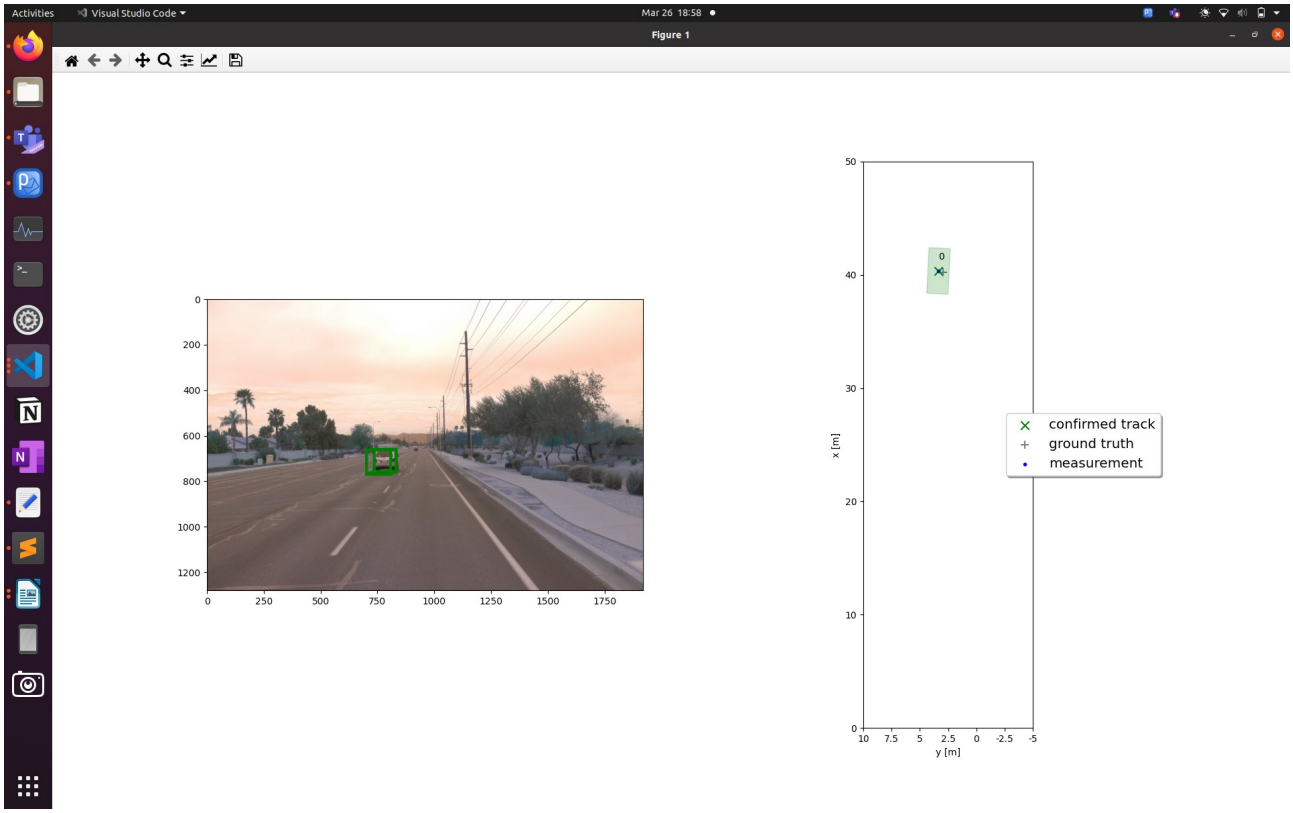
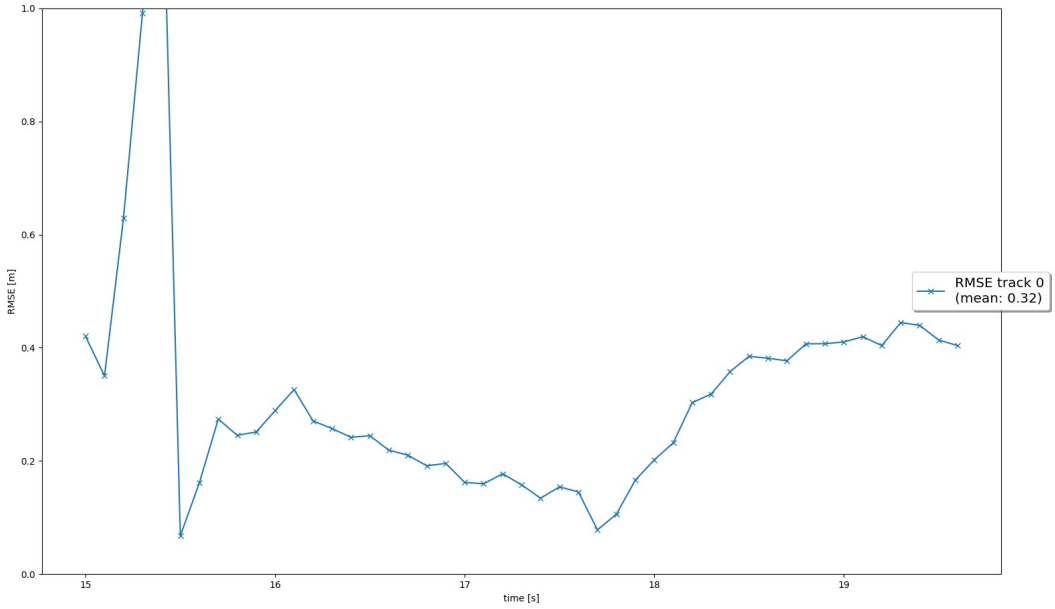
# Final: Sensor Fusion and Object Tracking

## Tracking:

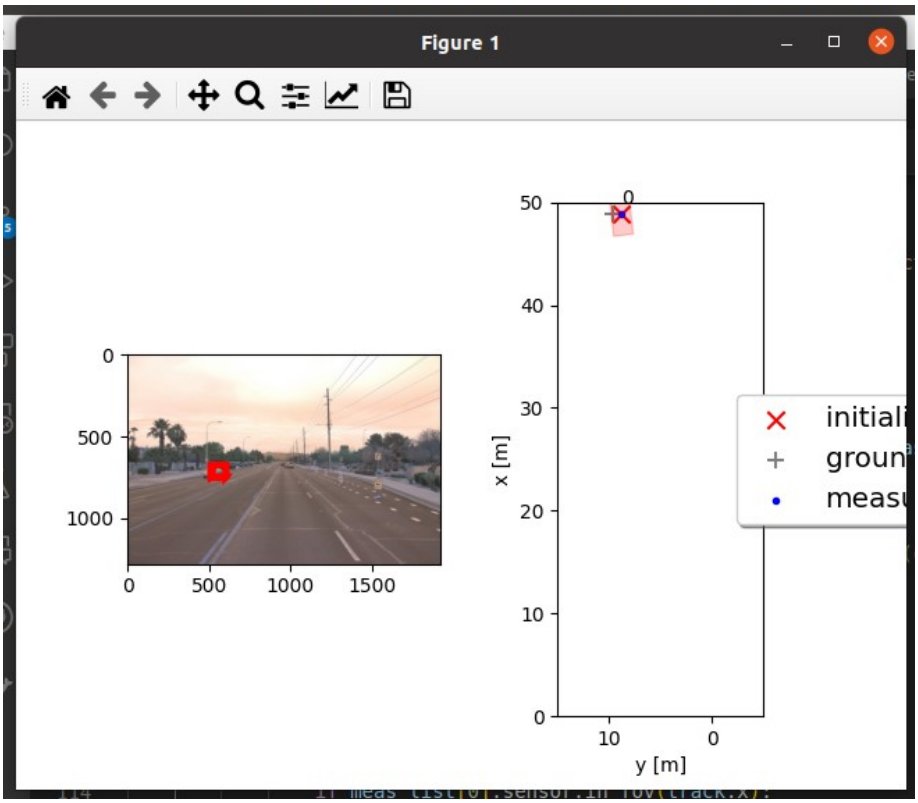
Track objects over time with a Kalman Filter.



