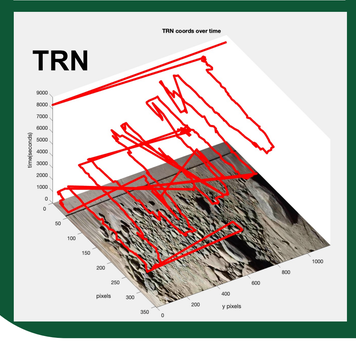
- Using IMU data and Terrain Relative Navigation (TRN) data in a Kalman filter, found the location of the drone in space with relation to the set
- Using that coordinate system, created a point cloud of Lidar data to create a hazard map
- Used Computer Vision and Shadow Detection to find boulders
- Created a combined hazard detection map to show where was safe to land

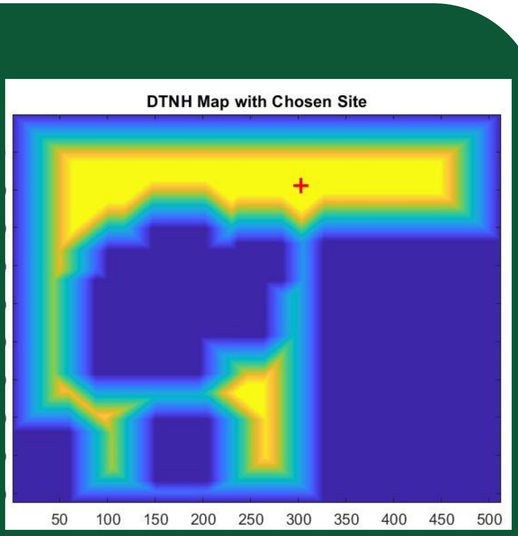
System Diagram





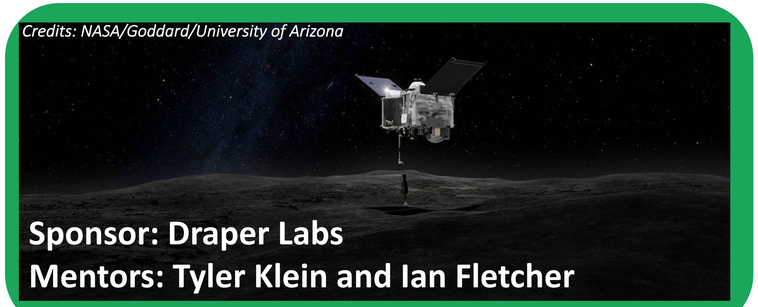






Future Improvements

- Improve run time
- Detect other surface features (ex: angle, roughness)
- Increase avoidance algorithm complexity
- Incorporate into closed loop flight



Results & Conclusions

- Built asteroid set
- Collected LiDAR, camera, and IMU data of set
- Processed camera images
- Detected boulder hazards in images
- Detected sharp terrain and large boulders through Lidar data
- Chose safe landing site based on hazard locations from Lidar, Computer Vision and Shadow methods combined