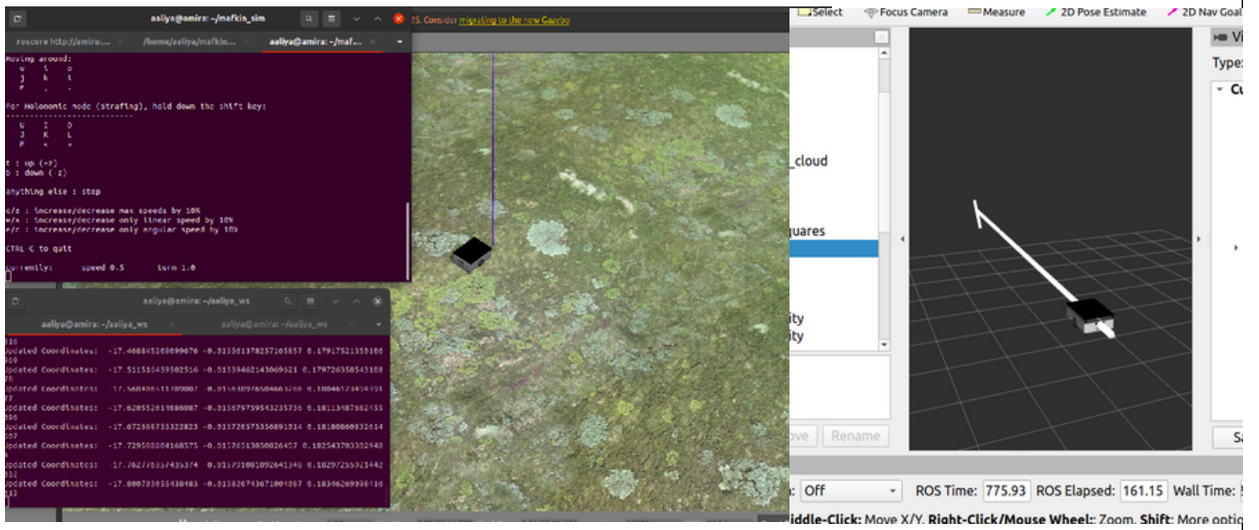
Title - IMU-Based Surface Mapping for Differential Drive Mobile Robots

Team - Atman Utkarsh Kikani 22BRS1253

Abstract:

This paper presents an IMU-based approach for terrain mapping and odometry in a two-wheeled differential drive robot. Using three IMUs to capture relative wheel–body orientation, the system estimates motion without encoders and reconstructs the surface through vector integration. Tested in Gazebo with ROS Noetic, it achieves reliable trajectory estimation and sparse surface mapping, offering an efficient solution for low-cost navigation over uneven terrain.

Output (RViz + Gazebo)



Introduction:

This project develops an IMU-based sparse terrain mapping and odometry system for a two-wheeled differential drive robot operating on hilly terrain.

Three IMUs—mounted on each wheel and on the body—measure relative orientation to infer wheel rotation and vehicle motion without encoders. The body IMU's direction vector guides vector integration for surface reconstruction, generating a sparse 3D profile of the traversed path.

Implemented in Gazebo under ROS Noetic, the setup employs bias-aware filtering, slip detection, and zero-rate updates to stabilize orientation estimates. Evaluation metrics such as path RMSE, endpoint drift, and elevation error confirm reliable mapping and odometry performance in GPS-denied, uneven environments.

Diagram: