

ENME488: Flight and Spaceflight Mechanics

Assignment 1 (Individual): Flight Mechanics Simulation

This is an individual assignment and the work you submit should be your own. Material cited from other sources (including figures) should be appropriately referenced in the text and displayed in the References section using the APA or IEEE format.

Task:

Select an aerospace vehicle that has successfully been operated (discuss your choice with the Course Coordinator), and create a 6 degree of freedom (DOF) model of the vehicle in flight. You will need to source (or estimate) aerodynamic coefficients and moments of inertia for the craft.

You can use an existing software package (such as the Aerospace Toolbox in MATLAB/Simulink), flight simulation software or available libraries, such as the SimuPy Flight Vehicle Toolkit for Python. It is a good idea to start with an existing example vehicle, but if you do, you must modify the inputs for the reported analysis.

Once you have a flight model, you should conduct the following performance analysis:

- Demonstrate that a trim condition can be achieved for the vehicle at a specified operating point.
- Perturb the initial condition and demonstrate the response of the vehicle.
- Finally, estimate the *handling/flying qualities* of the vehicle, and compare these with any published information (this may be a qualitative comparison).

It is not necessary to visualise the flight path of your vehicle (though it is fun!)

Hint: You might find the following test cases useful: <https://nescacademy.nasa.gov/flightsim>

Reporting: 20%

Submit your assignment as a short report (< 10 pages not including References or Appendices) in .pdf format via Learn by *23.55 NZST Wednesday, 13th of September*. The report will be assessed using the standard Masters Thesis/Research Portfolio rubric, available on Learn.

The report should include the following:

- An Executive Summary, briefly describing the purpose of the vehicle and the main results of the analysis
- A Background section that includes an appropriate image/schematic and description of the main components of the vehicle.
- A Methodology section outlining the modelling approach
- A Results section demonstrating trim, perturbation response and comparing modelled flying qualities with known qualities.
- A Conclusions section to summarize findings and suggestions for future refinements of the model.
- A References section in APA format.
- Appendices should include the input data to your model and any additional figures.

A list of acronyms can be included if necessary.