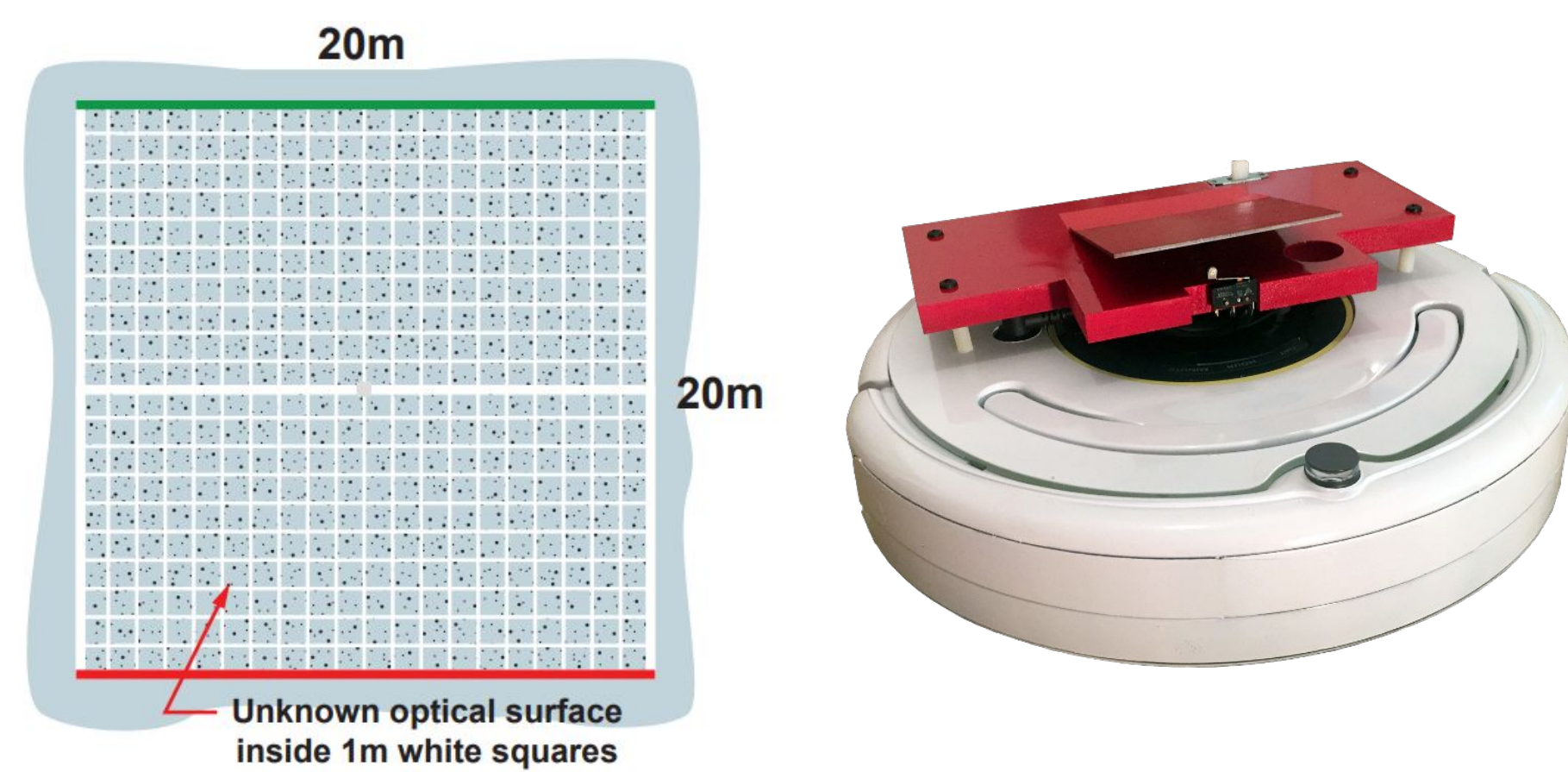


Autonomous Flight and Interaction with Moving Targets

IARC 2017 Mission 7, Robotics and Automation Society, University of Pittsburgh

Competition Rules

The goal of IARC Mission 7 is to guide ground robots through physical interaction with an autonomous drone.

