

# Sensor Fusion and Object Tracking

## Setup of Code

The URL of all the code and associated document (Including this one) is:

[https://github.com/HarisAshraf/Project\\_3](https://github.com/HarisAshraf/Project_3)

The repository includes the following structure:

```
└─ results

└─ student
  │ └─ association.py
  │ └─ filter.py
  │ └─ measurements.py
  │ └─ objdet_detect.py
  │ └─ objdet_eval.py
  │ └─ objdet_pcl.py
  │ └─ trackmanagement.py
  │
  └─ loop_over_dataset.py
```

The analysis will follow the following steps (It is assumed that classroom workspace is provided)

## Section 1: Tracking

Updated `filter.py` For this section

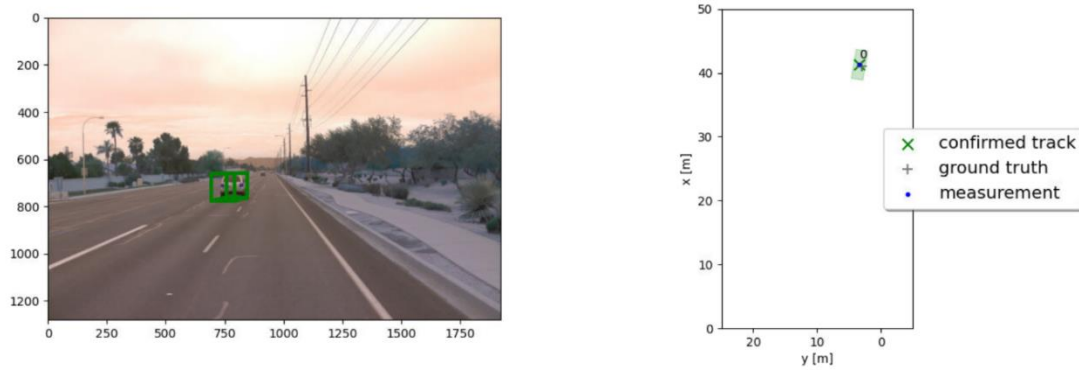


Figure 1: Single Target Tracking, Lidar Only

Ground Truth, Confirmed Track and Measurement are very close to each other.

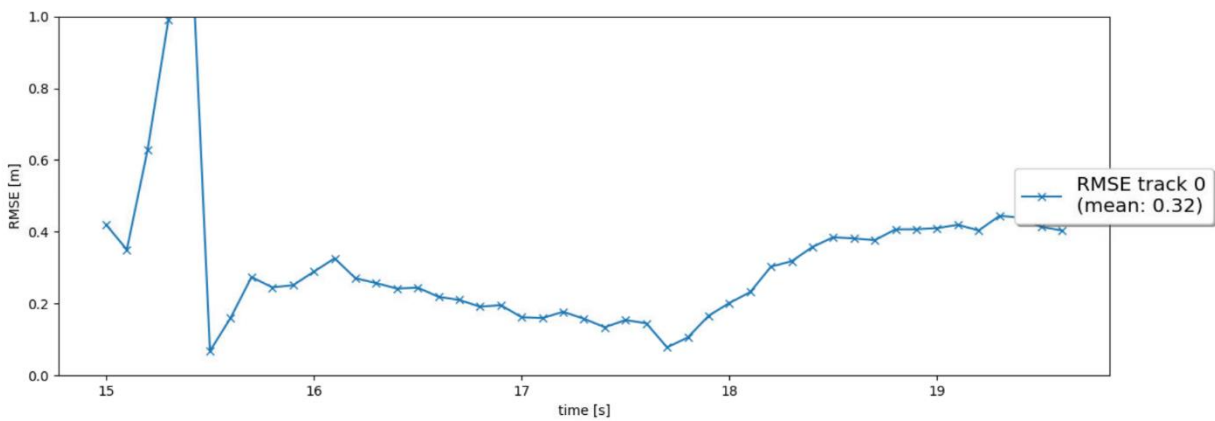


Figure 2: Single Target Tracking RSME

Mean RSME is 0.32m which is smaller than 0.35m

## Section 2: Track Management

The results of this section are shown in Fig. 3 and Fig 4.

Due to a constant bias in the data the Kalman filter results had a bias too. Kalman filter assumes all variables to have zero mean.

