AERO 4630 - Aerospace Structural Dynamics

Project 3

Assigned: Friday, February 21 2020
Due: Friday March 6 2020 at 17:00, uploaded on Canvas

Office Hours: Davis 335, Wednesdays 1300-1400 hrs

Instructions

1. You are to submit a single **.zip** file containing a) your code as .py file, and b) a PDF containing your solution with appropriate plots.
2. Practice good coding guidelines with appropriate comments and meaningful variable names. Good coding practice will be rewarded with bonus points.
3. Plagiarism of any sort will not be tolerated. You code might be checked against plagiarism software (like MOSS). Any instance of plagiarism will be dealt in accordance to AU policy.

Problem 1: Cantilever beam vibrations

Let's pick up where we left off in Project 2. Consider a steel ($E = 200GPa, \nu = 0.3$) rod of rectangular cross section area. The dimensions are length $L = 50mm$, $W = 5mm$ and $H = 5mm$. Just like last time, the face $x = 0$ is clamped, and a traction (force/area) is applied on a patch in the negative y direction. We have a constant traction of $T = 20kN/m^2$ applied uniformly on a patch located at $0.9L \leq x \leq L$, $y = W$ and $0 \leq z \leq H$.
As a consequence the beam will bend. We are interested in vibrations of the beam once the traction is removed.

(1a) Plot the vertical displacement of the point $(L, W/2, H/2)$ as a function of time. Run the simulation for at least 10 cycles and obtain the frequency of vibration. *Note: your displacement should not decay significantly. Choose your timestep wisely*

(1b) Repeat this problem for copper and aluminum rods, of the same geometry and compare the results. For which material is the frequency highest? Which one has the lowest?

(1c) Now let's study the effects of frequency with change in moment of inertia. Let's use the steel rod and repeat the analysis for $H = 1mm, 2mm, 3mm$ and $4mm$. How does the frequency of vibration change with H?