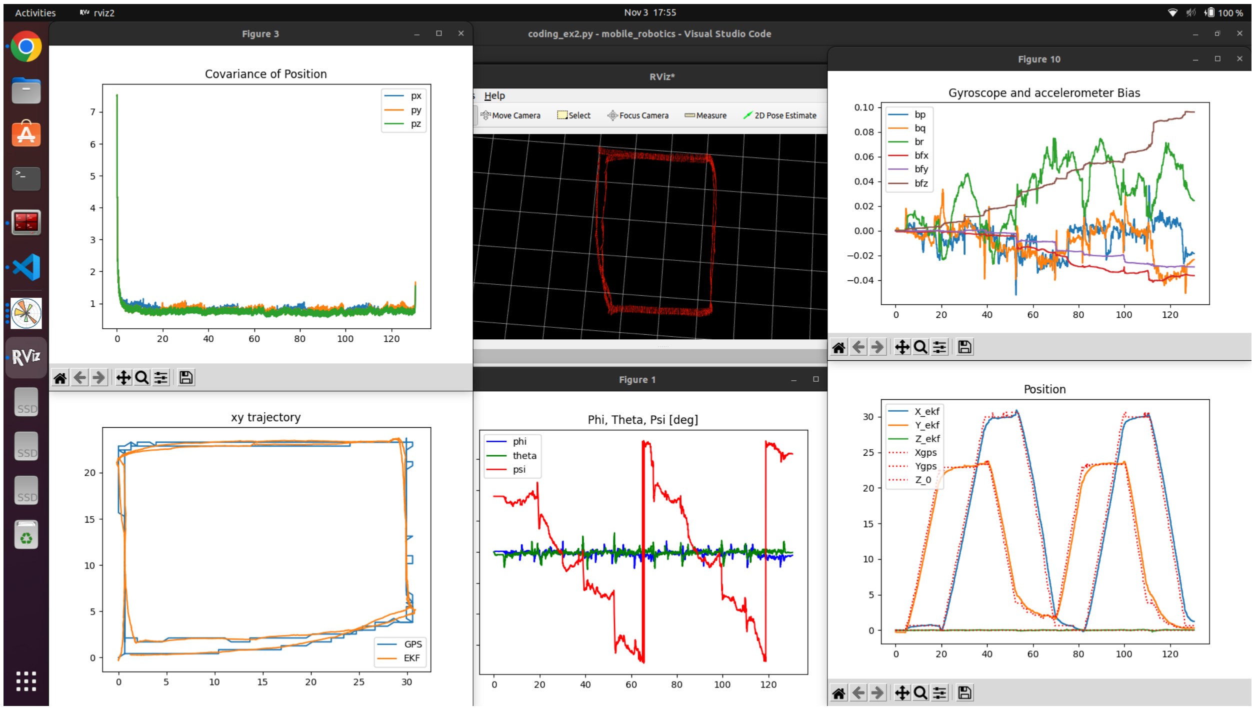
Report Coding Excercise 2

1. Play the rosbag file solar_house_v3 and identify the publishing rate of the IMU and GPS measurements (add results to your report). Check if the sample time (self.dt) in the main template is correct.