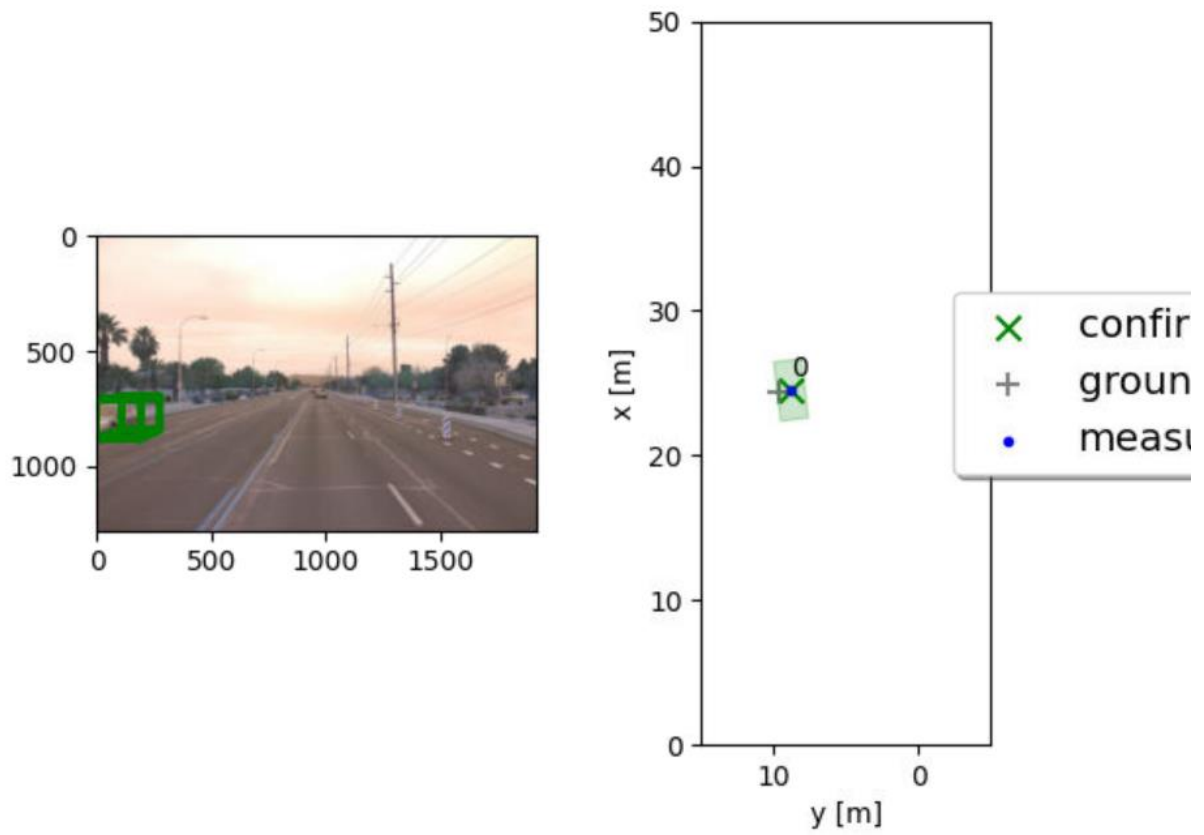


Figure 3: System with  $y$ -offset

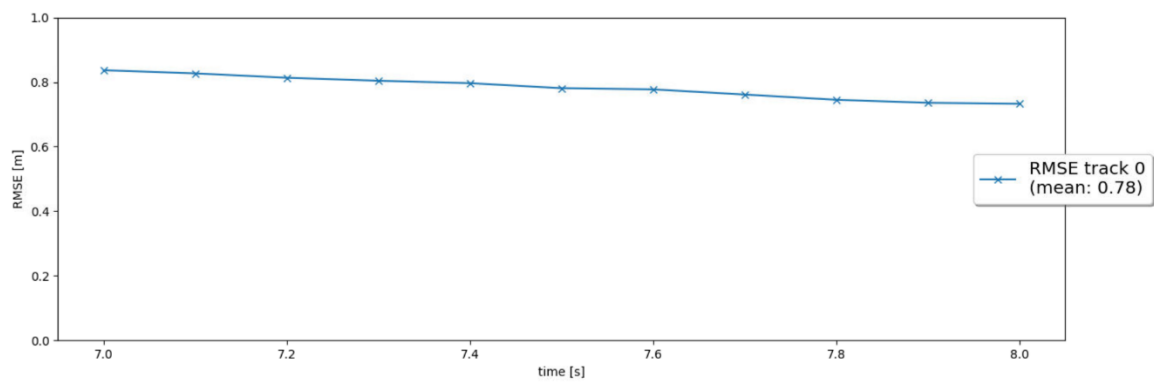


Figure 4: RSME with  $y$  offset

### Section 3: Data Association

Multiple targets, multiple tracks are updated with multiple measurements. Good RSME plots were obtained. All the ghost tracks, were gone after few frames.

