

AE4580 Introduction to Avionics Integration

Spring 2006 Homework #5

Due: Friday April 7, 2006 at 9:05pm (beginning of class) or before

1. Develop an Extended Kalman Filter (EKF) design that utilizes three range measurements from distinct DME transponders, that each become available at the same fixed time interval (a simplification from real life, where they would arrive at different time intervals), to estimate the 2-D (North, East) velocity and position of a vehicle in approximately steady/level atmospheric flight.
 - (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 if your system was used for real.
 - (b) Write down all equations necessary to implement the filter, and indicate the order of operation, and how to start the algorithm.
 - (c) In MATLAB, implement and test your filter for the first 60 seconds after the initial condition. Provide plots of the actual position, estimated position, north and east velocity estimate error (as a function of time), north and east position estimate error (as a function of time). Use the following: (and use your answer to part (a) for any parameters missing here)
 - (i) Aircraft starts at (0 North,0 East) and moves with velocity (300,400), units are *ft* and *ft/sec* respectively
 - (ii) Initial guess for aircraft position and velocity estimates are (-1000,0) and (300,450) respectively (i.e., both state estimates are initially incorrect)
 - (iii) DME transponders are located at (30000,0) and (10000,30000), update rate is once per second for both – and both update at the same time

Note: be sure to add *appropriate* zero-mean Gaussian noise to your simulated DME measurements used to test your design.

2. Extra Research: Select a Flight Management System (FMS) used on an in-production commercial aircraft (e.g. G-550, B-737NG, 747-400, 767, 777, A-319, 320, 321, 330, 340, 380 etc.). Summarize what it can do in about 500 words. As always, indicate your sources of information.