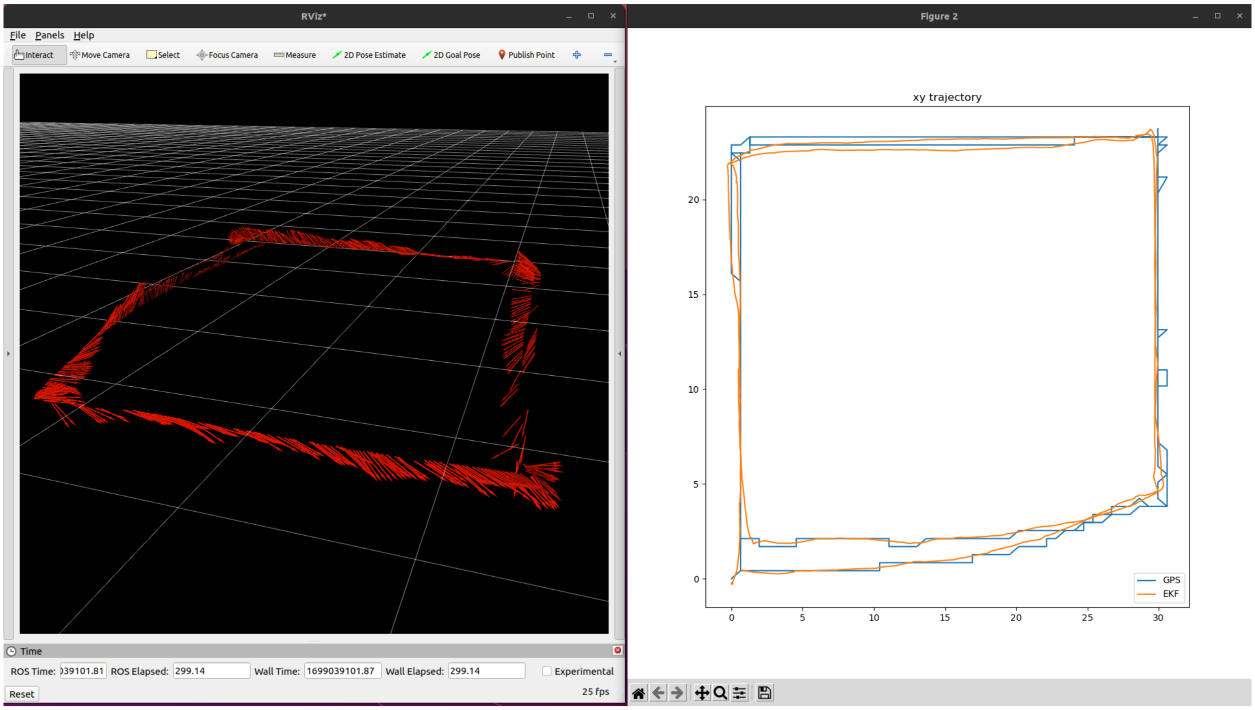
IMU publishing rate: 80
GPS_lat publishing rate: 5
GPS_lon publishing rate: 5
GPS_north publishing rate: 5
GPS_east publishing rate: 5
Yes, it’s the same as in the code

4. Plot the estimated xy trajectory, euler angles, gyroscope bias, accelerometer bias, and covariance of position ((add results to your report).



Original Image

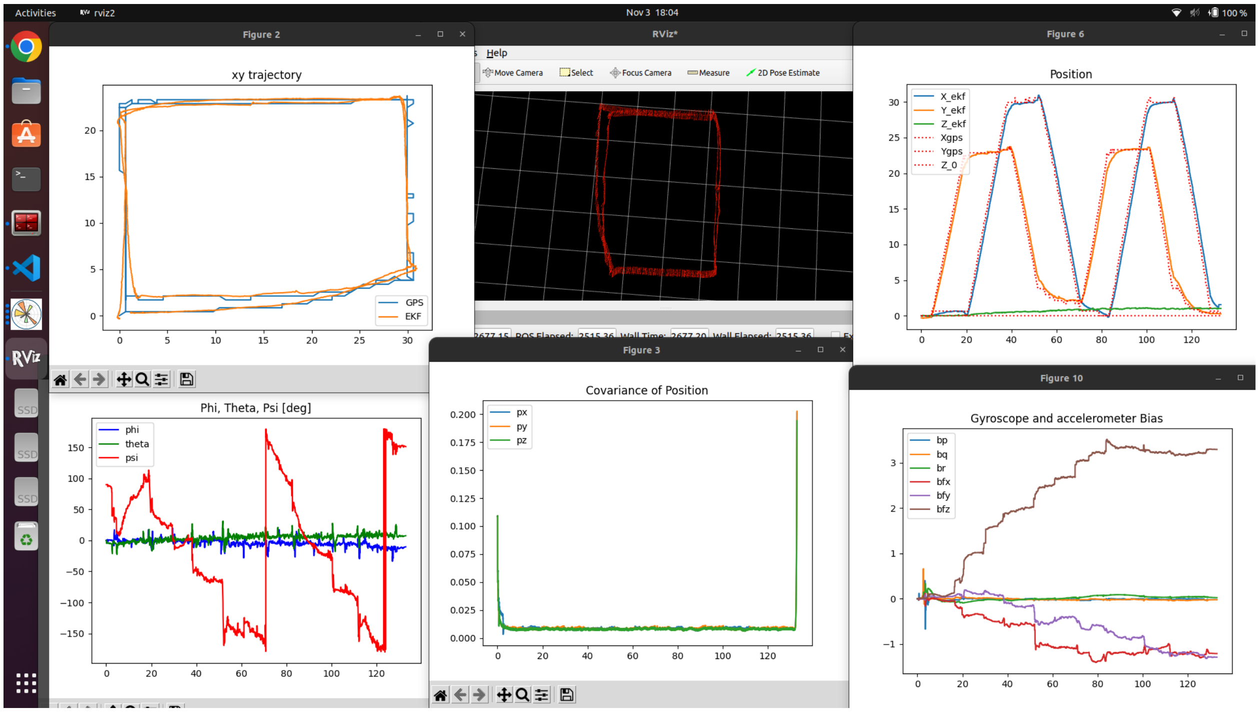
5. Create an odometry publisher that publishes the estimated position and orientation of the robot. Visualize the trajectory on rviz2 (add a screenshot to your report).