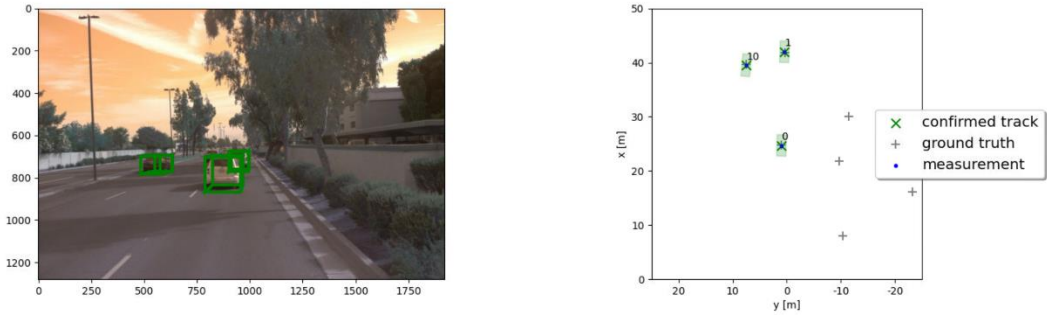


Figure 5: Multiple tracks updated

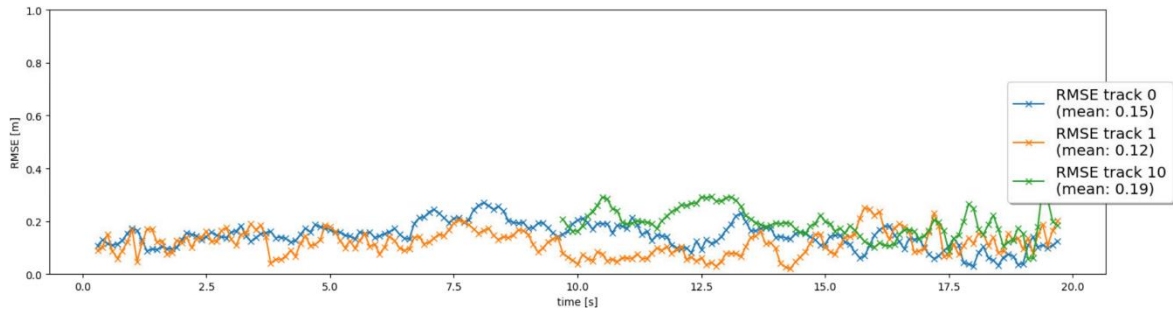


Figure 6: RSME of multiple tracks

### Section 4: Evaluation and Conclusion

Initially all tracks for the objects that were in the camera FOV were always in **initialized** state. This was shown in Figure 7.

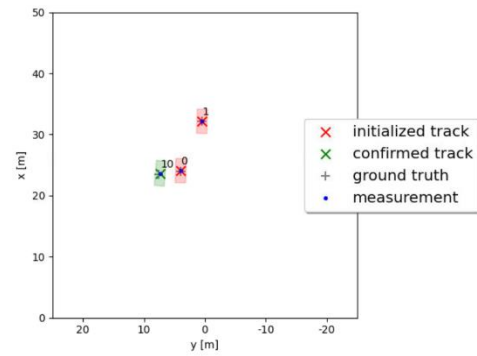
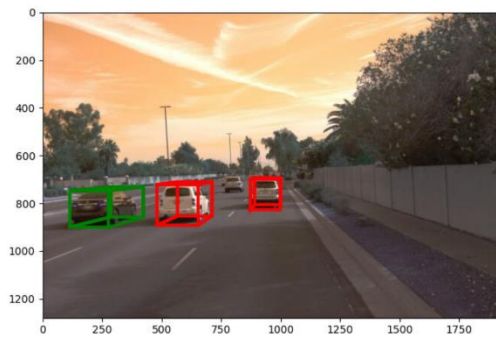


Figure 7: Camera tracks, all initialized but never confirmed

After some research on the **Mentor Help** board following changes were made:

<<Copied from message on the board >>

```
if meas_list[0].sensor.in_fov(track.x):
```

Was change to

```
1
if not meas_list[0].sensor.in_fov(track.x):
```

<<End copy>>

Giving the following results shown in figure 8 as expected.

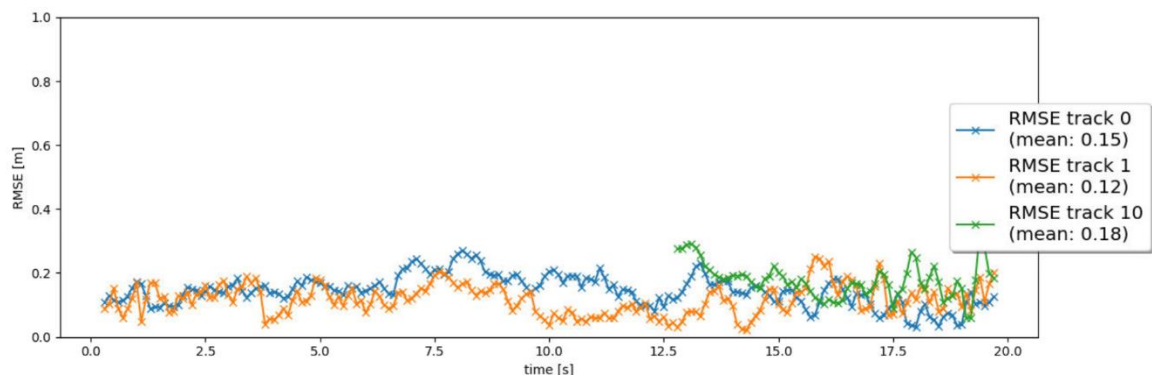


Figure 8: RSME of the LIDAR track

## Conclusion

A sensor fusion system using a camera and LIDAR was implemented that is able to track vehicles over time with real-world camera and lidar measurements.

LIDAR measurement used a linear measurement model, whereas the camera uses a linear model which had to be linearized and the resulting matrix was used.