The Kalman Filter: An Introduction to Concepts

Autonomous Robot Vehicles, I. J. Cox and G. T. Wilfong, Eds., New York: Springer-Verlag..
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1. Explain, using a simple example, what a Kalman filter does. Explain how the predict-update-cycle works?

2. What does it actually mean that the Kalman filter is a minimum variance estimator? The Kalman filter belongs to the *unbiased* linear filters – what does this actually mean?

3. Under what assumptions is the Kalman filter the best estimator? What do these assumptions actually mean?

4. Take a close look at the filter equations (Equations 1.3 and 1.4) – do they make sense to you - motivate? How come the variance is decreasing? In which case do you have the largest decrease of variance?

5. Assume you are using a Kalman filter to update a robots position (which is based on encoder values – dead reckoning – and observations that are matched to earlier experiences) – what will happen if you e.g. overestimates your uncertainty in dead reckoning? How will this affect the performance of the system?

6. Assume the robot (in question 5) stops, i.e. doesn't move for a long time, but keep observing the environment and updating the position. What will happen to the robots position estimate (i.e. position and co-variance matrix)?