Darian Irani – irani2

Question 1:
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.

Question 4:
Plot estimated xy trajectory, euler angles, gyroscope bias, accelerometer bias, and covariance of position.

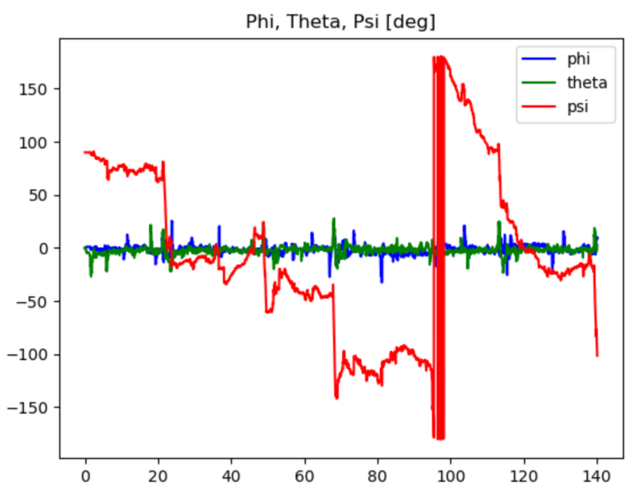

Figure 1: Euler angles

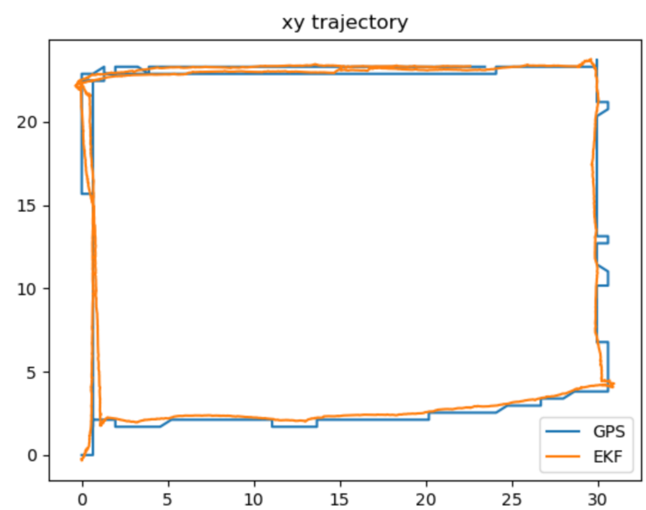

Figure 2: XY trajectory

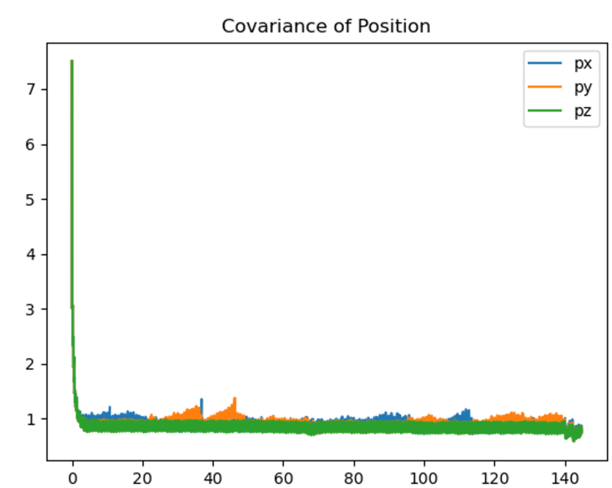

Figure 3: Covariance of position

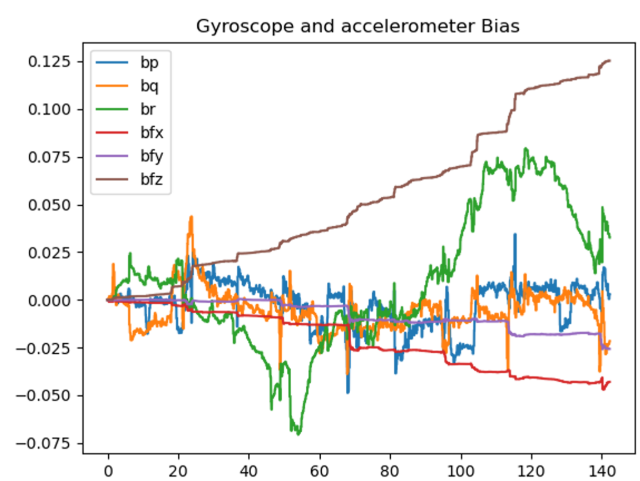

Figure 4: Gyroscope and accelerometer bias

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Question 5:

