

CYBER PHYSICAL SYSTEMS VIRTUAL ORGANIZATION CHALLENGE 2021

MOHIT MATHUR

(TEAM GREEN)

TARAPREETH MUTYALA

LUNAR LANDER EXOCAM -- EARTH ANALOG

- Themed around NASA TestFlight's Lunar Exocam project.
- Challenge includes three stages with aim to throw a sensor probe using a multi-rotor drone .
- Iris IF750a drone with PX4 autopilot stack

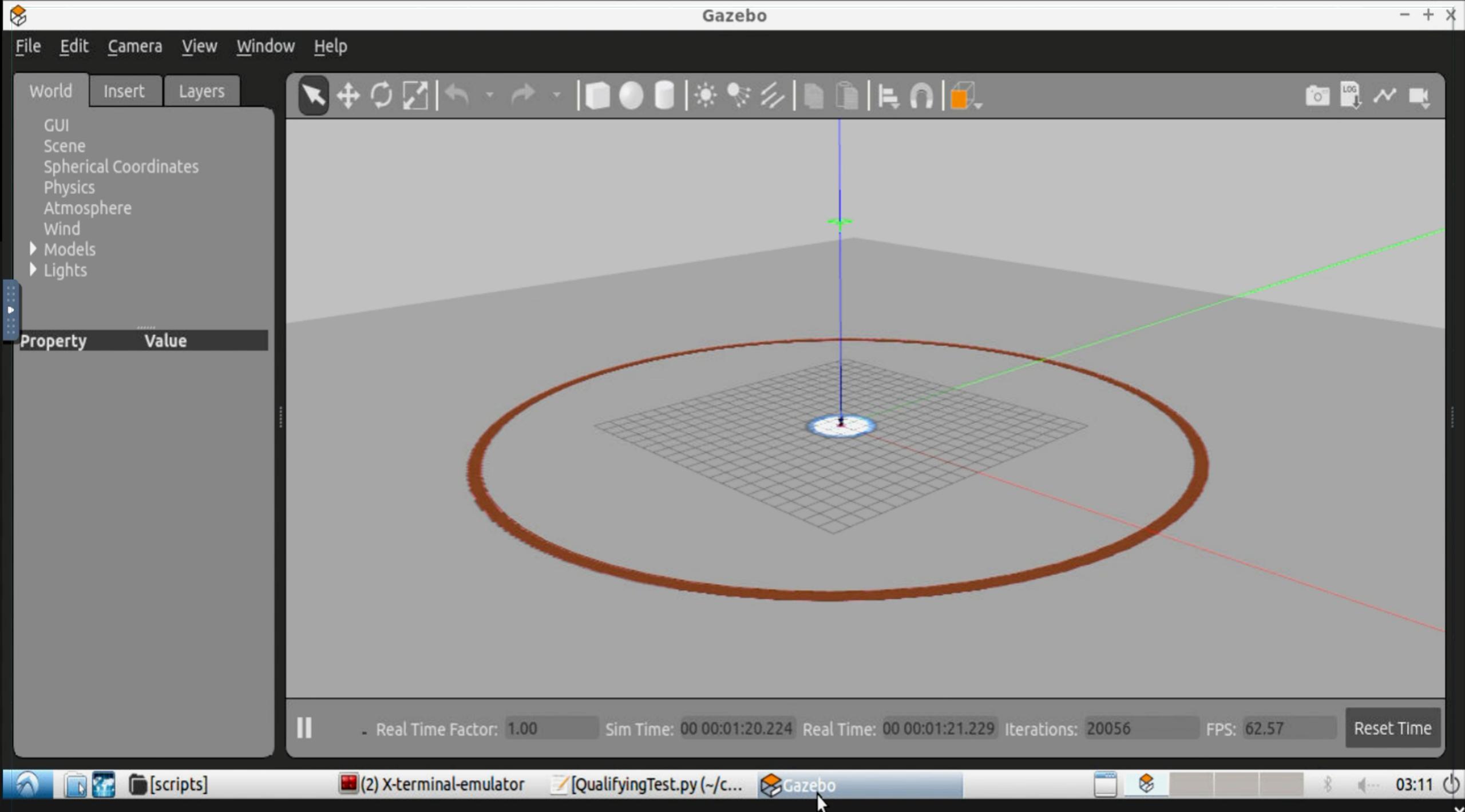
QUALIFICATION ROUND

- **Objective**

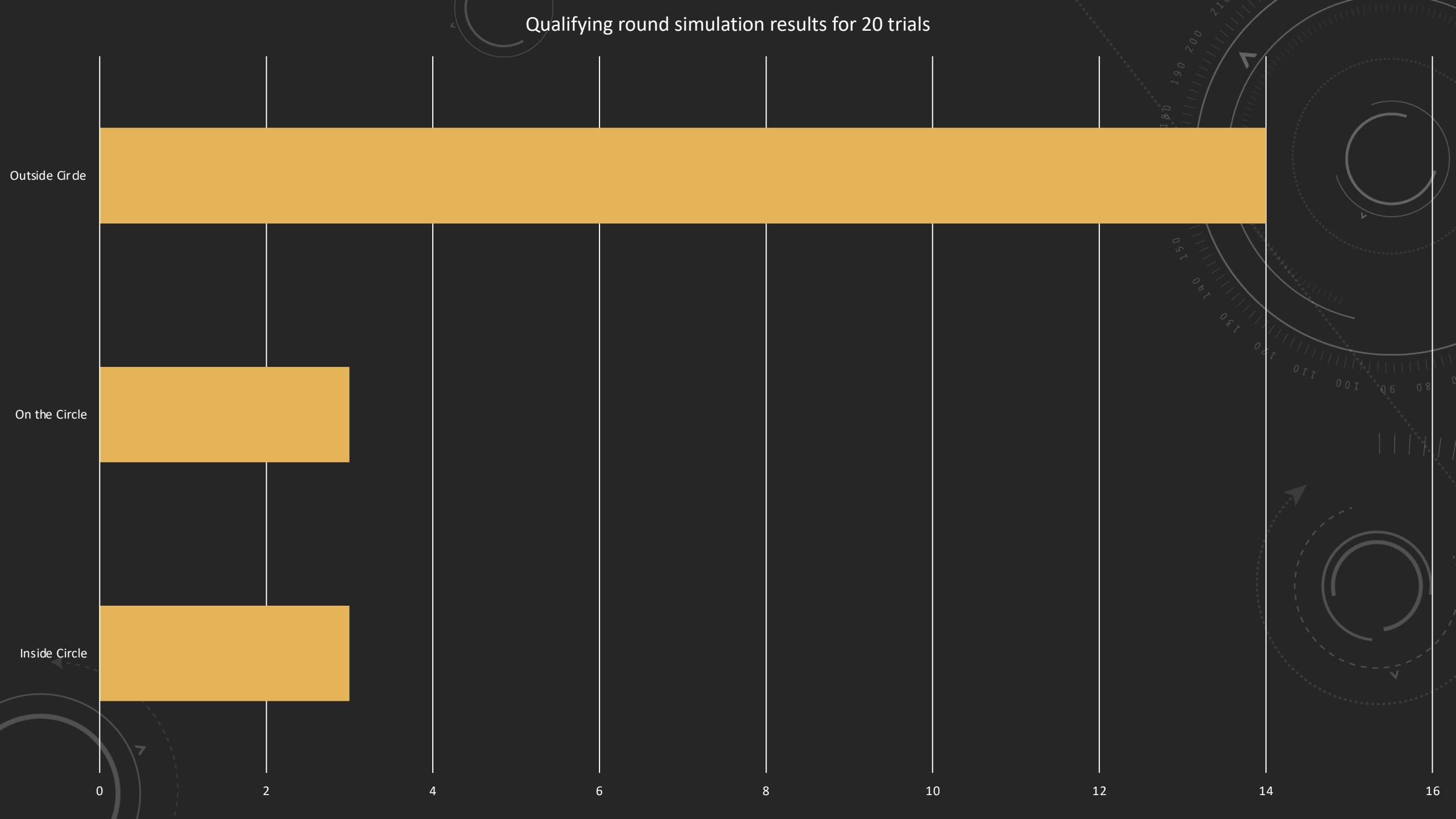
- To throw the probe using the UAV at least 20m away (outside the circle).

