

Tucker Guen - Project 1

Project Overview

Although all files are well commented and their purposes should be apparent, here is an overview of the important files and their purposes:

- config_ws.m - Sets up the project workspace, adding variables for the map, initial states and beliefs, motion command and measurement lists, and evaluates the true robot motion with no motion error.
- EKF.m - Implementation of the extended kalman filter for a single timestep. Takes in the previous state belief, a motion command, a measurement, a map, and error parameters
- EKF_main.m - Runs the extended kalman filter of all timesteps and plots the graph of motion, pre-update uncertainty, and post-update uncertainty
- particle_filter.m - Implementation of the particle filter for a single timestep. Takes in the previous timestep particle set, a motion command, a measurement, a map, and error parameters.
- PF_main.m - Runs the particle filter for all timesteps and plots the pre-update and post-update particle sets.

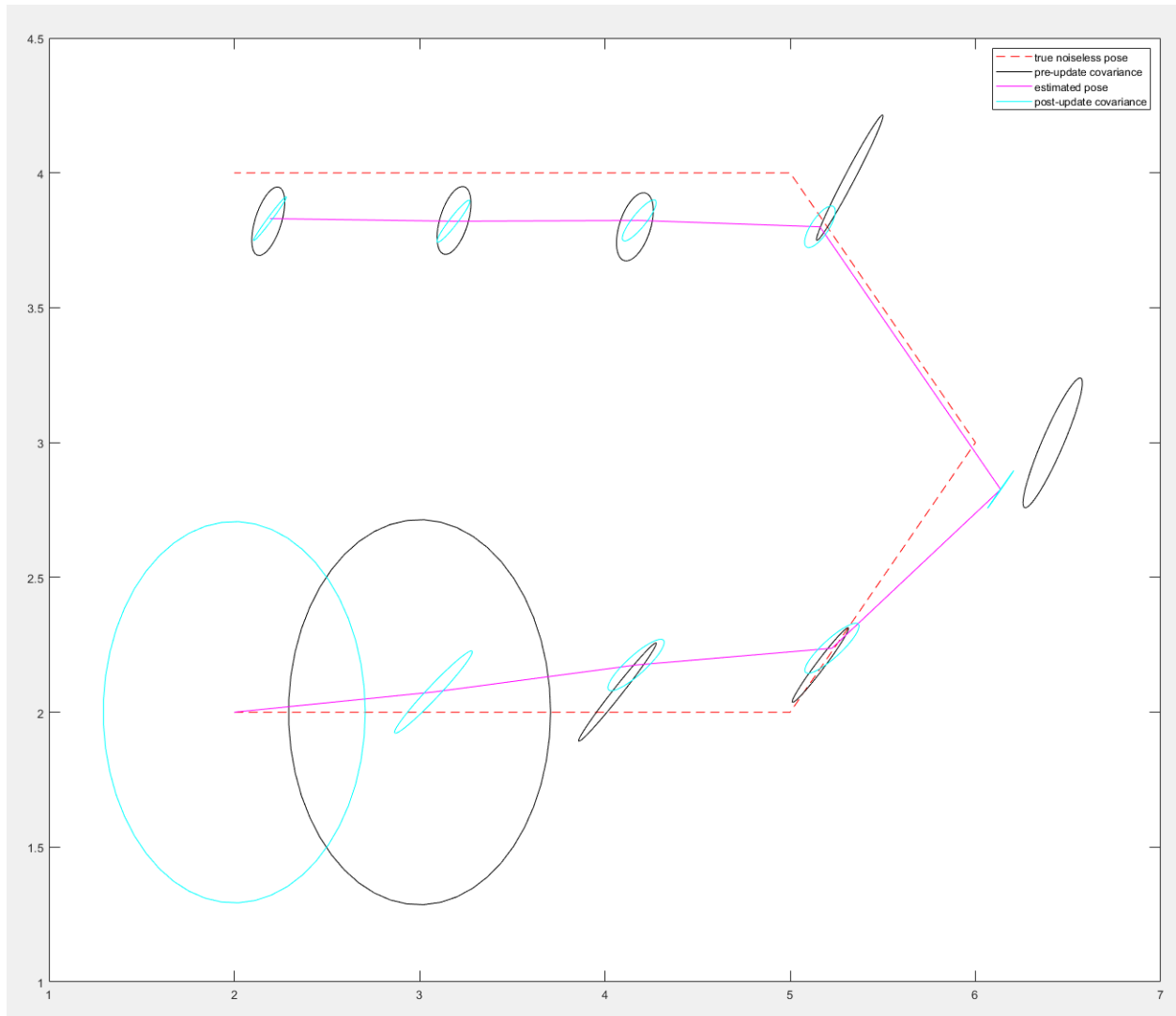
All other files are either classes that serve as abstract data types for storing aspects of the state space, or are scripts with clear purpose.

- Note: plot_gaussian_ellipsoid.m was sourced from:
https://www.mathworks.com/matlabcentral/fileexchange/16543-plot_gaussian_ellipsoid

Extended Kalman Filter

The initial covariance was picked to be a 3×3 identity matrix. The first two circles are of somewhat arbitrary size.

- Legend (also labeled on figure)
 - **Orange dashed line:** True robot motion using velocity motion model with same input commands and no motion uncertainty ($\alpha = [0, \dots, 0]$)
 - **Magenta solid line:** Noisy robot motion computed during each step of the EKF
 - **Black Circles:** The pose covariance ellipse before the measurement update
 - **Cyan Circles:** The pose covariance ellipse after the measurement update



Particle Filter

- Legend:
 - **Orange dashed line:** True robot motion using velocity motion model with same input commands and no motion uncertainty ($\alpha = [0, \dots, 0]$)
 - **Black Dots:** The set of particles before measurement update (resampling)
 - **Cyan Dots:** The set of particles after measurement update

Due to the randomness of resampling, the results of the particle filter can vary, but here are a few good runs that converge well and demonstrate resampling.