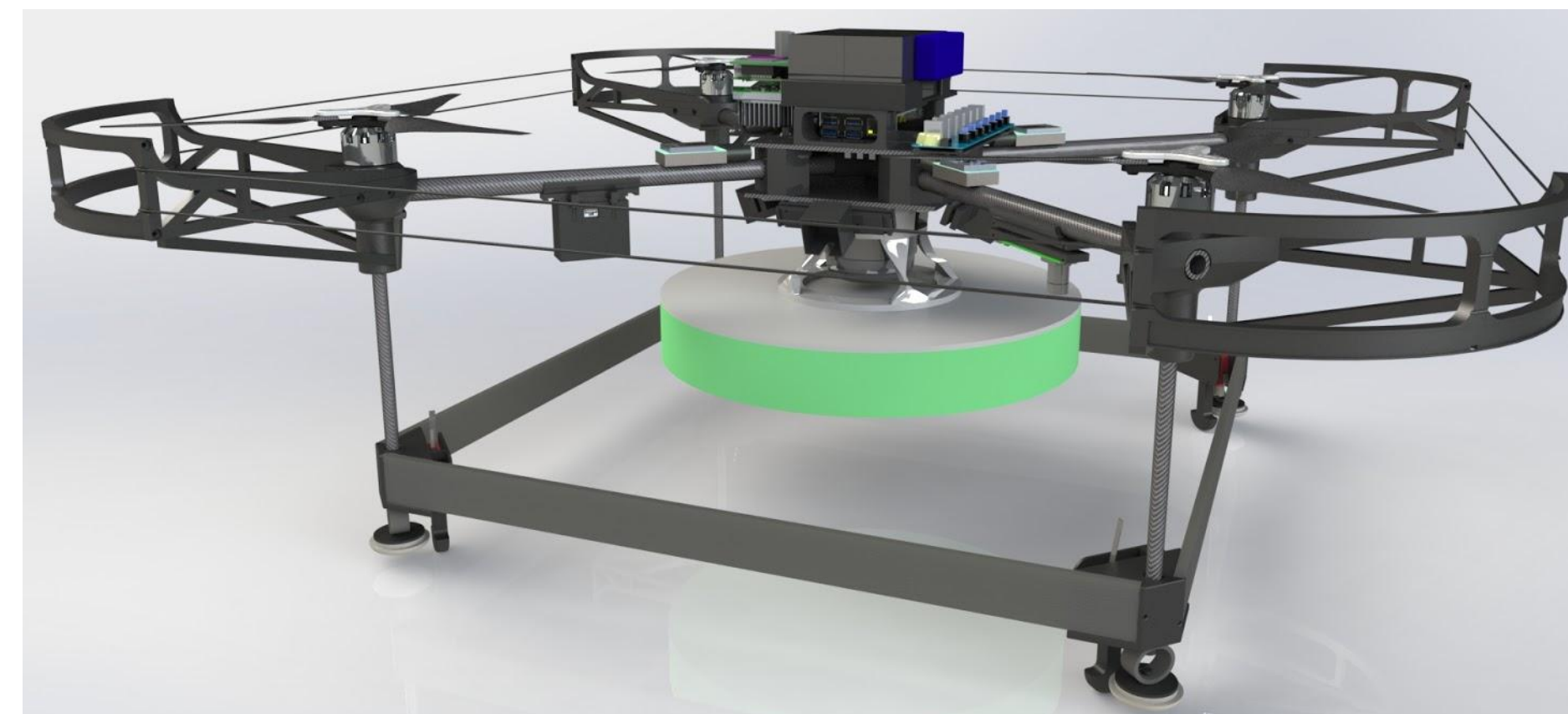


Rules:

- Top switch turns the robot 45 degrees
- Front bumper turns the robot 180 degrees
- Must get 4 robots across the green line
- 10 minutes of flight time allowed
- Autonomous from takeoff through landing
- No external navigation aids (GPS, SLAM)