6. Evaluate the performance of the Kalman filter for different values of Q and R matrices, in particular, try the following different cases and qualitatively describe what happens to the estimated trajectory with respect to the GPS trajectory. Is the filter fairly robust to Q and R? (add xy plots and description to your report).

R=0.01*Roriginal

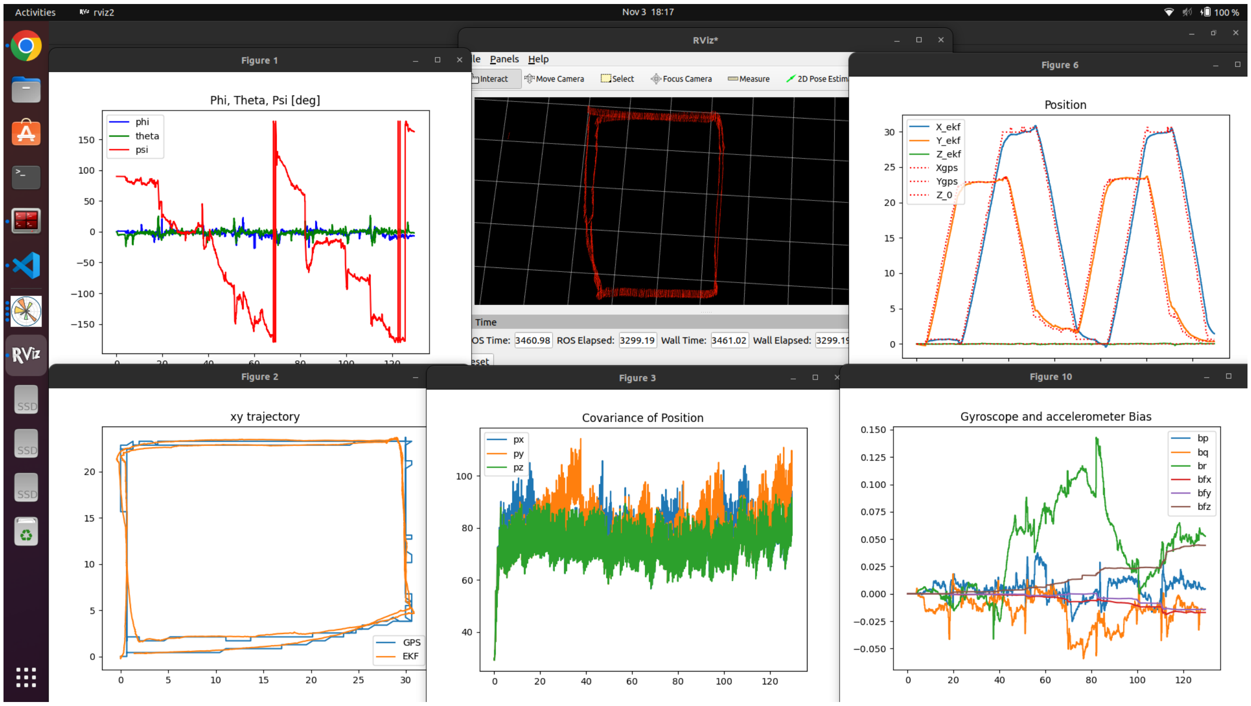
Q=0.01*Qoriginal



Result: The estimated trajectory will be very smooth and will closely follow the GPS trajectory. However, in situations where there are rapid changes in the GPS data, the filter lag a bit due to its high trust in the inherent system model.

