Prelim Exam #1, **AOE 5784, Model-Based Estimation & Kalman Filtering** Fall 2022

Exam rules: Do all problems. Hand in completed exam by due date and time, either by submitting a single .pdf file to the Canvas assignment site or by slipping a hardcopy under Prof. Psiaki's office door in 335 Durham hall. No collaboration or consultation is allowed with any other humans except Prof. Psiaki. He is willing to talk about problems if available. You may use (inanimate) outside sources (e.g. books). If you use such sources, then list them.

[10 pts] Problem Set 1, Number 11

[15 pts] Problem 1-1 in Bar-Shalom.

[10 pts] Problem Set 2, Number 2

[20 pts] Problem Set 2, Number 5

[20 pts] Problem Set 3, Number 1, except modify the two equations to be

$$0 = x_1 + x_2 + x_1 * x_2 + 5.1$$

$$0 = (x_1)^2 + 2*x_2 - (x_2)^2 - 1.9$$

That is, slightly change the two constant terms in the equations. Hand in your MATLAB code and your results, including the iterates and the norm(f) values.

[25 pts] Problem Set 3, Number 5, except use the data and the $\underline{x}$ first-guess that are contained in the file radarmeasdata_cart03.mat, which is available for download from the course web site. Hand in your initial Gauss-Newton step $\underline{\Delta x}$, your final estimate of $\underline{x}$, your initial and final values of the weighted nonlinear least-squares cost, and your combined dynamics-model/measurement-model function that computes [hj,Hj] = hjcart(x, tj, lradara, lradarb), i.e., the function that does the equivalent of what the function hjmissle.m does for the missile tracking problem that was discussed in lecture. Ignore the figure on sheet 5 of Assignment 3 because the new data come from a completely different cart trajectory. Make the equivalent plot of y_{r2} vs. y_{r1} using the function psiy1y2cart.m, the thist vector from radarmeasdata_cart03.mat, and your estimate of $\underline{x}$.