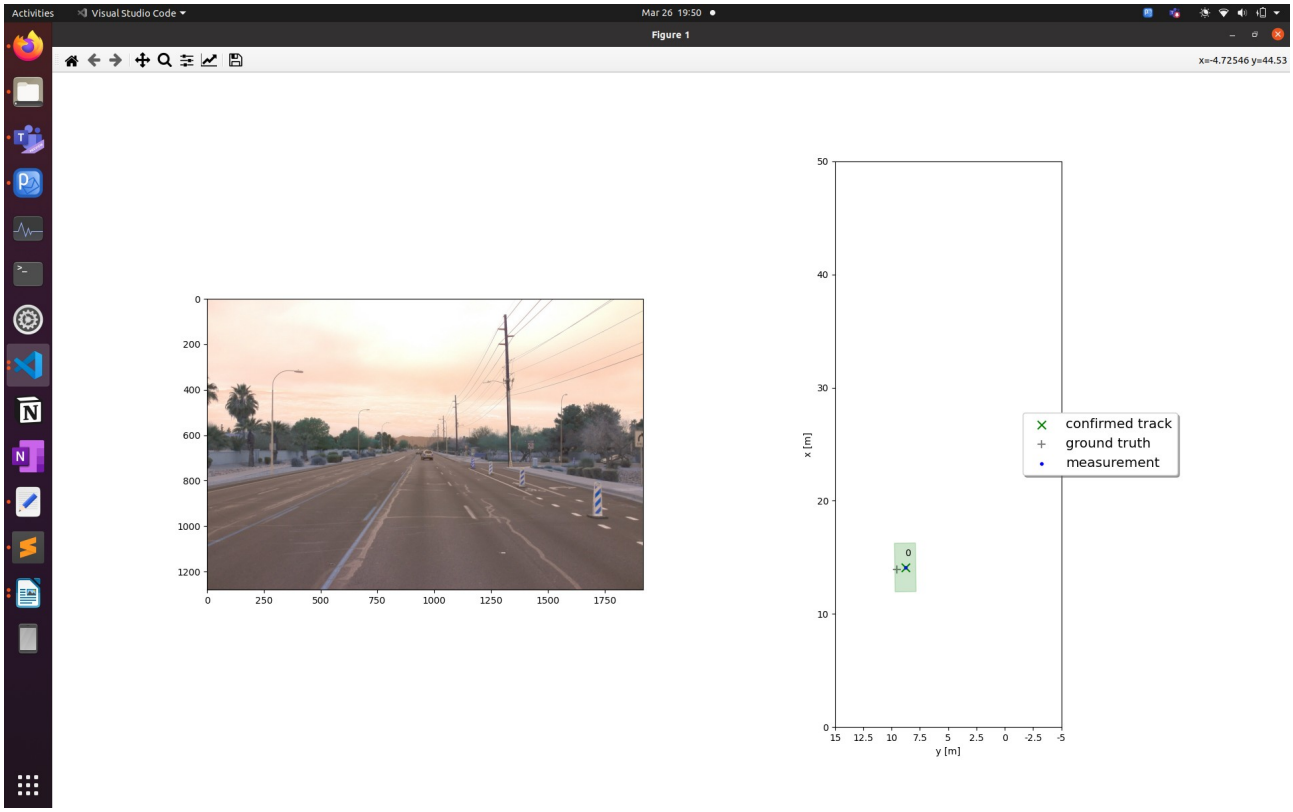



## Track Management:

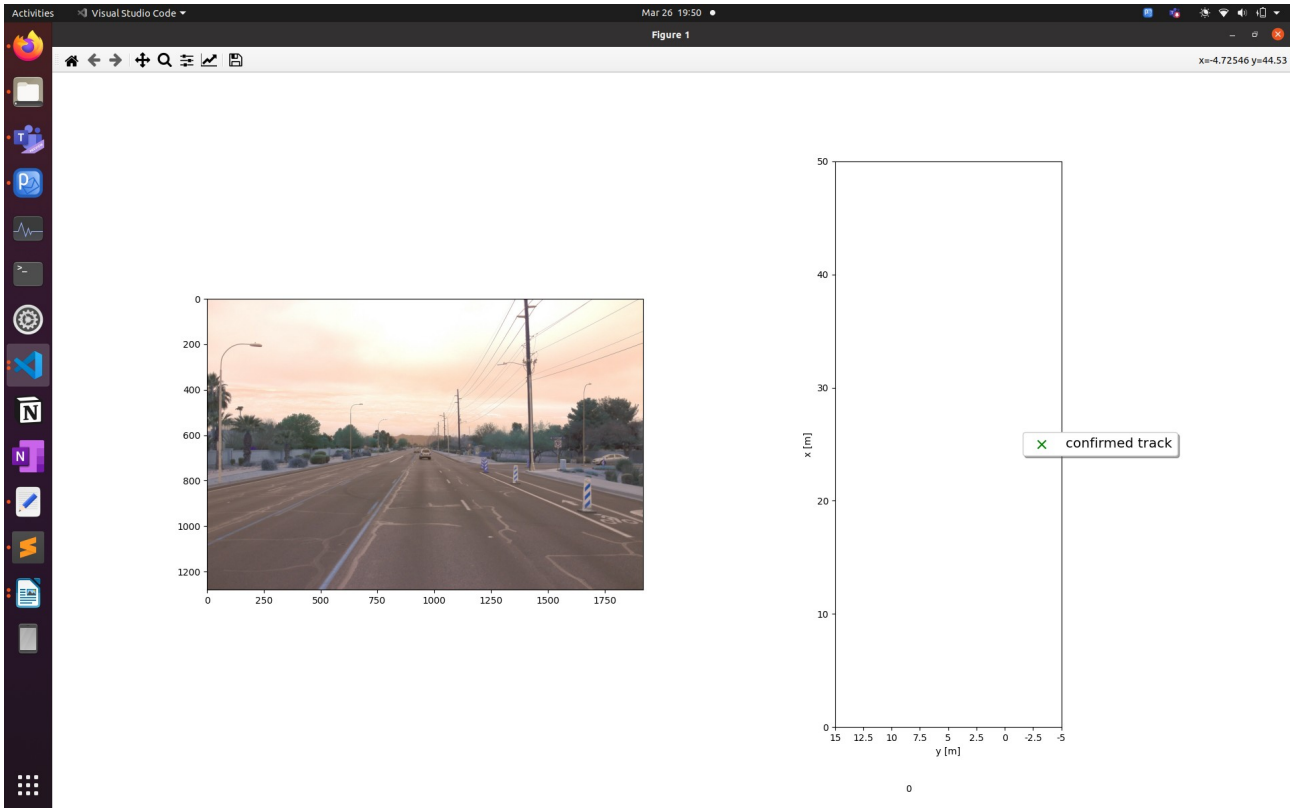
Initialize track:



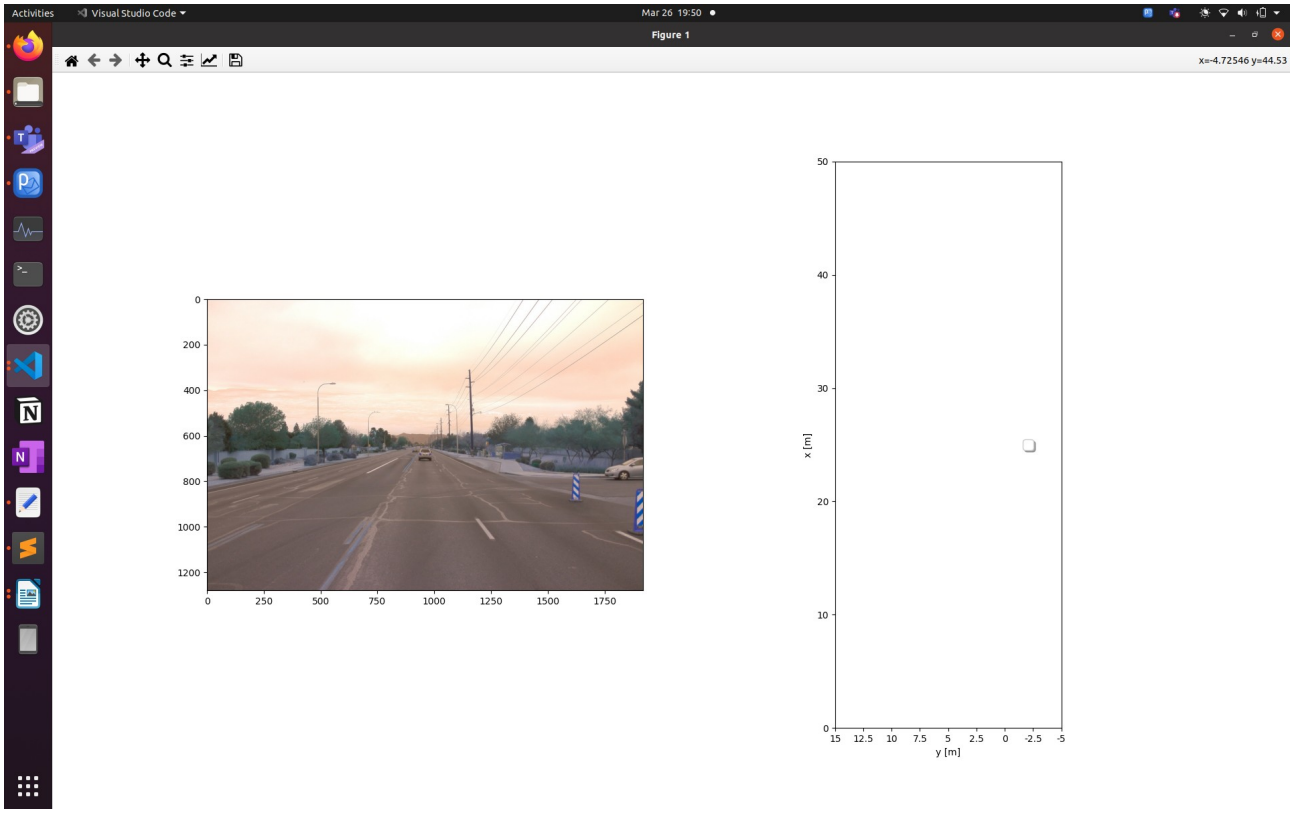

Update and confirm track:

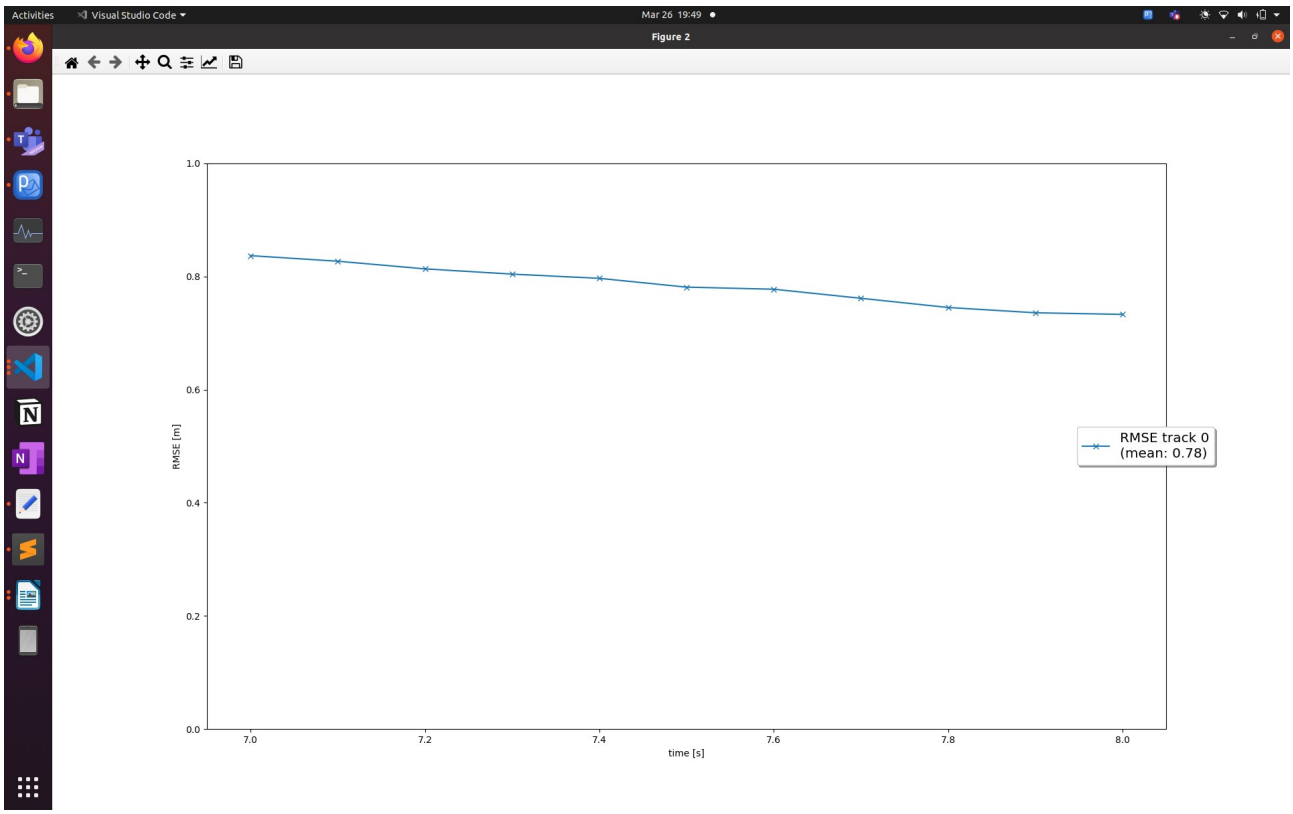


Keep track alive for a while even though you don’t have new measurements:



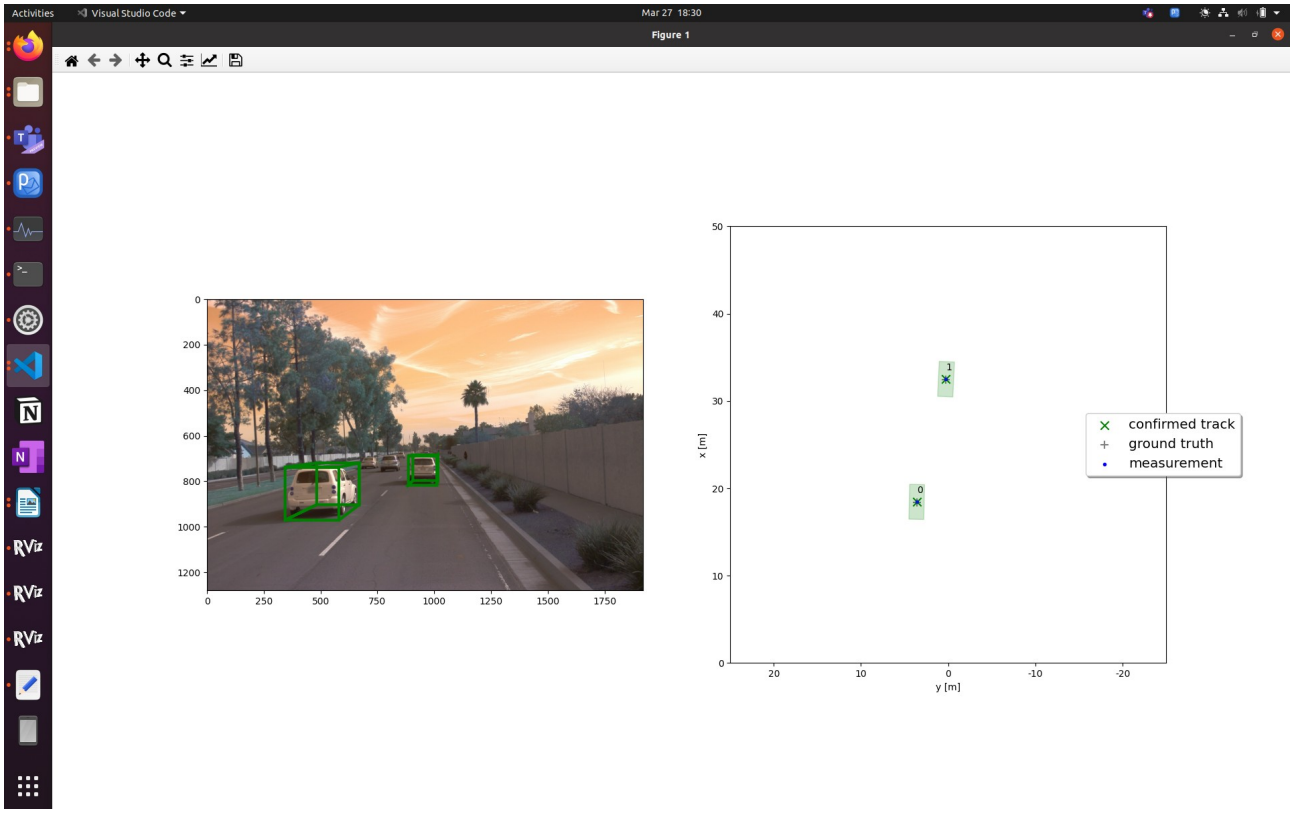

Ultimately delete the track:



