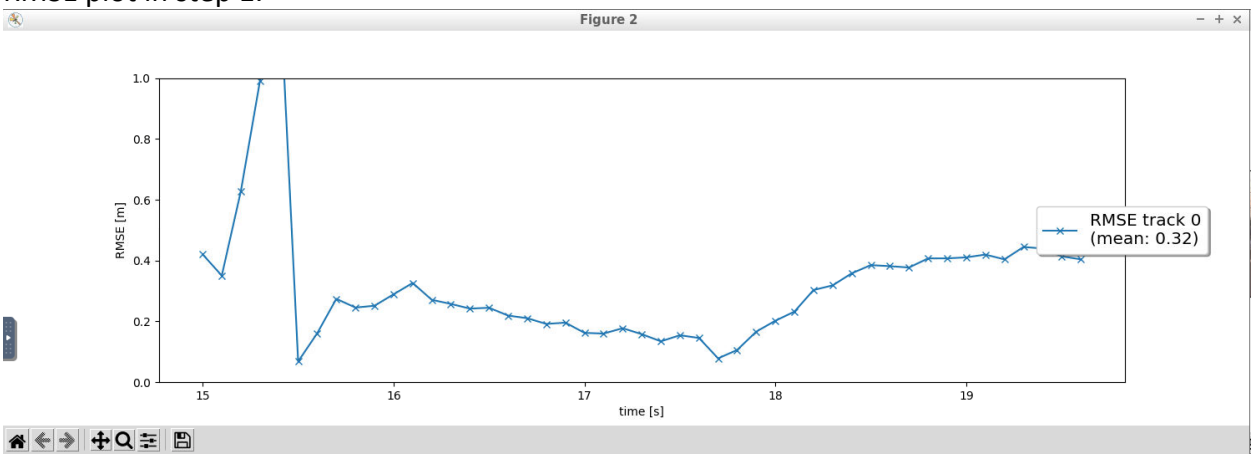
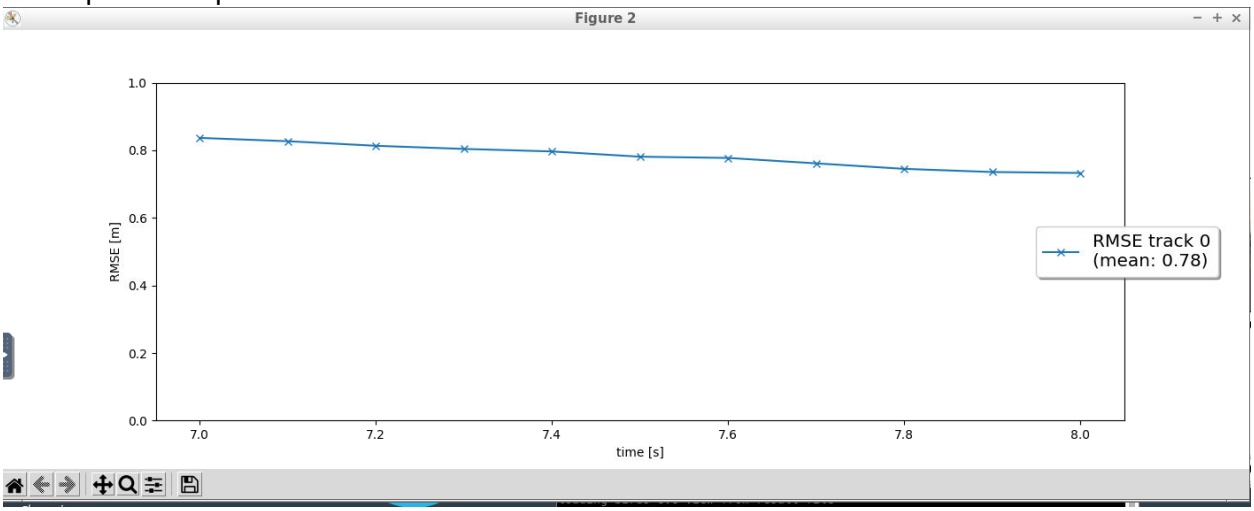
# Sensor Fusion and Object Tracking

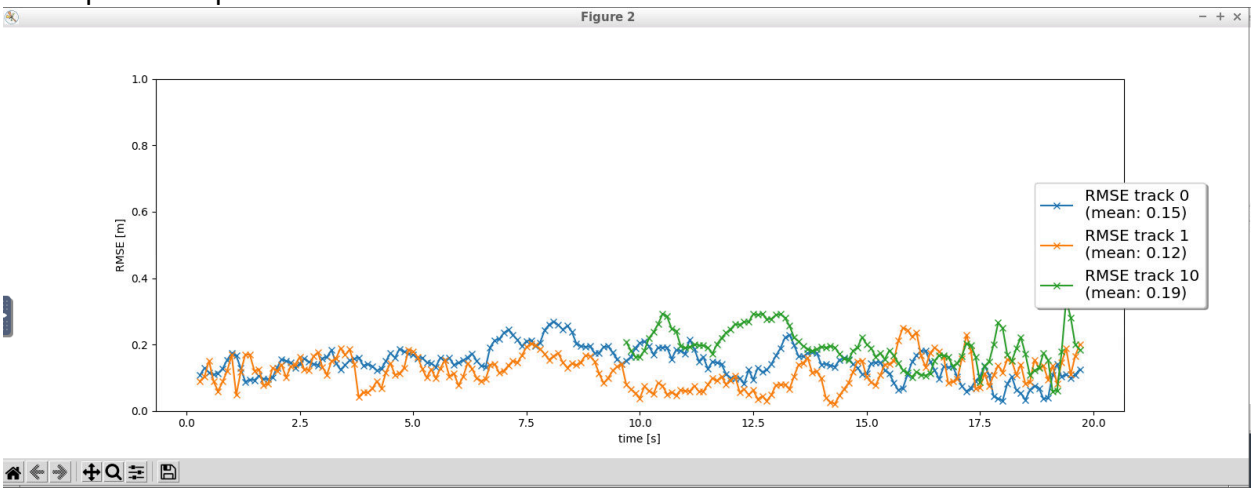
1. RMSE plot in step 1.




2. RMSE plot in step 2




3. RMSE plot in step 3.



4. 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.

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

    I haven't seen any benefits in sensor fusion because of my bug. 😂

6. 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.

7. 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?