- **Implementation**

- UAV ascends to a height of 15m along the z axis.
 - Shifts to Belly-Flop mode and throws the probe at pitch value 0.5



Qualifying round simulation results for 20 trials



PHASE 1-A

- **Objective**

- Use the UAV to throw the probe attached as close as possible to the given 2D target

- **Implementation**

- UAV ascends to 15m along Z-axis
- Performs the Belly-flop maneuver and detaches the probe at pitch value 1.4
- Parachute deploys after 1.98 seconds



Gazebo

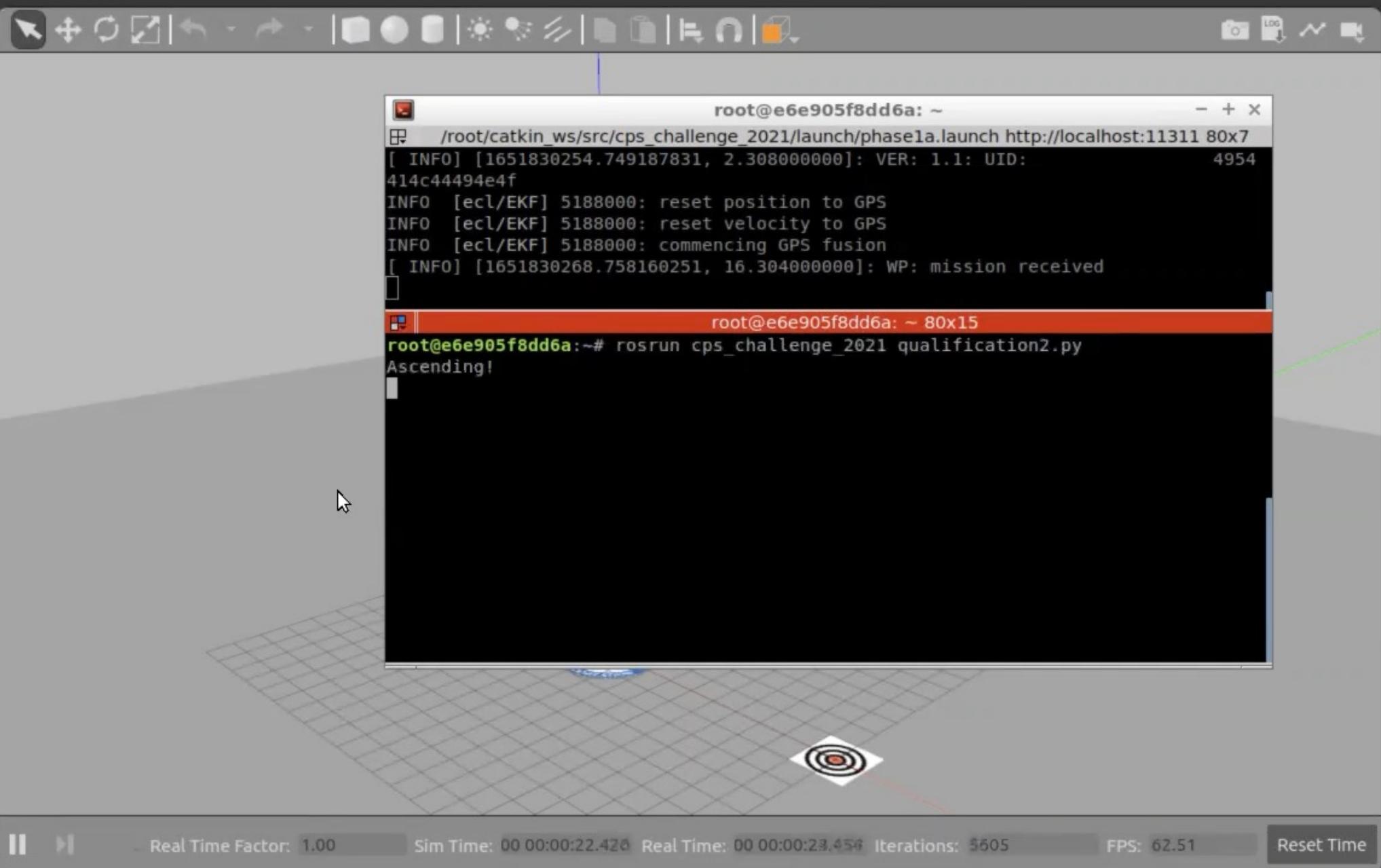
- + ×

File Edit Camera View Window Help

World Insert Layers

GUI
Scene
Spherical Coordinates
Physics
Atmosphere
Wind
Models
Lights

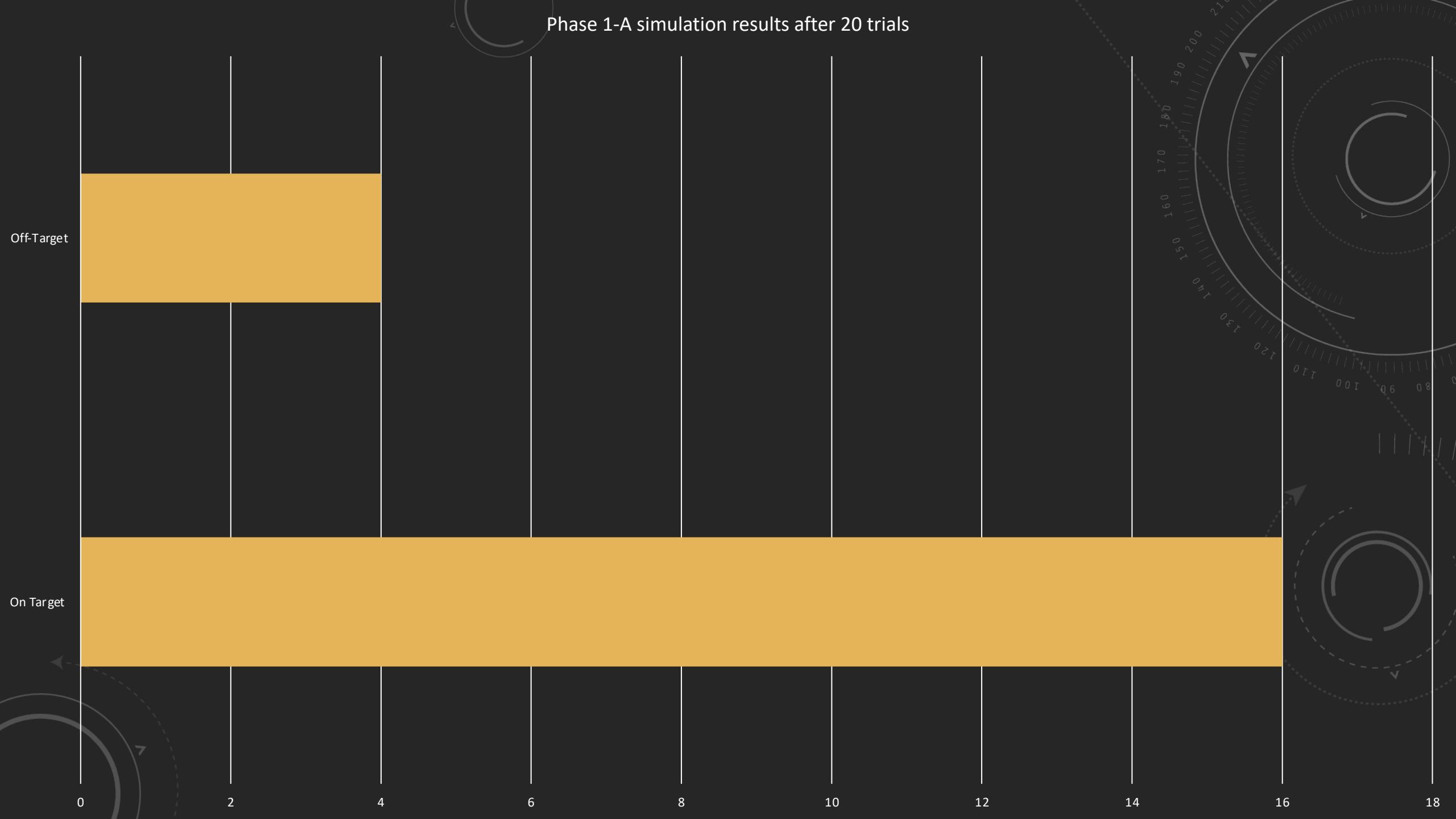
Property Value



root@e6e905f8dd6a: ~

cps_challenge_2021 - q... Gazebo

Phase 1-A simulation results after 20 trials



PHASE 1-B

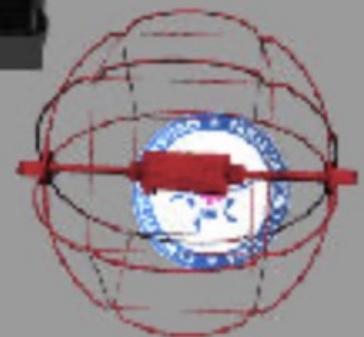
- **Objective**

- Throw the probe attached to the UAV on the trunk of the Polaris Ranger which is to be detected using the onboard camera.