R=100*Roriginal

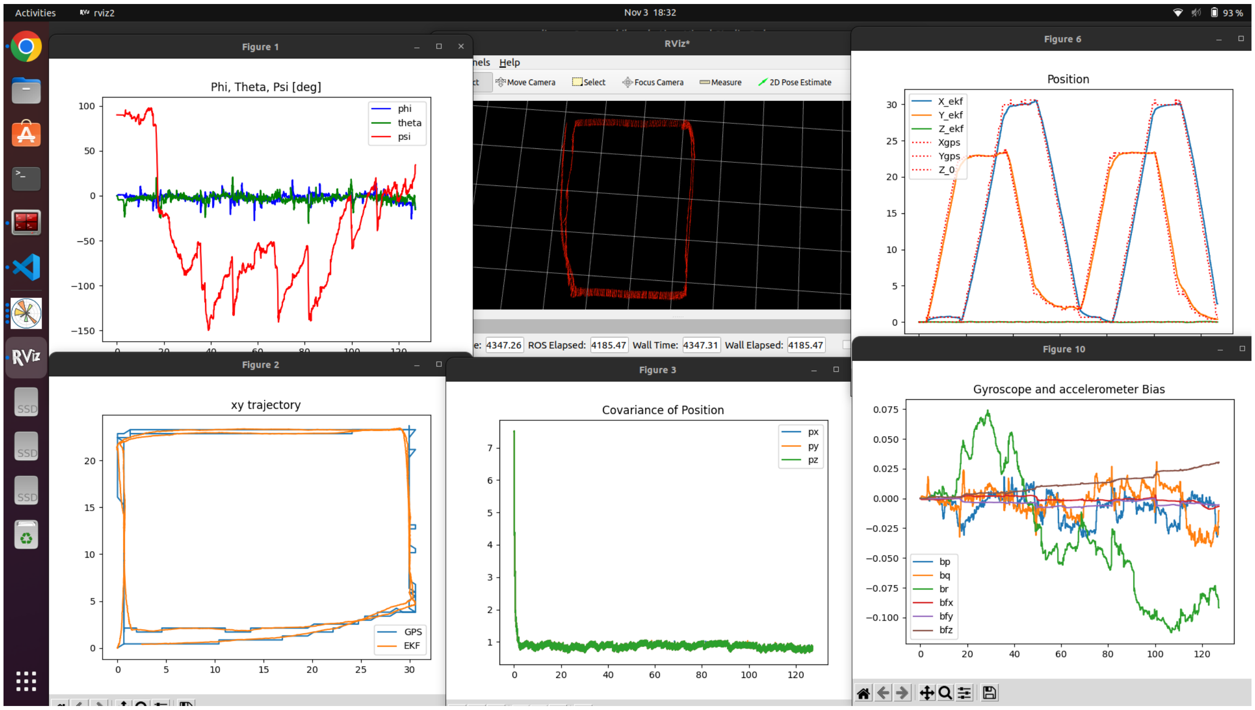
Q=100*Qoriginal



Result: The filter will be highly adaptive and reactive to any changes in the GPS data. However, because it considers the GPS data noisy, it might end up factoring in actual noise from the measurements. This leads to a trajectory that appears noisy and less smooth, potentially drifting away from the actual path.

Conclusion: The Extended Kalman Filter (EKF) demonstrates a commendable robustness in handling various system and measurement noise levels. Its adaptability and predictive capabilities ensure consistent performance in diverse scenarios, affirming its reliability as a state estimation tool.

7. Set the R_GPS to zero (I.e. assume the GPS is mounted at the CG), what happens to the position estimates and the attitude estimates? Explain why it happens in your report.



Position Estimates:
By mounting the GPS at the Center of Gravity (CG), positional offsets from system rotations are minimized. The Kalman Filter trusts the GPS readings more due to zero noise covariance, causing position estimates to closely align with the GPS trajectory.

Attitude Estimates:
With the GPS on the CG, attitude estimates become more accurate since positional discrepancies from rotations are reduced. However, other system dynamics might still influence certain attitude measurements, as seen with the psi angle discrepancy in Figure 10.

In summary, GPS placement at the CG enhances position accuracy and generally improves attitude estimation, but other factors can still affect some attitude aspects.