CA 4: Flutter analysis using PK method

In this CA, you will submit an **A3 poster**. The poster should be in Microsoft Powerpoint format (only if you created the slides in LaTeX, then upload compiled PDF). Please **upload the poster and the code, separately, to NTULearn where there will be checks on plagiarism.**

Poster

1. On the first slide of your poster, you should include your working (typed or by hand then scanned), including the 4 X 4 matrix with equations inside, plots and discussions.
2. On the second slide of your poster, cut and paste your code.

Code

3. Upload the code in *.m format

In this assignment, you are required to find the flutter speeds and frequencies of a plunge-pitch 2D airfoil using PK method. The parameters for the airfoil and operating conditions are given below.

Structural parameters	Density	$\mu = 800$ kg/m^3
	Chord	$c = 2$ m
	Location of elastic axis from leading-edge	$x_f = 0.45c$ (a = -0.05c)
	Thickness	$t = 0.01$ m
	Length	$l = 3.0$ m
	Plunge natural frequency	$\omega_h = 2$ Hz
	Pitch natural frequency	$\omega_\alpha = 6$ Hz
	Plunge stiffness	$K_h = m\omega_h^2$
	Pitch stiffness	$K_\alpha = I_\alpha\omega_\alpha^2$
Air density		$\rho = 1.225$ kg/m^3

1. Solve using PK method the flutter speed for a plunge-pitch airfoil
2. Plot frequency and damping against air-speed. Determine flutter speeds
3. Plot a root locus for plunge and pitch for velocity between 0 to 100m/s. (i.e. directly plot the largest two eigenvalue in imaginary form.) Indicate which root is for plunge and which is for pitch. Also indicate direction of root movement as velocity increases.

General approach for using Matlab

- General approach
  - g. *Clear all* *% remove all stored info*
  - h. *Constants* *% define the constants*
    E =…
    rho_f = …
  - i. *Loop increasing values of velocity using for loop*
    - a. *Define the first order EOM and assemble matrices for each velocity*
    - b. *Perform eigenvalue analysis. The eigenvalues will be complex conjugate pairs*
    - c. *Store two eigenvalues with the highest complex pairs among the four.*
  - j. *From the eigenvalues, obtain the frequency and damping ratio at each velocity*
  - k. *Flutter occurs when the damping ratio for either of the eigenvalues turns negative.*
  - l. *Analyse and plot results*