Robot Localization with ROS: EKF-based Sensor Fusion Implementation

Mini-Project 1 Progress Report

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September 18, 2025

Outline

1. Team & Scope

2. Project Overview

3. Status & What's Next

Team Workflow & Scope for This Week

- All teammates use macOS; VMs made Wi-Fi connection to the robot tricky.
- We split work to move faster:
  - **Group A:** Fix connectivity to the real robot (prep for mapping in Step 2).
  - **Group B:** Use the dataset (.bag) and implement Step 1 (EKF with `robot_localization`).
- Collaboration: shared notes, common checklist, quick pair-debug sessions on TF and timing.
- **This presentation:** Focus on Step 1 progress with the dataset. Step 2 will follow next week.

Project Objectives

Main Goal

Implement and test robot self-localization using Extended Kalman Filter (EKF) based localization with ROS `robot_localization` package

- **Platform:** TurtleBot3 Waffle Pi with real sensor data
- **Sensors:** IMU, wheel odometry, laser scanner
- **Method:** EKF-based sensor fusion
- **Data:** Pre-recorded rosbags with ground truth from Motion Capture System
- **Framework:** ROS Noetic environment

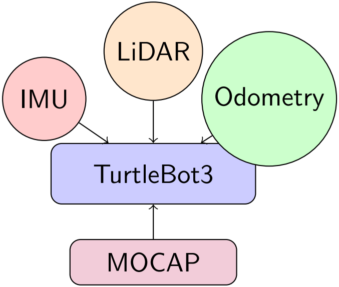
Key Learning Outcomes

Understanding Bayesian filtering, ROS navigation stack, and practical sensor fusion implementation

Dataset Information

What's inside:

- Wheel odometry (`/odom`)
- IMU measurements (`/imu`)
- Laser scans (`/scan`)
- Ground truth in TF (`mocap` but not used this week yet)
- Camera topics are present but not used this week



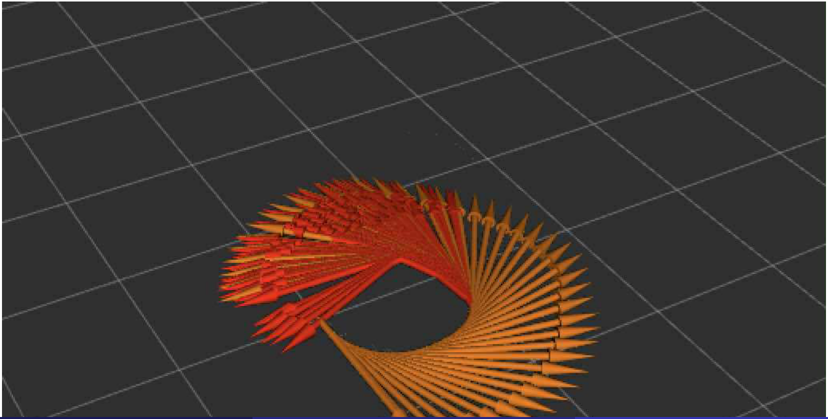
Dataset source:
`https://github.com/irob-labs-ist/turtlebot3_datasets`
This week we did not use the helper TF script and we did not compare to mocap yet.

Status and Next Steps

- **Status:** EKF running on the dataset; we compared `/odom` (orange) vs `/odometry/filtered` (red) in RViz.
- **Observation:** There is a small, slow drift between the two trajectories.
- **Next:** Extract mocap ground-truth trajectory and quantitatively compare against both.
- **Coming up:** Map-based trajectory comparison and gmapping with the real robot (Step 2).

RViz Trajectory Comparison

- **Fixed Frame:** `odom`.
- **Odometry (orange):** `/odom`
- **Filtered odometry (red):** `/odometry/filtered`
- We did not use the map-based trajectory yet, that's for next week.
- We can see a slow drift between the two. To know which is more accurate, we'll extract the mocap ground-truth trajectory next week and compare.



Final Remarks

Progress Summary

Successfully established a working EKF setup with visual comparison between odometry and filtered odometry. We kept the analysis simple and focused on Step 1.

Next Session Goals

1. Extract mocap ground-truth trajectory and align frames
2. Quantitatively compare mocap vs `/odom` and `/odometry/filtered`
3. Add map-based trajectory comparison
4. Prepare for Phase 2: SLAM with gmapping

Thank you for your attention!

Questions?