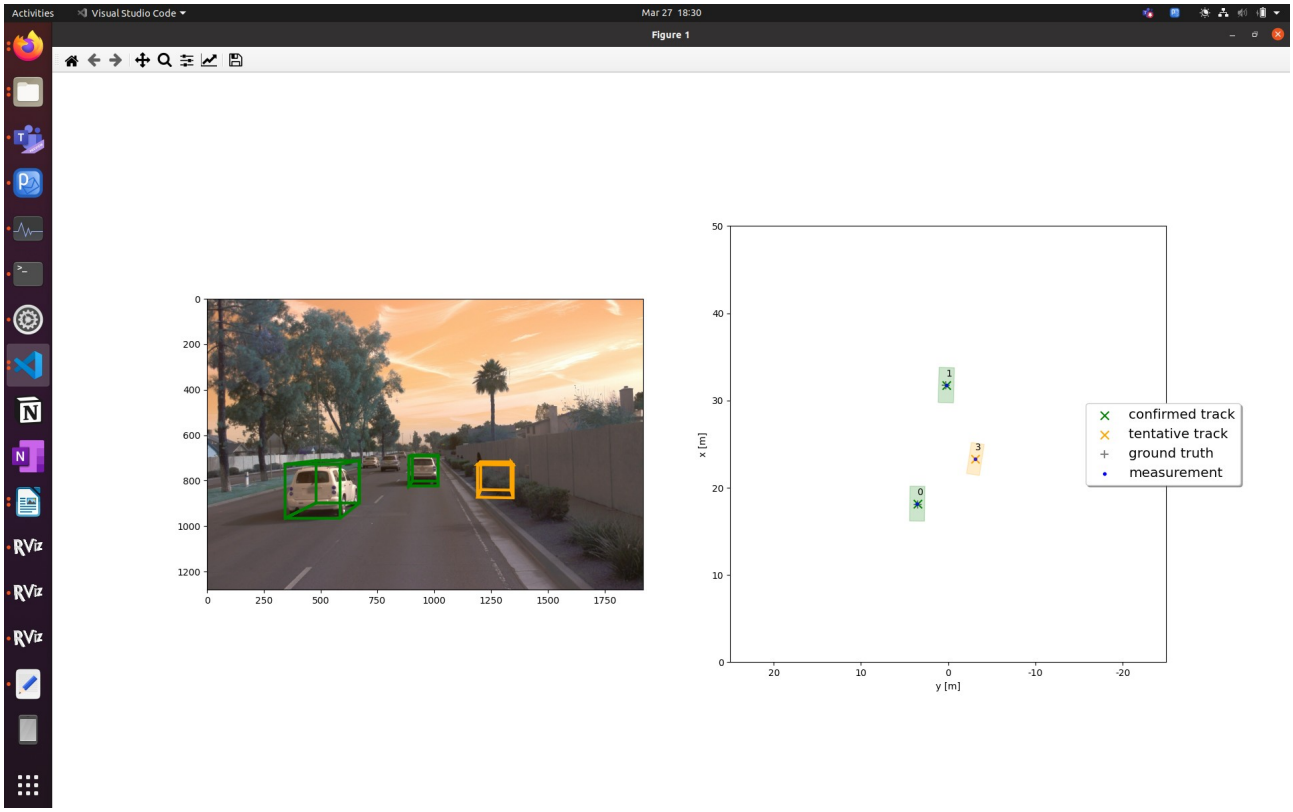



## Data Association:

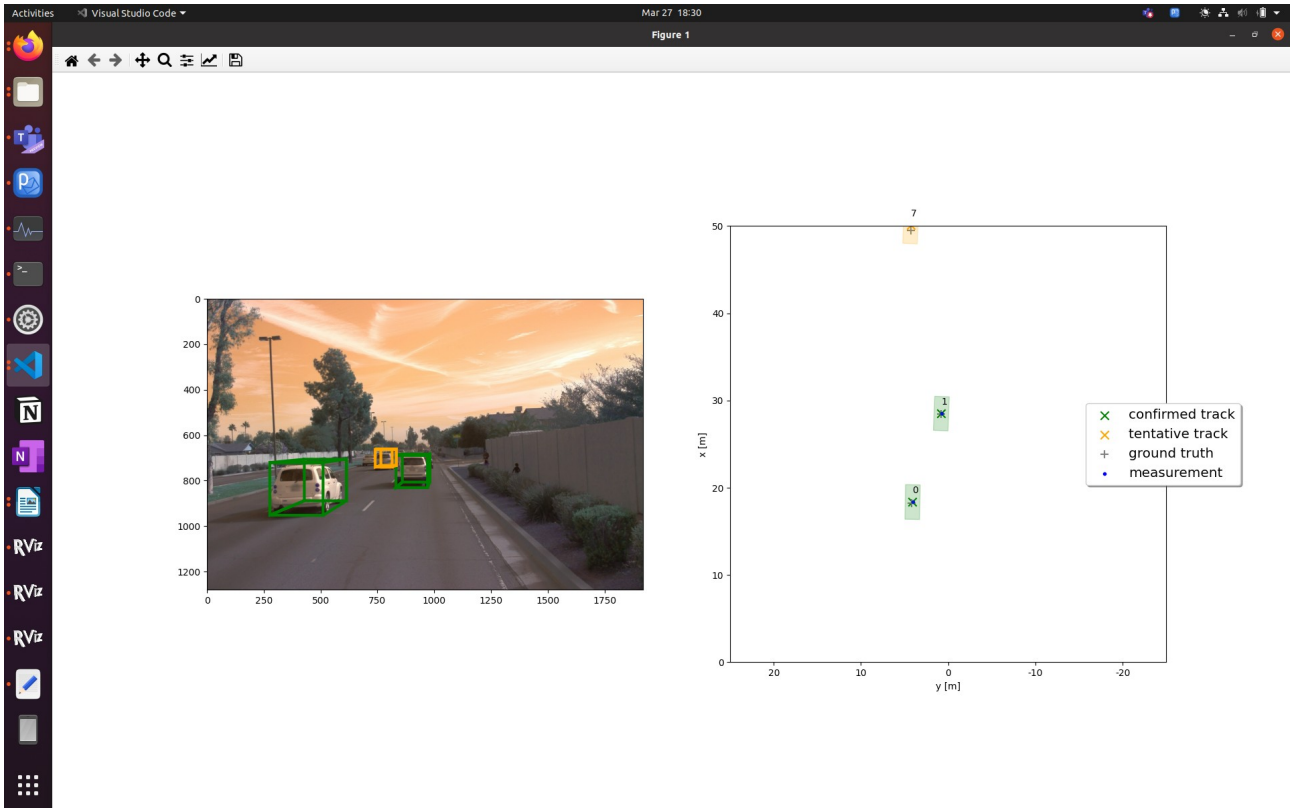
Associate measurements to tracks with nearest neighbor association.



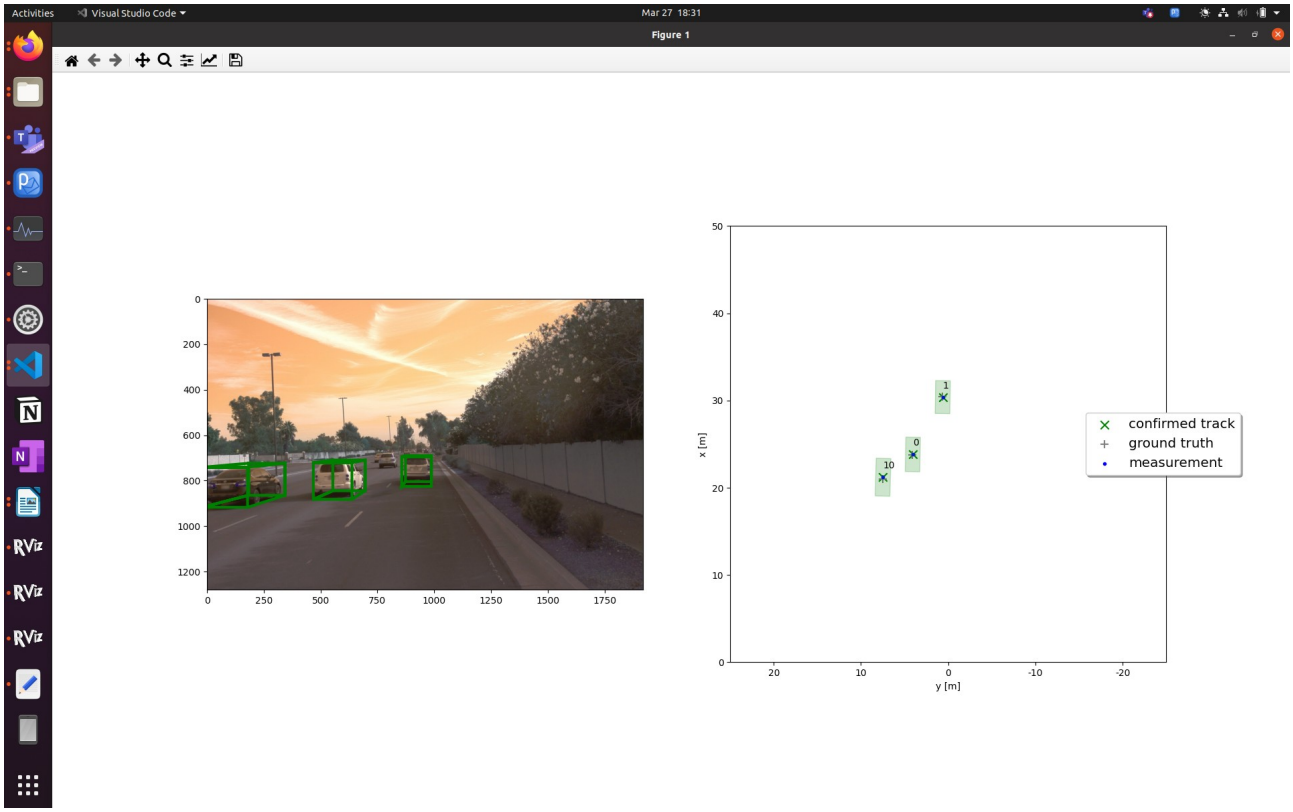
There are some false detections (ghost tracks) but they don’t reach the confirmed state.



