Unscented Kalman Filter Project Starter Code

Self-Driving Car Engineer Nanodegree Program

Overview

In this project an Unscented Kalman Filter is utilized to estimate the state of a moving object of interest with noisy lidar and radar measurements.

Results

The RMSE result of the tracking algorithm meet the challenges of [.09, .10, .40, .30] as long as both, the radar data and the lidar data are used. If only one of the sensor data sets are used the results are significantly worse and do not meet the challenge whereby lidar data only leads to better results than radar data.

the tables below show the RMSE results and the NIS results of lidar data and radar data that were obtained by this implementation.
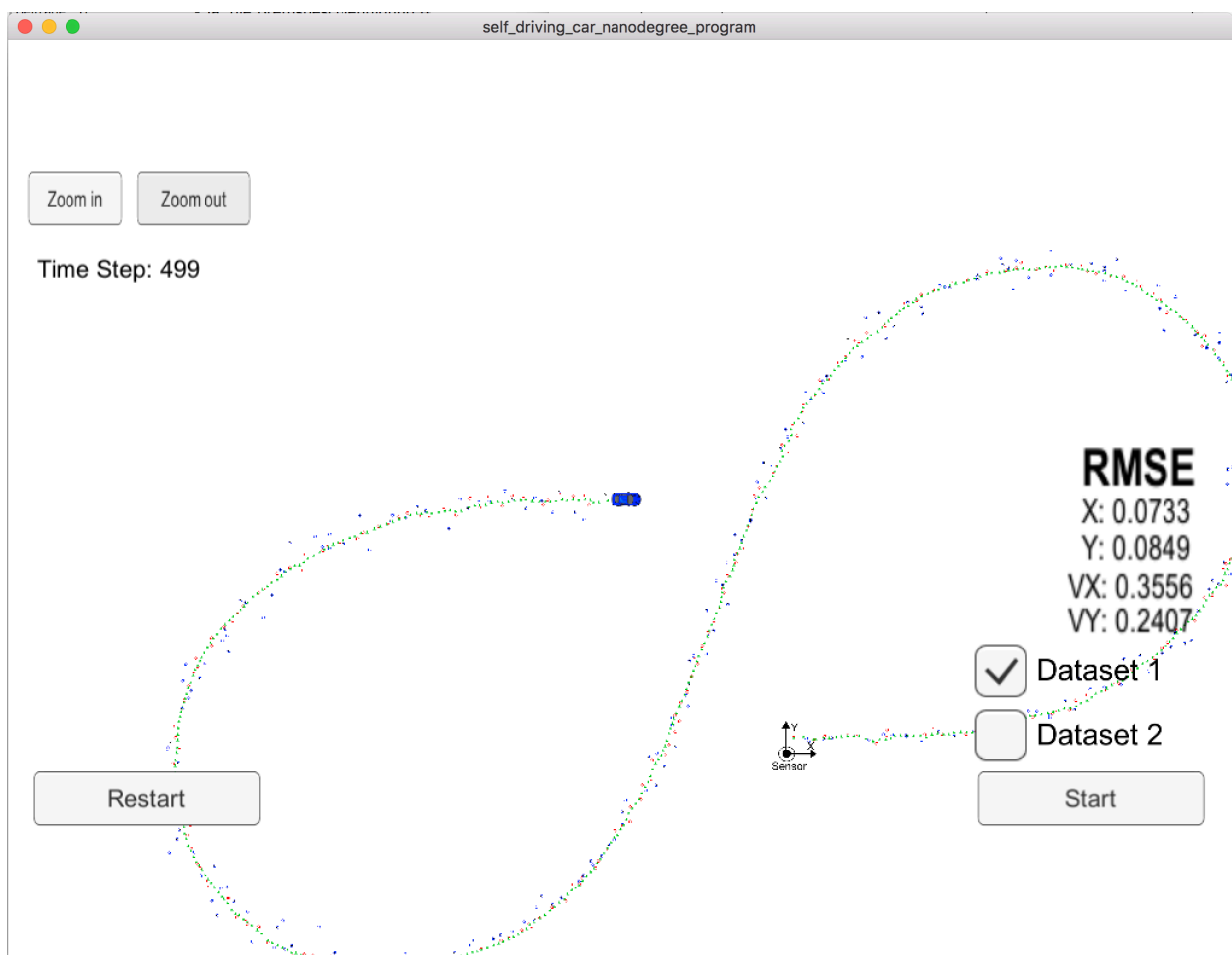
Dataset 1:

| RMSE	Radar and Lidar data	Lidar data only	Radar data only
x	0.0733	0.1747	0.2246
y	0.0849	0.1507	0.3027
vx	0.3556	0.6363	0.5222
vy	0.2407	0.3028	0.3965
NIS_Lidar	2.81%	4.82%	n/a
NIS_Radar	3.61%	n/a	3.22%

Dataset 2:

RMSE	Radar and Lidar data	Lidar data only	Radar data only
x	0.0882	0.1656	1.0988
y	0.0758	0.1453	1.2352
vx	0.6679	0.6156	2.0273
vy	0.3269	0.3321	3.8268
NIS_Lidar	5.22%	3.22%	n/a
NIS_Radar	5.24%	n/a	14.92%

The image below shows the tracking results using radar data and lidar data of dataset 1:

Tracking problems with dataset 2 if only radar data is used

The tracking results are very poor if only the radar data of dataset 2 is used. When the tracking starts the object is predicted at totally wrong positions. After some data sets have been processed, the tracking results are much better (refer to the area around button "Restart" in image below).
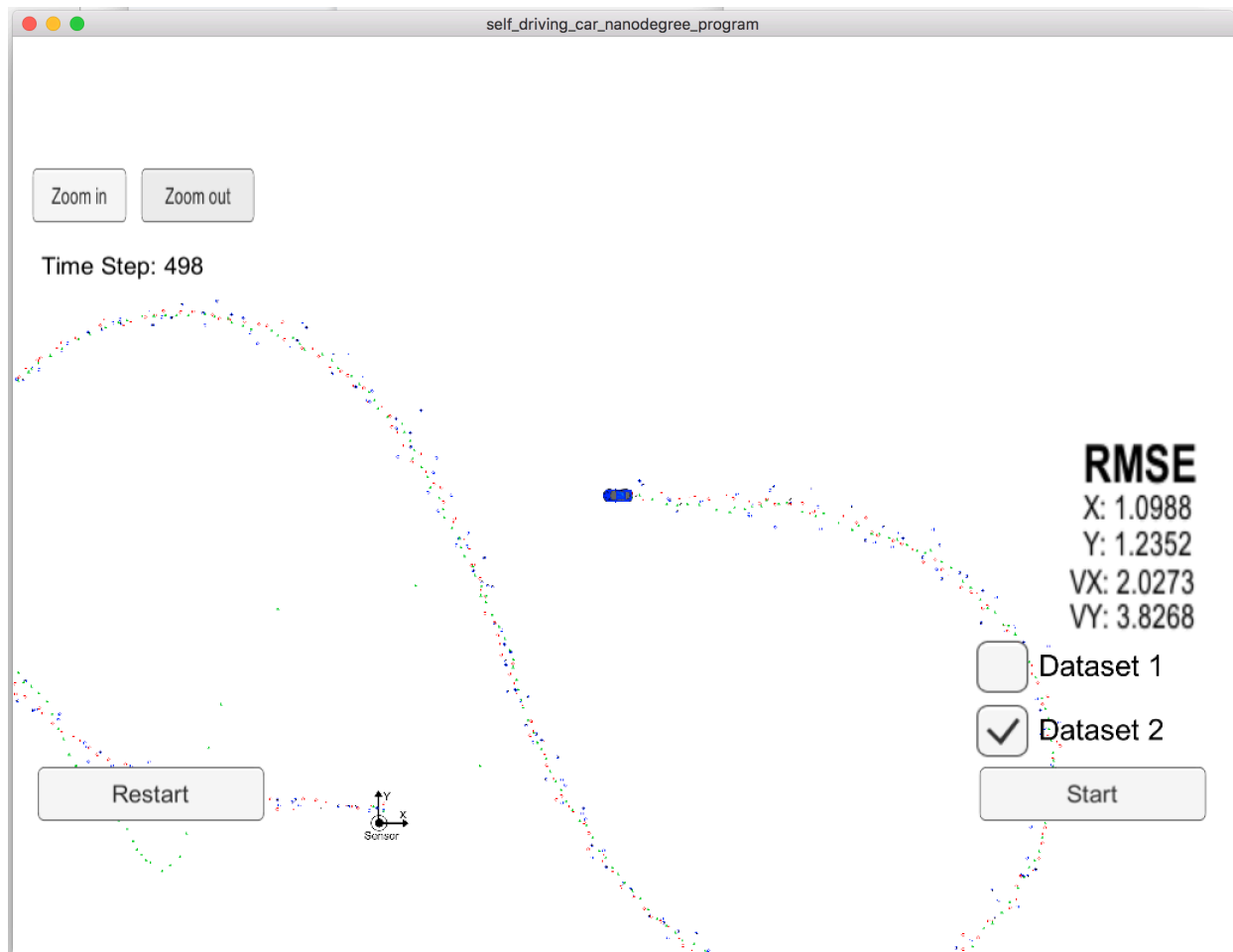
Comparison of the results of UKF versus the result of EKF

Compared to the EKF the UKF reached the same accuracy of the tracking of the object position. The tracking of the objects velocity is more accurate when using the UKF.

The table below shows the tracking accuracy of UKF and EKF for dataset 1.

RMSE	UKF	EKF
x	0.0733	0.0973
y	0.0849	0.0855
vx	0.3556	0.4513
vy	0.2407	0.4399

Dependencies

- cmake >= 3.5
    - All OSes: [click here for installation instructions](#)
- make >= 4.1 (Linux, Mac), 3.81 (Windows)
    - Linux: make is installed by default on most Linux distros
    - Mac: [install Xcode command line tools to get make](#)
    - Windows: [Click here for installation instructions](#)
- gcc/g++ >= 5.4
    - Linux: gcc / g++ is installed by default on most Linux distros
    - Mac: same deal as make - [install Xcode command line tools](#)
    - Windows: recommend using [MinGW](#)

Basic Build Instructions

1. Clone this repo.
2. Make a build directory: `mkdir build && cd build`
3. Compile: `cmake .. && make`
4. Run it: `./UnscentedKF` Previous versions use i/o from text files. The current state uses i/o
   from the simulator.