Competition Results

- Demonstrated autonomous flight
- Awarded "System Design"
- Highest American Venue



Overall Design Concepts

Carbon Fiber Core

- Unidirectional pultruded tubes for arms and landing gear
- Stacked carbon fiber plates in center

3D-Printed ABS Brackets

- Fail first to protect expensive carbon fiber
- Easy to replace

High- and Low-Voltage Wiring Harnesses

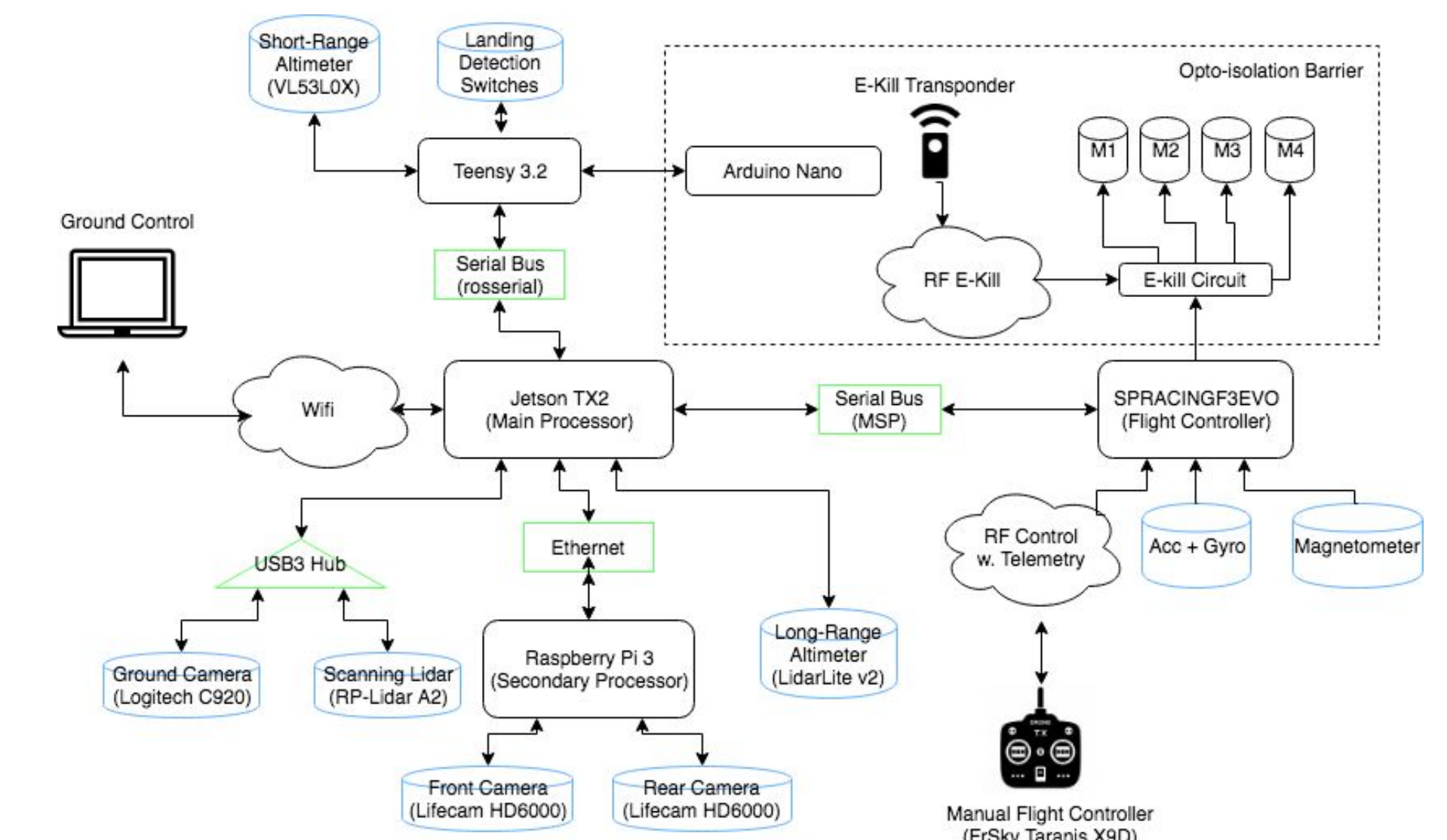
- Opto-isolation barrier to protect electronics from voltage spikes