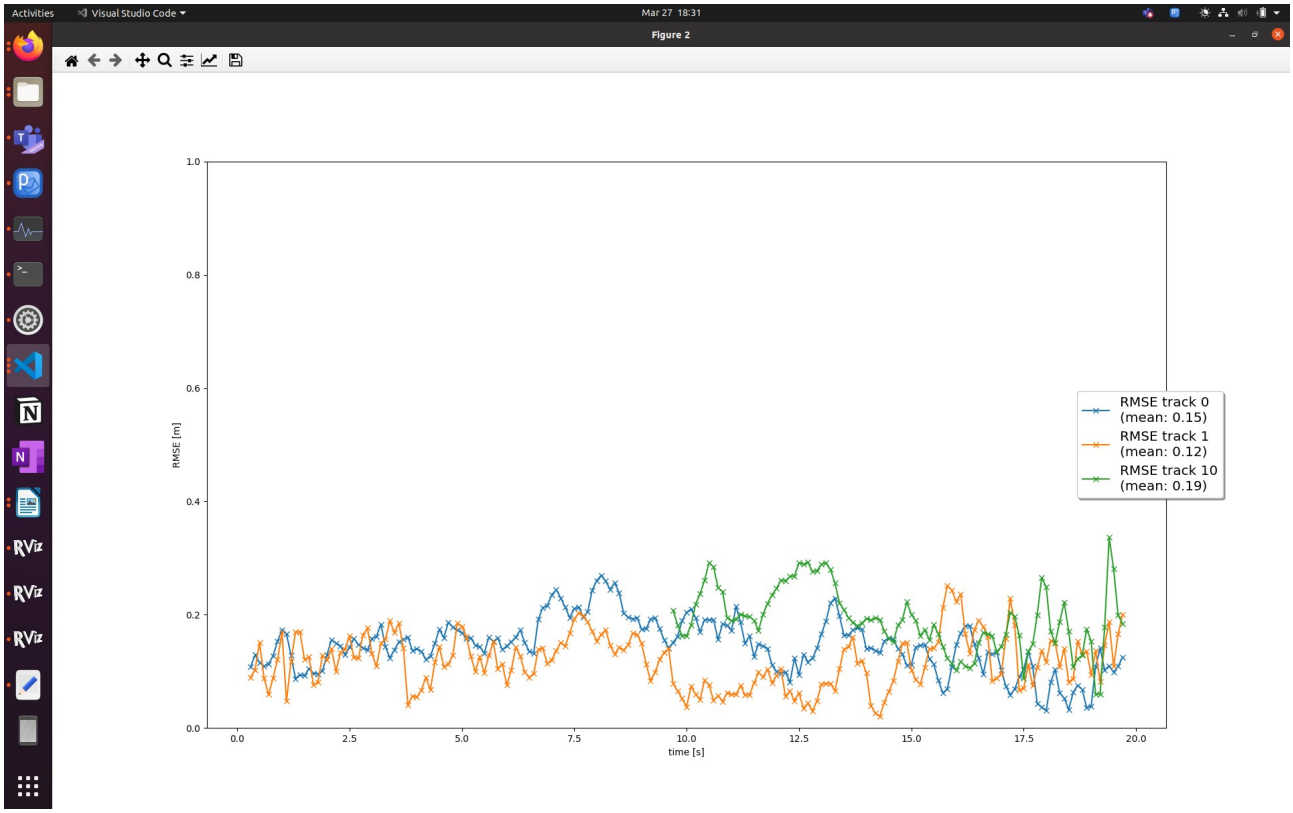

Sometimes there can be positive detections with low visibility so they are not detected long enough to reach confirmed state.



Although, when a car enters the sensor's FOV it eventually reaches the confirmed state.

