Assignment

Luis Manuel

February 2026

The implemented code is available at Luis Assignment Github Repository.

1 Task 1

A mars explorer ground robot, namely nasa perseverance, is simulated leveraging the existing Gazebo environment from Space Robotics Github. The environment is depicted in Figure 1.

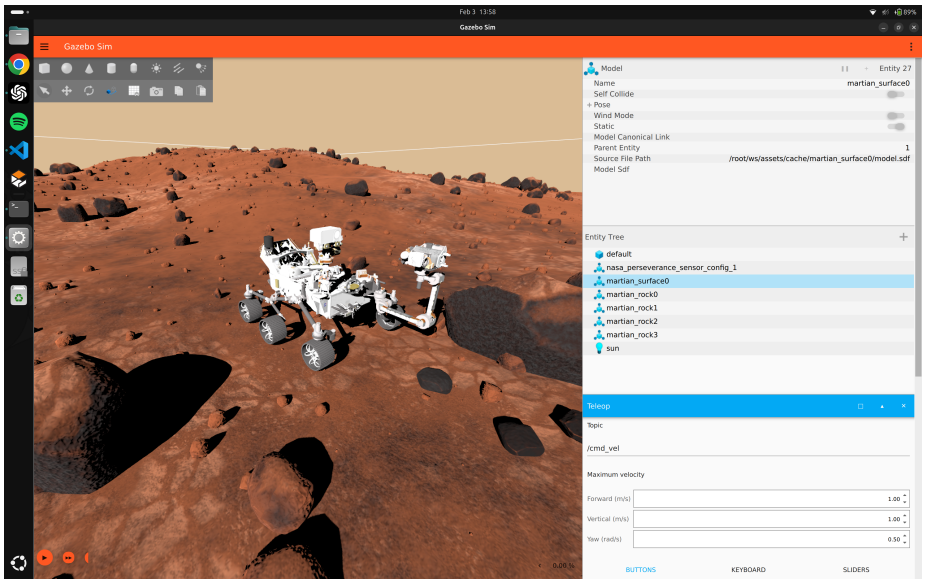

Figure 1: Simulated Gazebo environment.

The simulated robot provides pose, odometry and velocity data through Gazebo topics. Similarly, it is controlled through linear and angular velocity commands sent to *cmd_vel* topic. The velocities are constraint to $[-5, 5]$ and to $[-1, 1]$ for linear and angular velocities respectively.

Therefore, a circular path can be simulated by sending simultaneously linear and angular velocity commands.

2 Task 2

For navigation purposes, sensors should be incorporated into the simulated robot model. Hence, a 3D LiDAR sensor can be added to visualize the surrounding environment and to detect obstacles.

Subsequently, collision boxes should be defined for the robot model to enable obstacle detection. This can be achieved by modifying the robot's URDF or SDF files to include appropriate collision elements that represent the physical boundaries of the robot.

For a more robust pose estimation, an Extended Kalman Filter (EKF) can be implemented to fuse data from LiDAR odometry, IMU, and wheel odometry (these sensors would also need to be added to the simulation).

3 Task 3

4 Task 4