Prof. Daniel J. Bodony
Aeroelasticity (AE 451)
Fall 2019

Project

Due 13 December 2019 On *Compass2g*

For the final project, you are to select from one of the following options. The project deliverable is a written report in the style of an AIAA Journal paper. AIAA Journal templates are available for MS Word and for LaTeX.

You may work in groups of up-to three people. You ***must*** *e-mail me your group list.*

Problem 1 Predict the divergence of a swept wing using the Rayleigh-Ritz method combined with the aerodynamic model from "Modern Adaption of Prandtl's Classic Lifting-Line Theory," by Phillips & Snyder, *J. Aircraft*, 2000, that is available on the class website. In this project you would need to:

(a) Formulate and implement the Rayleigh-Ritz problem for the bending and twisting of the wing.

(b) Implement and verify the aerodynamic model.

(c) Formulate the static divergence problem to be solved using (a) and (b).

(d) Implement the static divergence problem.

(e) Verify the static divergence code using an unswept wing by comparing with an existing panel divergence prediction from any of the text books listed on the class website, or another source of your choosing.

(f) Apply the static divergence code to a swept wing of your choice, being sure to document the wing properties and convergence through model refinement using more wing panels and more Rayleigh-Ritz modes.

Problem 2 Predict the flutter Mach number as a function of altitude for the initially-flat clamped panel described in "Flutter at Mach 3 of Thermally Stressed Panels and Comparison with Theory for Panels with Edge Rotational Restraint," by Shideler, Dixon, and Shore, NASA TN D-3498, 1966, using Rayleigh-Ritz or a modal model of the panel. In this project you would need to:

(a) Develop and implement a Rayleigh-Ritz or modal model of a fully clamped rectangular planel and verify that either approach correctly predicts the first four free vibration frequencies (1-1, 1-2, 2-1, and 2-2 modes) when given sufficient resolution.

(b) Couple the panel model to a piston theory approximation of the external aerodynamics. You may assume that the static pressure difference across the panel is zero.

(c) Formulate and implement the condition necessary to solve for the flutter Mach number as a function of altitude assuming an International Standard Atmosphere (ISA).

(d) Verify your panel flutter tool by comparing with an existing panel flutter prediction from any of the text books listed on the class website, or another source of your choosing.

(e) Plot the flutter Mach number as a function of altitude, from sea level to 100 km, for the panel described in NASA TN D-3498, being sure to document convergence through model refinement using more Rayleigh-Ritz modes or more panel grid points.

If you are taking AE 451 for 4 credit hours: please prepare and submit a short video (3–4 minutes) describing your project, describing your methods, and presenting your results. Slides are highly encouraged. The videos are *individual* and not a group effort.