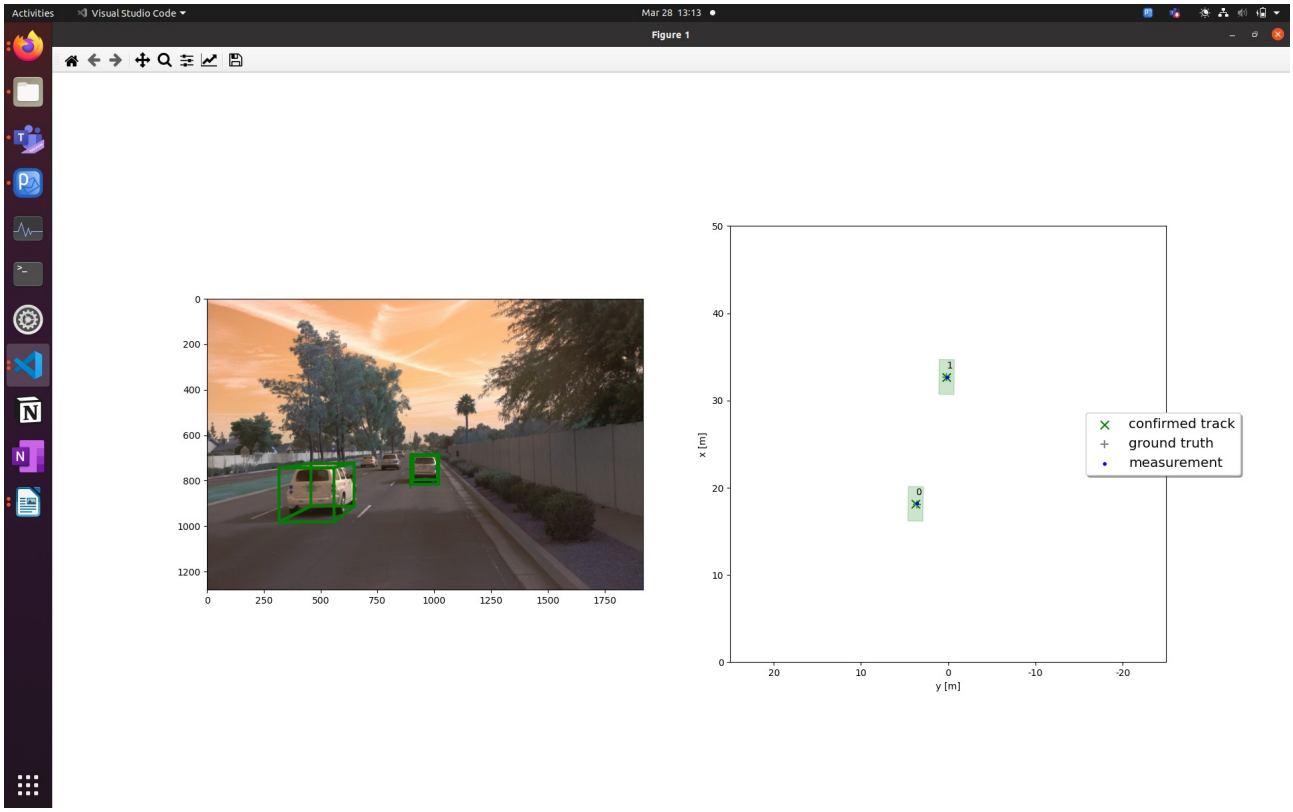


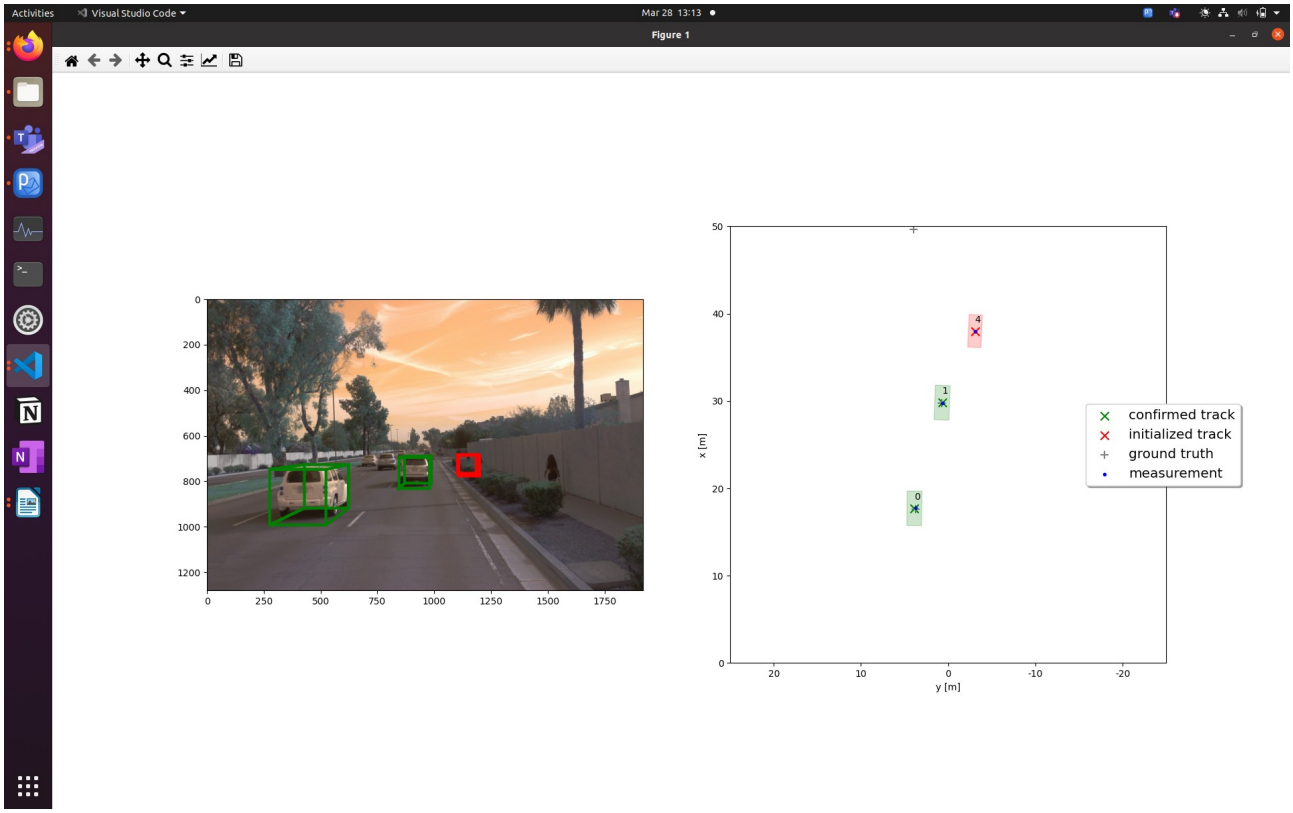

The image below shows the RMSE plot:

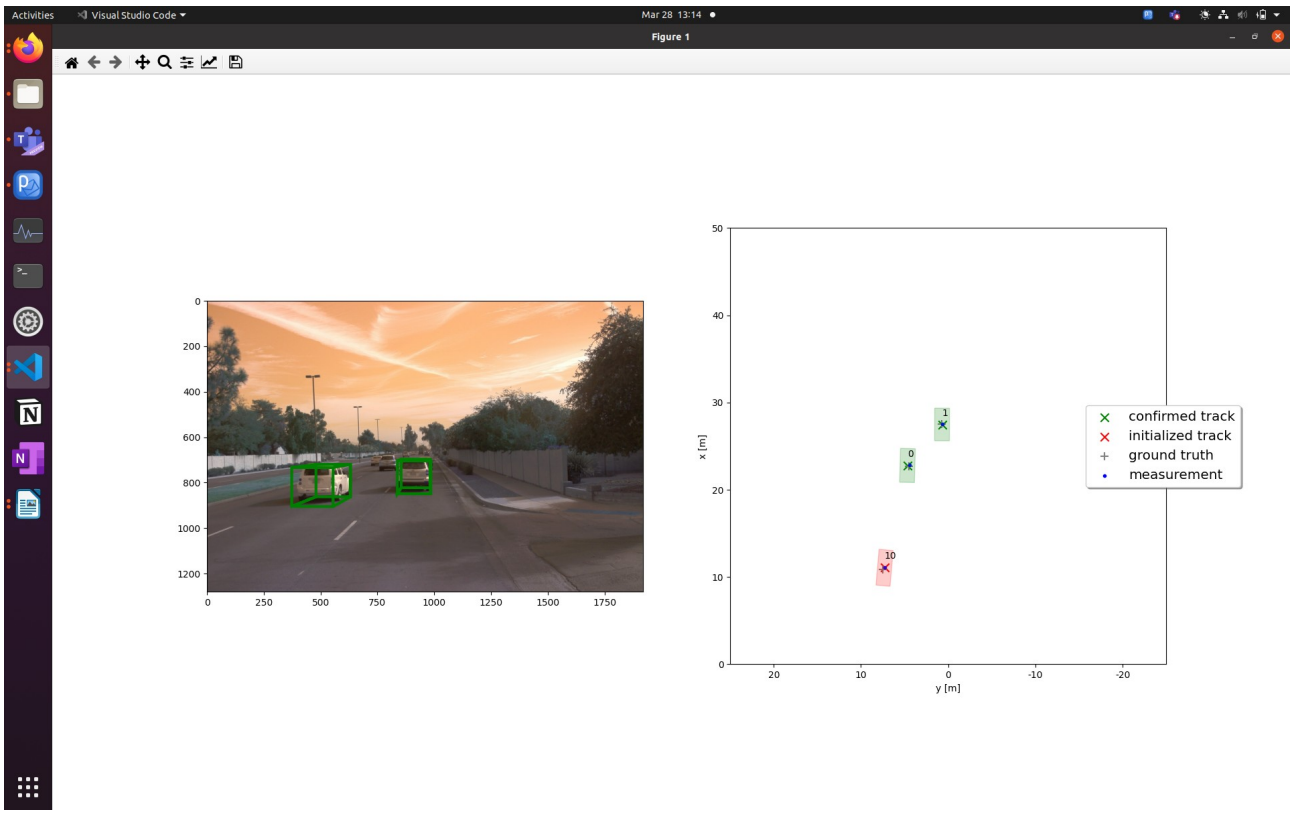


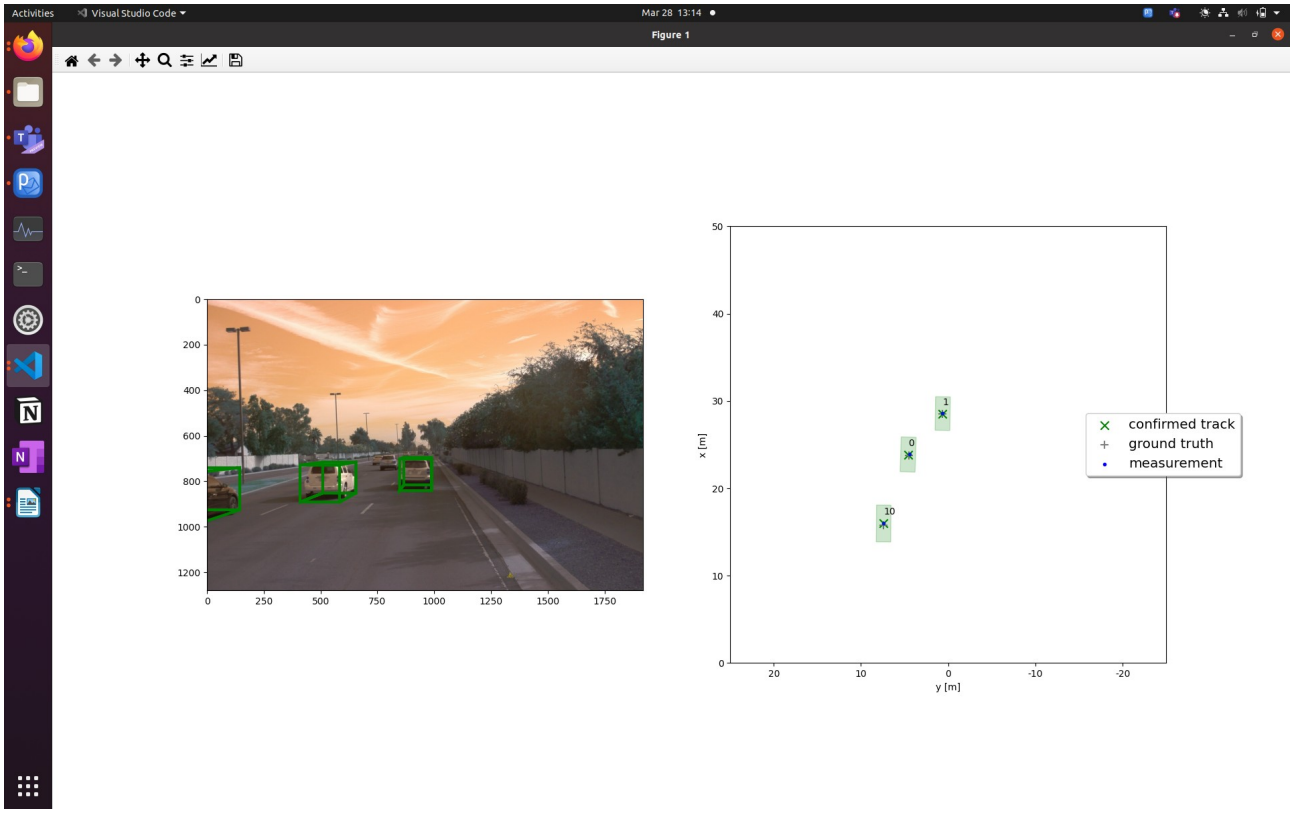
## Sensor Fusion:

Here are some images from the sensor fusion visualization:

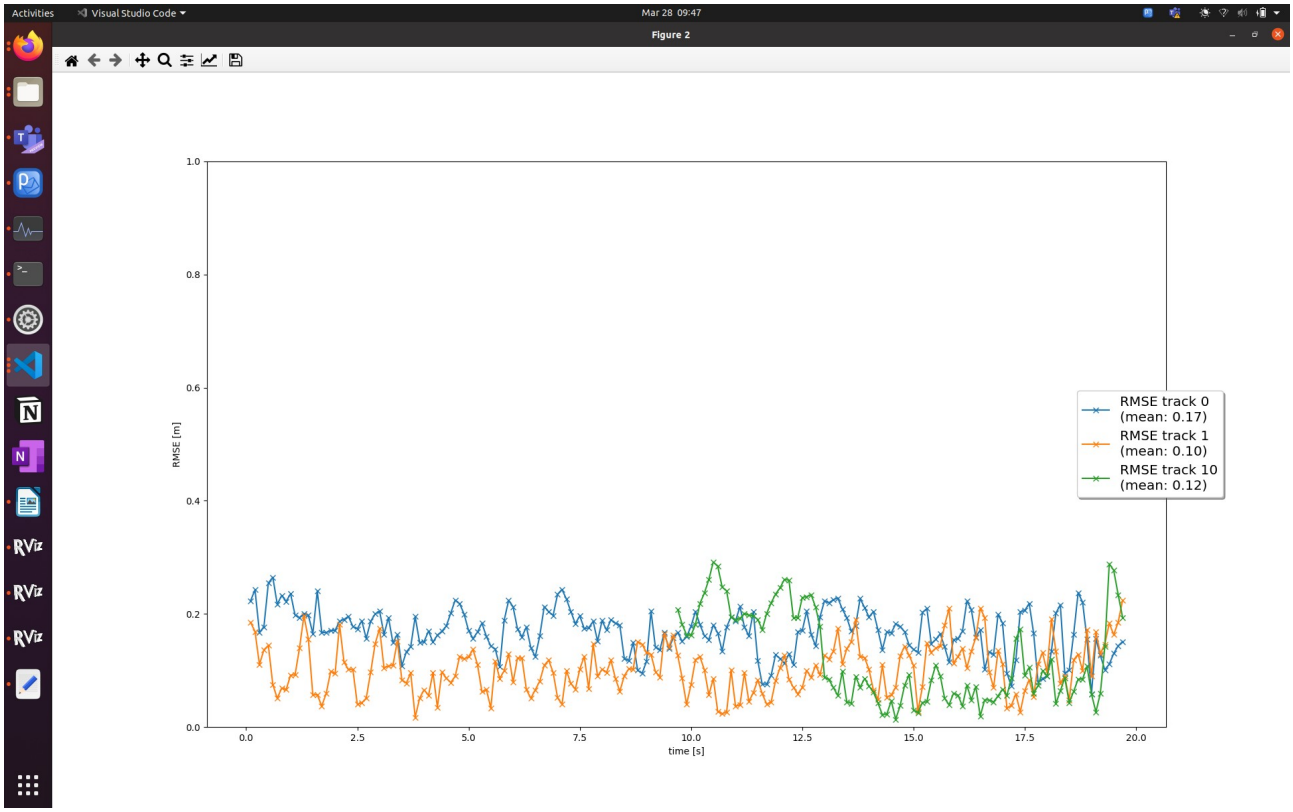



Activities
Visual Studio Code
Mar 28 13:14
Figure 1
confirmed track
initialized track
ground truth
measurement
x [m]
y [m]


Activities
Visual Studio Code
Mar 28 13:14
Figure 1
confirmed track
ground truth
measurement
x [m]
y [m]

Ultimately, here is the RMSE plot:



**Evaluation and Conclusion:**

- **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?**
- This section has been partly answered in the previous pages. For me the most difficult part of the project was understanding the different classes and their methods and how they were related with each other.
- **Do you see any benefits in camera-lidar fusion compared to lidar-only tracking (in theory and in your concrete results)?**
- In this project in the chosen segments I can't aprecciate any significative difference. Nonetheless, the camera detections are useful for distant cars which are not detected by the lidar. In this case the problem is that the camera detections can't initilize a track, so they are not used.
- **Which challenges will a sensor fusion system face in real-life scenarios? Did you see any of these challenges in the project?**
- The range of positive detections must increase to allow an acceptable velocity of driving which means many blurred detections and false positives that must be treated correctly. Also in a real world scenario the tracks would have changing velocities which would lead to incorrect predictions and therefore incorrect associations.
- **Can you think of ways to improve your tracking results in the future?**
- The main improvement I would do is allowing the camera detections to initialize a track for the reasons commented before.