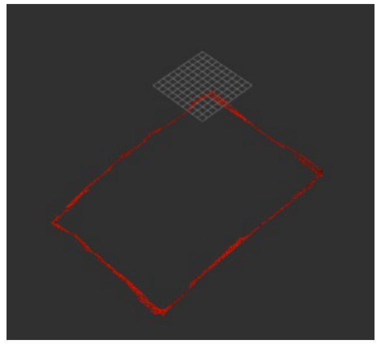

Figure 5: RViz2 trajectory

Question 6:

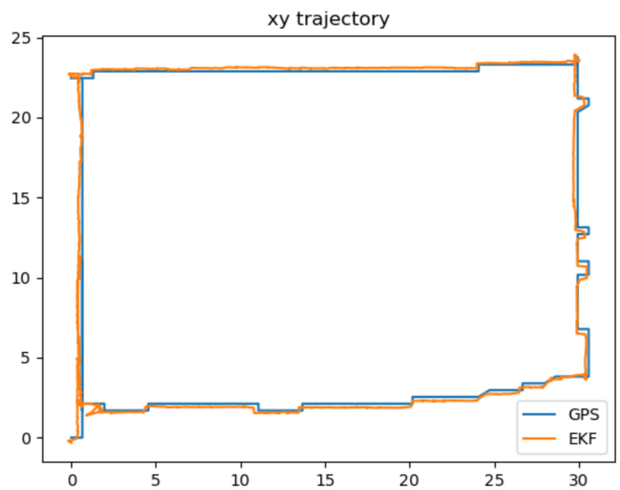

*Figure 6: R = 0.01*R_original*

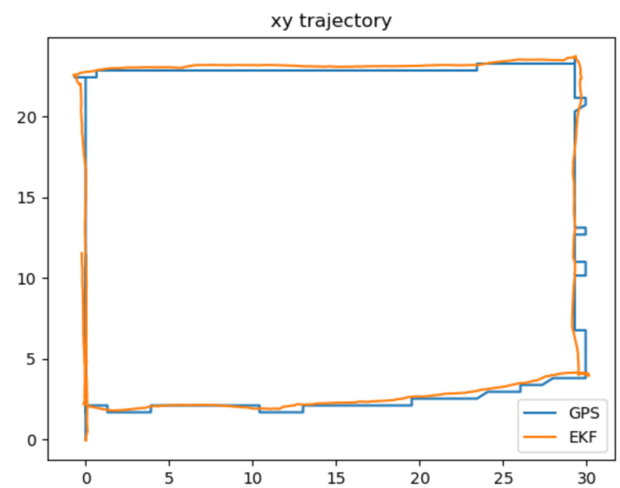

*Figure 7: 100*R_original*

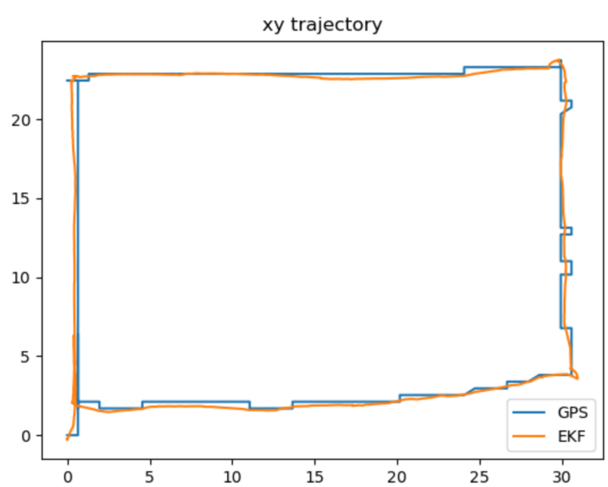

*Figure 8: 0.01*Q_original*

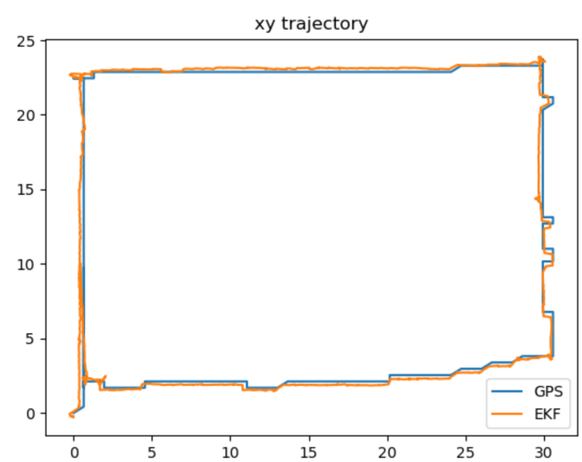

*Figure 9: 100*Q_original*

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R = 0.01*R_original:
The measurement noise is reduced by a magnitude of 100, the KF gives a lesser weight to its predictions and hence the estimated trajectory will more closely follow the GPS trajectory than before.

R = 100*R_original:
The measurement noise is reduced by a magnitude of 100, the KF relies on the predictions more and gives lesser weight to its measurements. The estimated trajectory may drift away from the GPS trajectory.

Q = 0.01*Q_original:
The process noise is reduced by a magnitude of 100. The KF behaves very much like the actual system, the predictions will be smooth, however, it may not capture rapid changes in trajectory. The estimated trajectory may lag behind rapid changes in GPS trajectory but it will be smooth overall.