Software Design using ROS

- Approximately 10 custom packages for perception, localization, planning, and AI

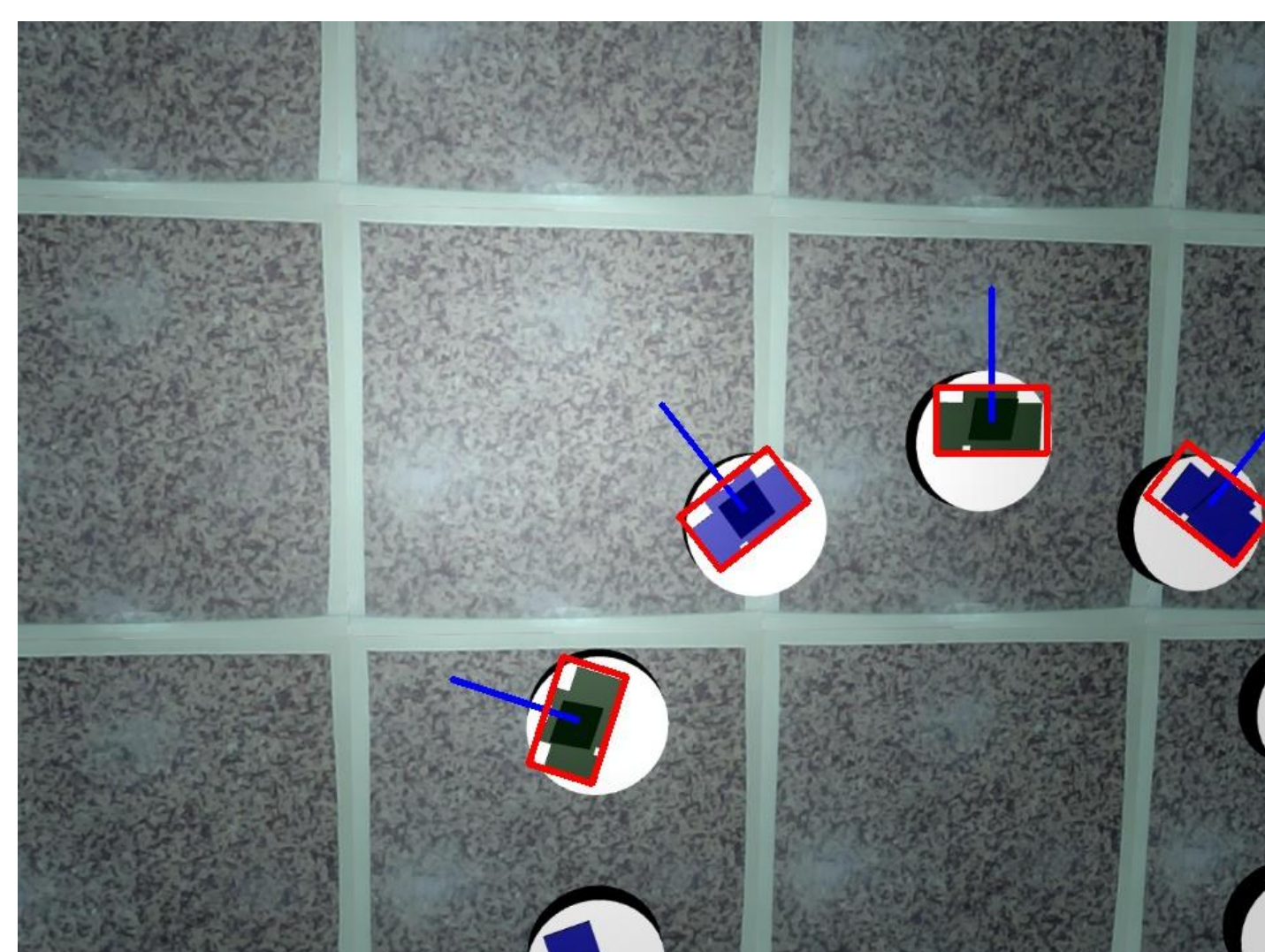
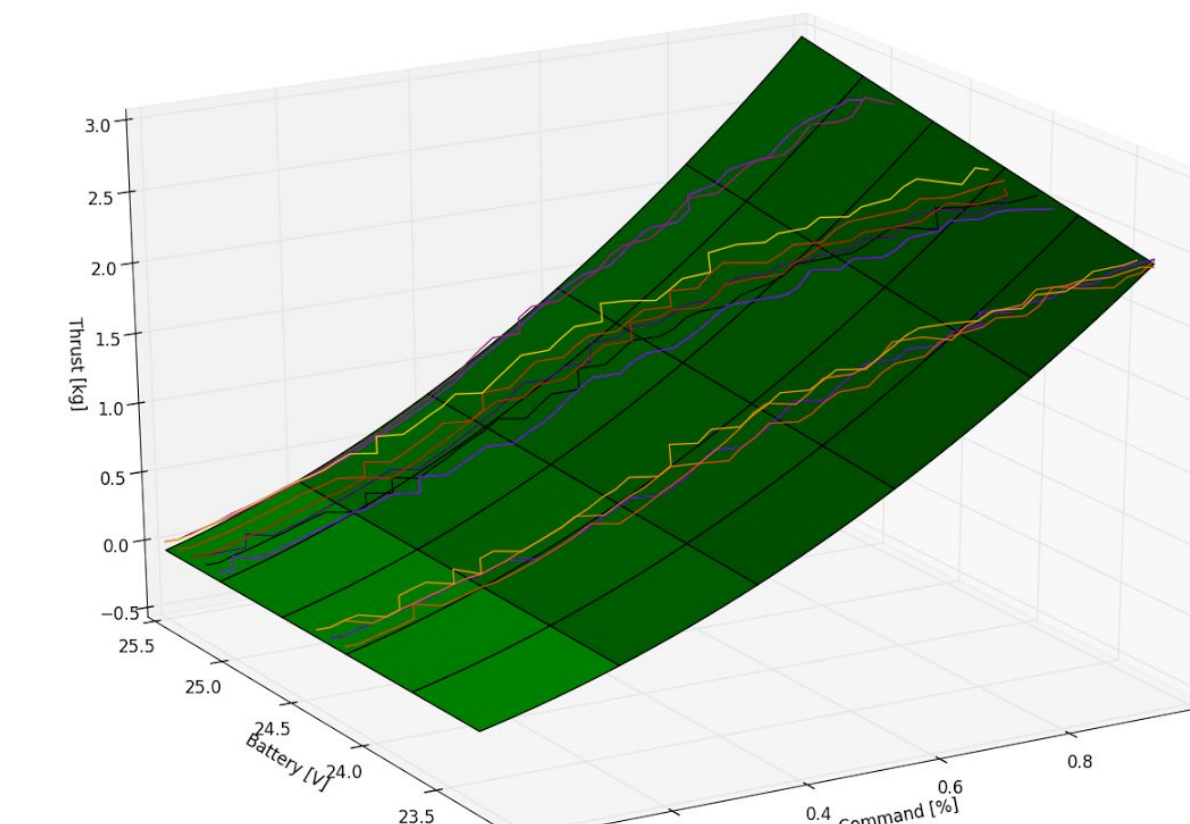


