Aerial Robotics Kharagpur Documentation Task 4

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***Abstract*— This is the documentation of Task 4 which involved applying the Kalman Filter**

I. INTRODUCTION

The task included applying the Kalman Filter on large number of data points available in CSV files with Gaussian noise in them. Our task is to estimate the trajectory of the drone.

II. INITIAL ATTEMPTS

The initial attempts were more or less same as the final approach.

III. FINAL APPROACH

The Kalman Filter

I will briefly try to describe the working of the Kalman Filter here

Step 1: Calculation of Kalman Gain:

$KalmanGain(K) = \frac{p}{p+r}$

where p is the error in the estimate and r is the error in the measurement

Step 2: Calculation of new estimate:

$U_n = U_p + K(U_p - X)$

where U_n is the new estimate and U_p was the belief for time t at before the new measurement X was taken.

Step 3: Update of the Error in the estimate(p):

$p_1 = p * (1 - K) + q$

where q is the process noise which prevents p from going to 0 in which case the new measurement would be completely ignored. p was the previous error in estimate and p_1 is the new error in the estimate, also known as the state co variance matrix.

Implementation:

The data was first read from the CSV files using file handling. Then the Kalman Filter was applied on it and the expected values gave the trajectory of the drone which can be plotted on an image with proper scaling using opencv.

The function for the Kalman Filter used a static variable p as the state covariance matrix would be needed for each iteration.

The process noise q was taken as 0.01 which restricts p from going to 0

The error in the measurement was taken as the variance of the previous 10 measured values.

The average velocity was taken as 0.001 to have a belief of time = t from the belief of time = t-1 before taking in the new measurement.

The points were plotted using opencv after scaling them appropriately.

IV. RESULTS AND OBSERVATION

The expected values reduced the Gaussian noise and the trajectory of the drone was achieved with reduction in the noisy readings from the ground sensors.

CONCLUSION

The Kalman filter was applied but as there was no data provided for velocity the results could vary. The filter was not applied in its matrix form and the variables were treated separately to reduce calculations. Overall it was good experience to learn about the Kalman filter.

REFERENCES

[1] https://www.youtube.com/watch?v=CaCcOwJPytQ&t=12s
[2] https://www.youtube.com/watch?v=ruB917YmtgE
[3] http://web.mit.edu/kirtley/kirtley/binlustuff/literature/control/Kalman%20filter.pdf