Q = 100*Q_original:
The process noise is increased by a magnitude of 100 and implies that the KF expects the system to have more variability. Predictions are more responsive to changes in measurements. The estimated trajectory is more reactive to GPS trajectory but also considers some of the noise.

Question 7:

The GPS being mounted on the CG will result in the position estimates being more directly aligned with GPS measurements. KF will trust the GPS measurements as the noise covariance is zero, ultimately meaning that the position estimates will closely follow the GPS readings with no offset. If the GPS were not to be mounted on the CG, any rotation of the system around its CG will cause the GPS to move in a circular path, causing a positional discrepancy between the true CG and GPS-reported position. Attitude estimates are generally better since there's no additional error from the GPS position offset. Figure 10 shows that when rgps is set to zero the psi angle has a discrepancy when compared to Figure 1.

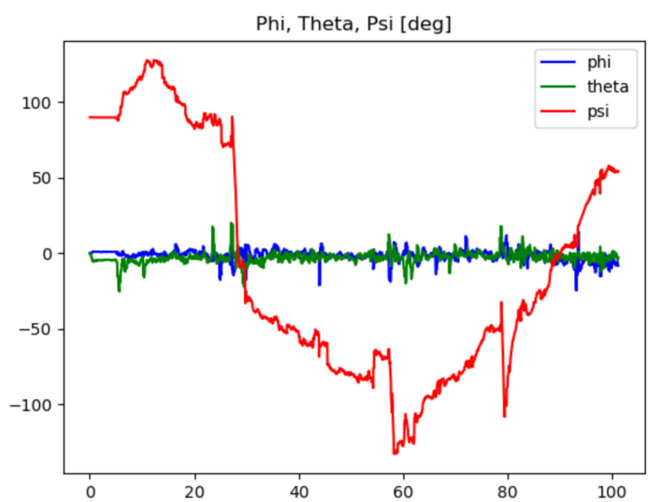

Figure 10: Euler angles with rgps = 0

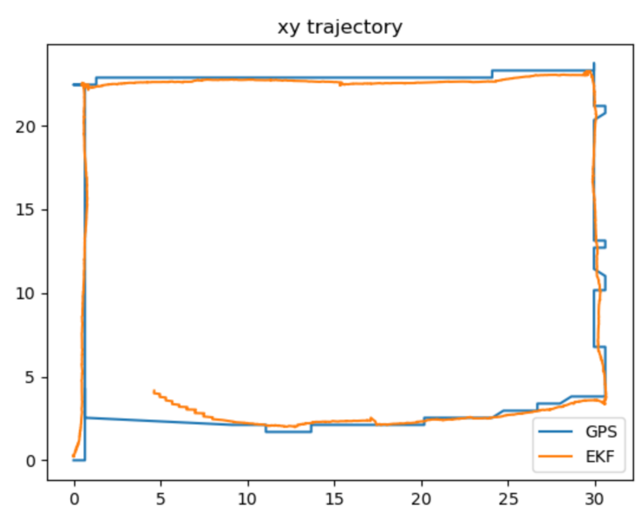

Figure 11: XY trajectory with rgps = 0