

UNIVERSITY OF CALIFORNIA, DAVIS

Dept. of Mechanical and Aerospace Engineering

Due: Tuesday April 21

Homework Assignment 2

From the class reader “Aircraft Dynamics and Automatic Control,” go to the Appendix and using the data for the F-89 aircraft (Flight Condition 8901) on pages A3 – A5

- 1.) Set up the equations of motion for both the longitudinal and lateral/directional motion. Assume elevator $\Delta\delta_e$ (longitudinal) and aileron $\Delta\delta_a$ (lateral/directional) are the control inputs for the simulation to be described. Your state variables should be:
 - a. Longitudinal: Δu , Δw , Δq , $\Delta\theta$, and Δh
 - b. Lateral/directional Δv , Δp , Δr , $\Delta\phi$ (roll), and $\Delta\psi$
- 2.) Complete an eigenanalysis of both longitudinal and lateral/directional motion. This should include:
 - a. identification of the characteristic roots
 - b. identification of the eigenvector elements for each of the state variables defined above (you need not sketch the modal time histories)
 - c. time histories using the MATLAB *initial* command in which you excite each mode separately. You will need two run lengths here to capture both the phugoid and short-period responses. Your plots should include each of the state variables. However, in defining your output equations, change Δw to $\Delta\alpha$, and Δv to $\Delta\beta$
- 3.) Find the following transfer functions using MATLAB:
 - a. $\frac{\Delta\theta}{\Delta\delta_e}(s)$ (pitch to elevator) and $\frac{\Delta\phi}{\Delta\delta_a}(s)$ (roll to aileron)
 - b. Compare your transfer functions to those given on p. A-5
- 4.) Using the MATLAB *step* command, show the responses to step control inputs:
 - a. $\Delta\delta_e = 5/57.3$ rad (longitudinal). Here just plot responses $\Delta\theta$, and Δh . You will need two run lengths here to capture both the phugoid and short-period responses
 - b. $\Delta\delta_a = 5/57.3$ rad (lateral/directions). Here just plot responses $\Delta\phi$ (roll) and Δr

NOTE: The uploaded handout “Eigenanalysis and Examples” describes the procedure for completing the assignment