- **Implementation**

- Detect black pixelated area using masks and morphological transformations.
- Mark a rectangle around the area.
- Find centroid of the rectangle as desired throw target.
- Turn the rover to the target and throw
- Fine tune the parachute deploy time, pitch value and angular velocity.

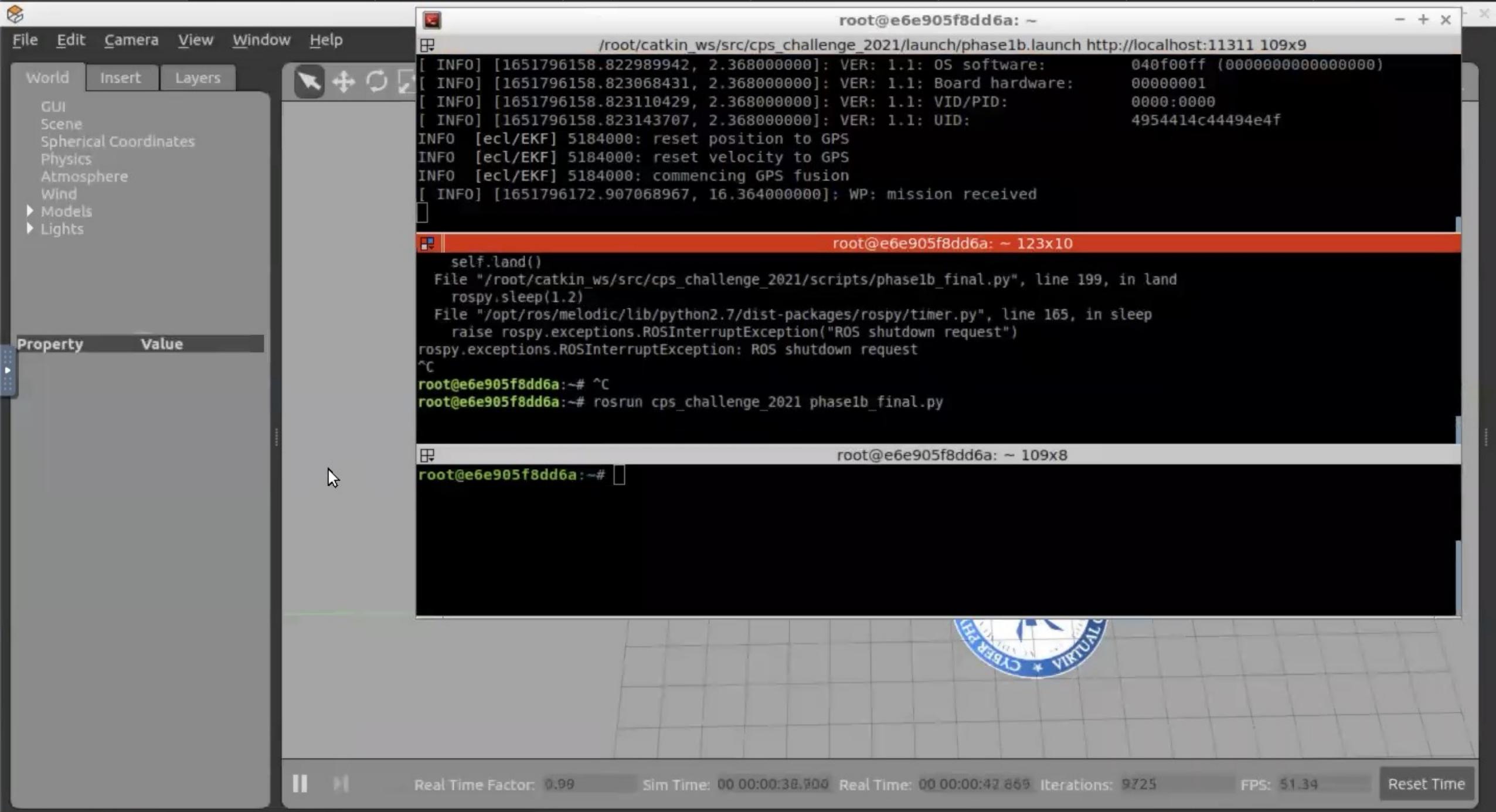




2



200
210



Phase 1-B simulation results after 20 trials

Off the rover

On the Trunk