System Architecture



Takeoff Calibration

- Contact switches on landing gear allow us to measure our throttle at the moment of takeoff
- This information is used to calibrate a model that allows the drone to calculate the throttle it needs to achieve a desired thrust at the current altitude and battery voltage



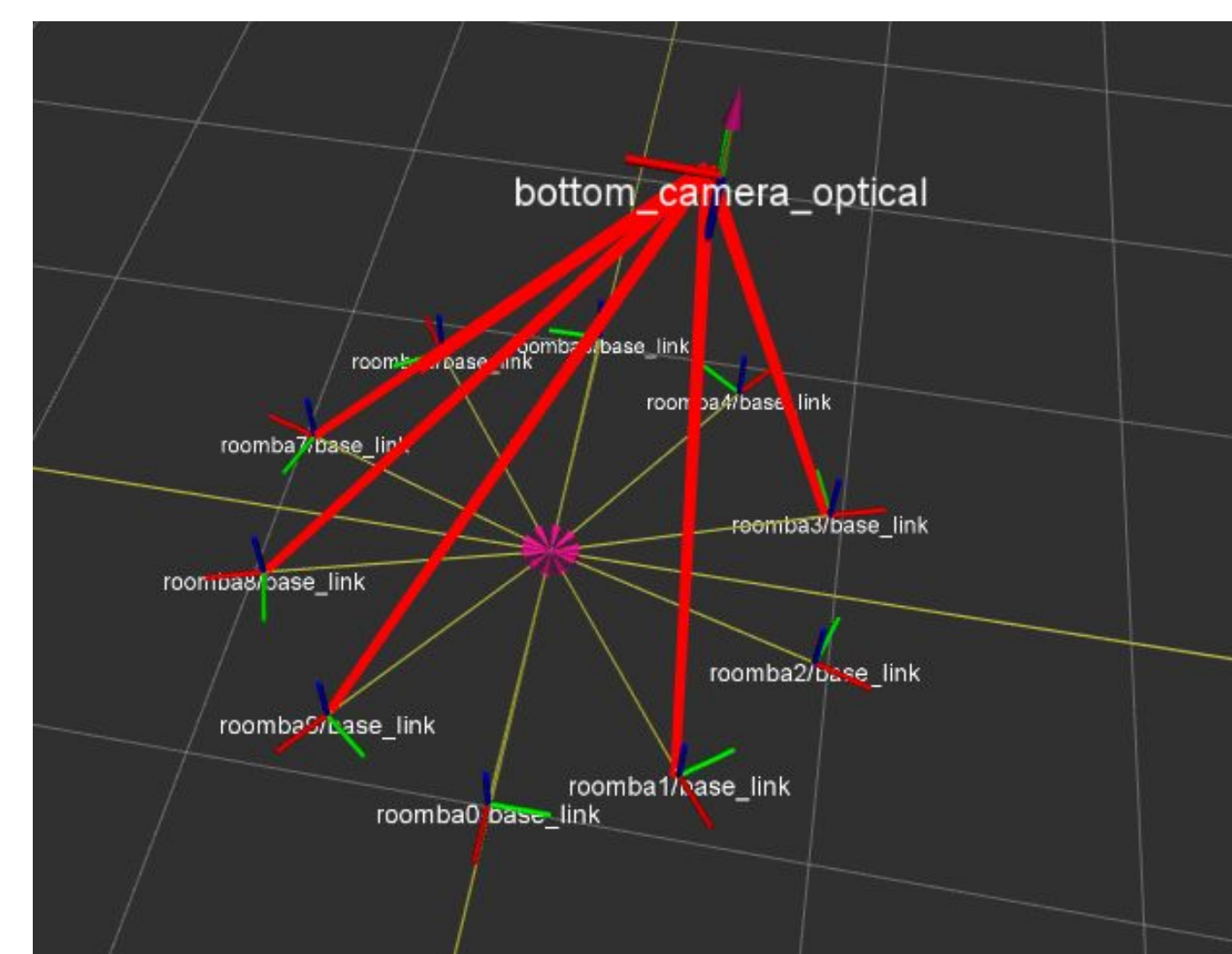
Ground Robot Tracking

Downward-facing camera

- Generalized Hough Transform to find top plates based on edges from Canny edge detector on saturation

Side cameras

- HSV slice to select for top plate colors



Obstacle Detection

RPLIDAR A2

- Planar scanning LIDAR, 1° angular resolution, 6m max range
- Points are clustered, then each cluster is fit to a circle representing the boundary of the PVC pipes on top of the obstacle robots

