Robot Localization with ROS: Final Presentation (Steps 1–3)

Mini-Project 1 Final Report

Nicholas Birch de la Calle (IST1116701)
Antonio Maria Trigueiros de Aragão Moura Coutinho (IST196837)
Gabriel Badan (IST1116537)
Janaína da Silva Pacheco (IST1117233)

Instituto Superior Técnico

September 24, 2025

Outline

Scope for This Week

- **Step 1 (Done):** Compare `/odom` and `/odometry/filtered` against mocap ground truth
- **Step 2 (In progress):** Built a map from the real robot; created a playback `.bag`
- **Step 3 (Planned):** Navigation on the built map (AMCL + move_base) with simple waypoint demo
- Same workflow: short syncs, shared checklist, pair-debug on TF/time alignment

What We Compared (Method)

- Topics: `/odom` (wheel odom), `/odometry/filtered` (EKF), mocap ground truth in TF
- Aligned frames: `odom` as fixed frame; mocap link chained via provided TF to `base_footprint`
- Time-sync: used rosbag timestamps; checked for TF extrapolation and IMU delays
- Metrics: lateral/longitudinal error and heading error over time; simple RMSE summary

Results (Simple Takeaways)

- **Tracking:** EKF `/odometry/filtered` follows mocap closely; reduces wheel-odom drift
- **Turns:** Largest error spikes during fast yaw rotations (IMU bias not fully compensated)
- **Numbers:** Example RMSE (x,y): *[fill in]* m; heading RMSE: *[fill in]* deg
- **Bottom line:** EKF improves consistency and stability vs raw odometry

Trajectories vs Ground Truth

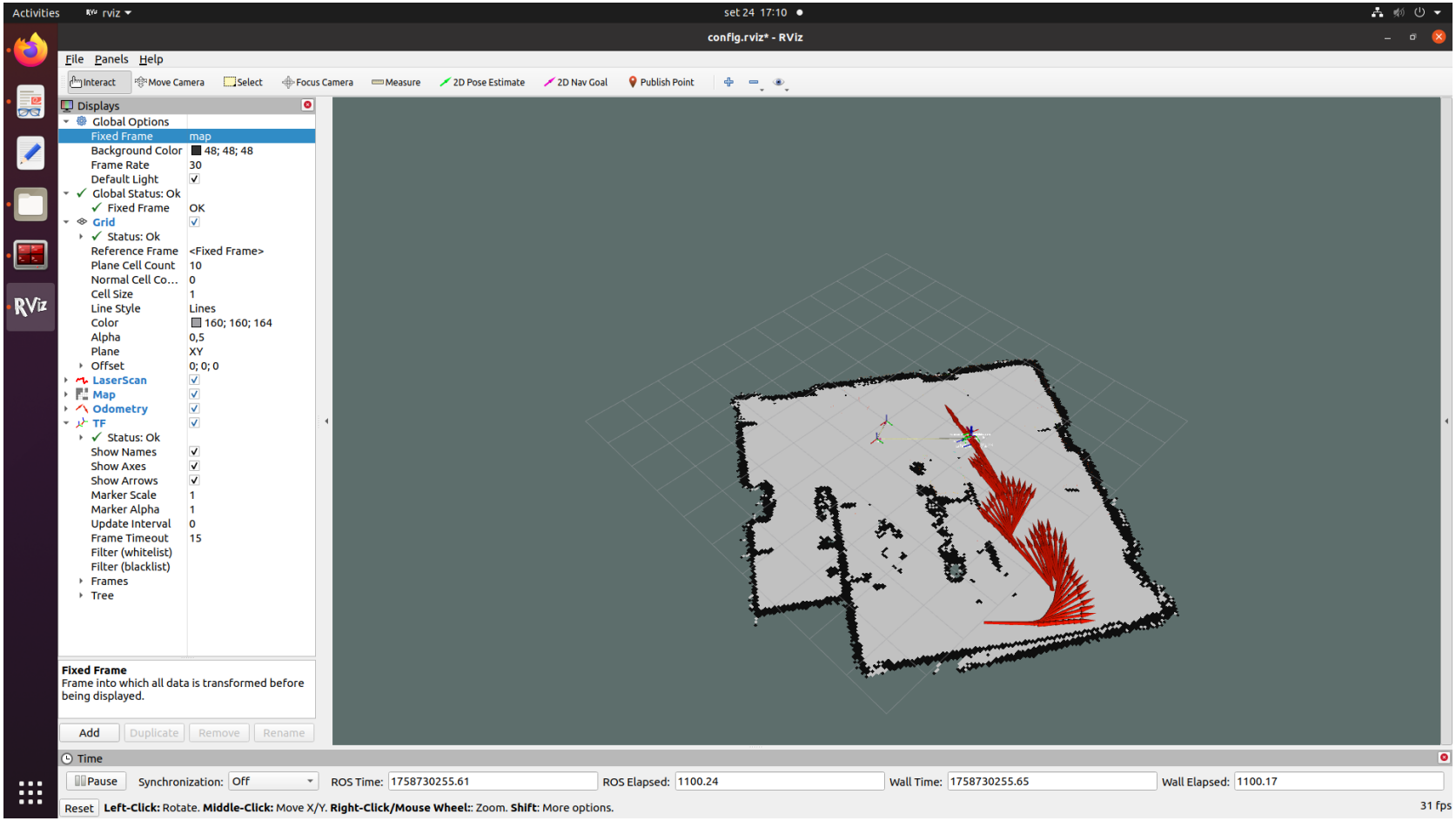
[Insert trajectory plot: mocap (black), odom (orange), filtered (red)]

Fixed Frame: `odom`; Data source: recorded rosbag from the TurtleBot3

Mapping Pipeline

- Inputs: `/scan`, `/tf`, `/odom` (filtered odom optional for stability)
- Tool: `gmapping` (2D occupancy grid)
- Procedure: teleop + slow loops; then saved map and a playback bag containing map + robot motion
- Validation: visualized map in RViz; checked TF continuity during playback

Resulting Map (Preview)



Resolution: *[fill in]* m/px; Area covered: *[fill in]* m^2; Loop closures: *[observed/rare]*

Playback Bag and Demo

- Created a `.bag` with map and robot playback for reproducible demos
- Makes it easy to re-run RViz overlays and evaluate localization on the fixed map
- **Next:** Use this bag to test AMCL and compare pose vs ground truth trajectory

[Optional: insert screenshot of playback]

What We Will Deliver

- **Localization on Map:** AMCL tuned with correct laser/TF frames
- **Navigation:** `move_base` with simple global/local planners; 2–3 waypoint demo
- **Safety:** costmap inflation + obstacle layer; conservative speeds
- **Evaluation:** path tracking error vs planned path; success rate on short routes

Final Remarks

Progress Summary

Step 1 completed with mocap comparison; Step 2 mapping underway with a usable occupancy grid and playback bag.

Next Steps

1. Fill in quantitative RMSE numbers and insert figures
2. Bring up AMCL + move_base on the saved map
3. Record short navigation demo and summarize tracking error

Thank you for your attention!

Questions?