Software Project One Assignment

Background

One learning outcome of this class is the ability to develop and prototype a Kalman filter. In software project one, you will develop a state-space signal model, generating both the input to the Kalman filter (the measurement or observation) and the "true" state vector values. In a later project, you will use this result to develop and test and Kalman filter. Each person will do their own project.

Project description

From the lecture, implement the discrete-time, time-invariant Kalman signal model in a MATLAB® function. The function should produce both a sequence of N length-N_r measurements and a sequence of N length-N_x state vectors. Use the random number seed you used in HW3.

Your function should be general, allowing for arbitrary F, G and C matrices as well as state vector initial conditions. You may assume that both the plant noise and measurement noise vectors consist of uncorrelated random variables, though they may have different variances. Thus, the corresponding covariance matrices are diagonal with possibly different diagonal elements.

Optional extra credit: You may research how to generate a vector of correlated random variables and use that, allowing the covariance matrices to be non-diagonal. The maximum score is still 100%, but the extra credit can be used to offset points taken off.

Project deliverable

Provide a short report (3-5 pages excluding appendix) in PDF that includes the following sections.

1. Background: Restate the problem in your own words, giving key equations.
2. Interface design: Give an example of how the function is called. Then provide a list of inputs and outputs, including an explanation of what each is.
3. Optional: If you do the extra credit, explain how you generated an arbitrary-length vector of correlated random variables and provide a test showing that you succeeded.
4. Benchmark example. Run your signal model for the one-dimensional motion model with roughly constant velocity (see lecture, example 9.10 in textbook). Use the parameter settings in Example 9.10 and produce two plots similar to Fig. 9.38 (omitting the curve for "Estimate"). Provide a set of plots for your code and a set of plots for your partner's code.
5. Conclusion. Summarize what you did and how your results compare to the textbook.
6. Appendix. Provide a printout of the source code you wrote.

Only provide what is asked for. The presence or absence of additional work has no grade impact.

Grading rubric: if you follow the instructions and provide all that was asked for in a clear manner, you get 100%. Points will be deducted if components are missing or wording is unclear.

Advice: carefully make a list of each item requested. In industry and academia, when responding to a request-for-proposal (RFP), this is called doing a "shred" of the RFP. Make sure each item is addressed in your report.