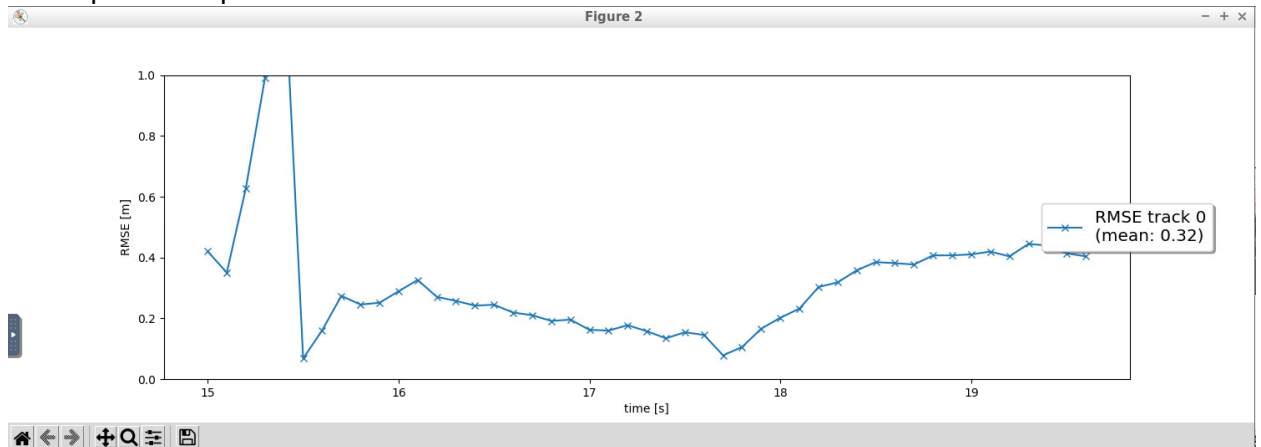
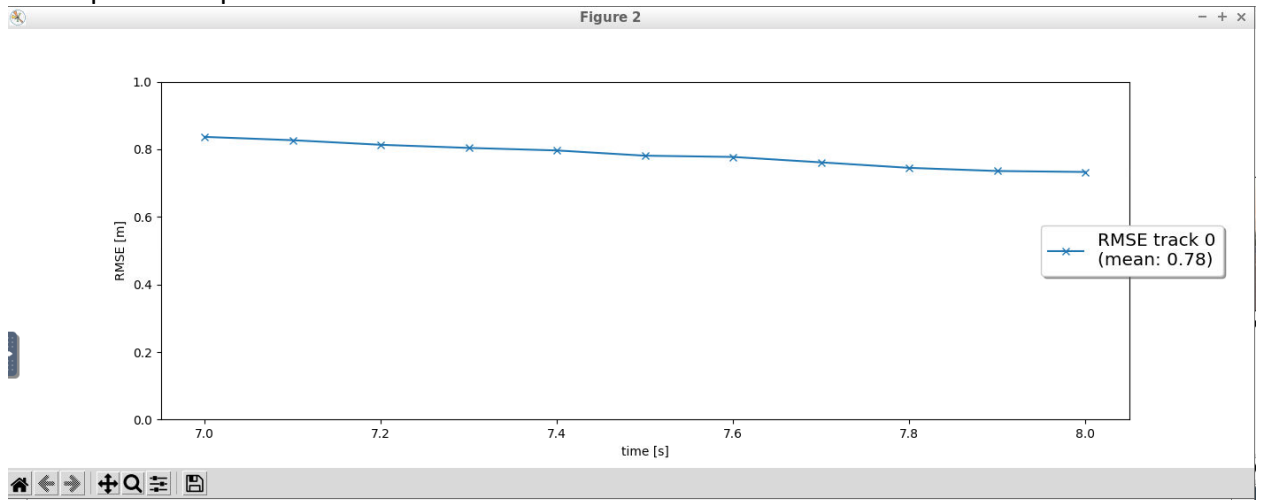


## Sensor Fusion and Object Tracking

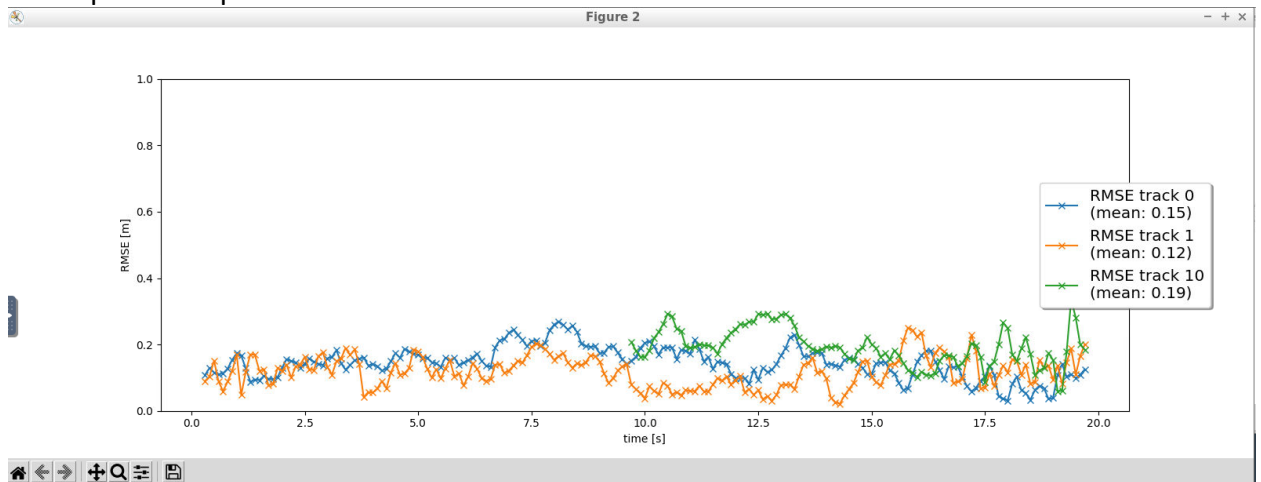
### 1. RMSE plot in step 1.



