AE4803B Introduction to Avionics Integration
Spring 2003 Homework #4
Due: Monday March 17, 2003 at 11:05am (beginning of class) or before

1. Extra Research: Read the rules and other materials for the DARPA grand challenge at www.darpa.mil/grandchallenge/ and then propose a choice for navigation sensor(s) to install on your entry to win the challenge (do not worry about obstacle detection, just worry about giving any onboard computers knowledge of where the car is at all times with sufficient accuracy) in 200-300 words.

2. Problem 7.2 in Kayton & Fried, parts (a) and (b) only.

3. Summarize the equations and order of operations for a Kalman filter that utilizes two measurements of position (for example, one from GPS, and a second from multiple DME), that each become available at the same fixed time interval, to estimate the velocity and position of a vehicle in steady/level atmospheric flight. To keep everyone consistent, please use $\vec{z}_1(k)$ as the output of the first sensor at update number *k* (as *k* goes 1,2,3,…), and $\vec{z}_2(k)$ as the output of the second. Use the term $\hat{\vec{p}}(k)$ to denote your position estimate, and $\hat{\vec{v}}(k)$ to denote your velocity estimate. You my use any appropriate symbol you like for the other parameters you require.

   (a) In tabular form, list all parameters that must be selected in order to utilize your filter, including any required initial conditions – and describe how they might be obtained.
   (b) Write down all equations necessary to implement the filter, and indicate the order of operation, and how to start the algorithm.
   (c) For this problem, under what conditions would the Kalman gain matrix (*K*) be constant? (and why)

4. Be prepared to discuss in class what you propose for your final project for the class. For this assignment, please turn in a viewgraph to describe your proposed project. The intent of the final project is to: bring together the many different components we have covered so far (or will cover), to consider the integration of them into a useful system, and to do additional research beyond that covered in lecture.

   There are at least two approaches you may take for the project:

   (1) Develop the design of a new avionics system: develop requirements, select components, select architecture, analyze your design. Examples: Spacecraft attitude estimation system, radar-guided vehicle, integrated stability augmentation system, innovative cockpit interface, an element of the Georgia Tech entry into the aerial robotics competition (for those of you involved in that), etc.
   (2) Analyze an existing avionics system: document history, describe components and architecture, and suggest improvements. Examples: Boeing 777 avionics system, space shuttle avionics, Mars pathfinder spacecraft, the Pioneer unmanned air vehicle, etc.

Your viewgraph needs to include: (1) Which of these approaches (or some other one…) you plan to take, (2) What will be the scope of the work (what issues will be considered, and types of analysis will be performed – will you implement any algorithms and test in a simulation?), and (3) What approach you will take to obtain necessary information.