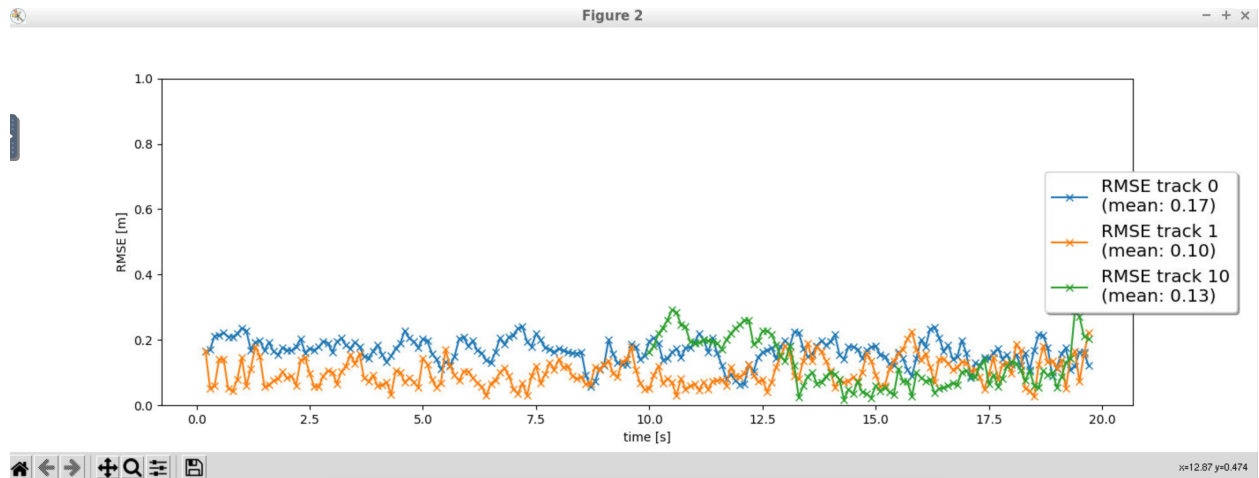
### 2. RMSE plot in step 2



### 3. RMSE plot in step 3.



### 4. RMSE plot in step 4.



5. Write a short recap of the four tracking steps and what you implemented there (EKF, track management, data association, camera-lidar sensor fusion). Which results did you achieve? Which part of the project was most difficult for you to complete, and why?
  - a. EKF: I implemented the system matrix  $F$ , process noise covariance  $Q$ , predict and update function. I get a better understanding after I modified the matrix and type the formula manually.
  - b. Track management: This part is mainly used to manage and update the score and state of tracks. I have trouble in the score decrease strategy.
  - c. Data association: I implemented the association matrix and related functions. It's a distance matrix and guides to keep or delete the relation between track and measurement.
  - d. Sensor fusion: I implemented the camera measurements mainly in this part.

The RMSE improved from 0.32 to 0.12+ after finishing all steps. The most difficult part is the sensor fusion part. It deletes more tracks than before when add the camera sensor, but I don't know how to fix it.

6. Do you see any benefits in camera-lidar fusion compared to lidar-only tracking (in theory and in your concrete results)?

Yes, the RMSE improved slightly.

7. Which challenges will a sensor fusion system face in real-life scenarios? Did you see any of these challenges in the project?

Sensor noise: Sensors can introduce noise in their measurements and dealing with this noise is crucial for detection and tracking.

Sensor calibration: Sensors need to be properly calibration to ensure accurate measurements.

Sensor synchronization: Sensors may not provide data at the same rate. Ensuring proper synchronization of sensor data is crucial for tracking. This is mentioned in the class.

I meet the sensor noise and calibration in the project.

8. Can you think of ways to improve your tracking results in the future?

I can use the ways in 'Suggestions' part in the project.

- Fine-tune the parameters in misc/params.py
- Implement a more advanced data association.
- Adapt the Kalman filter to also estimate the object's width, length, and height.

[Questions]

1. Is EKF still the SOTA algorithm for tracking now?
2. Is there any website where I can find all the SOTA algorithm in auto driven domain?