User Guide for AeGIS: Aero-elastic Graphical Interface Simulator

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What is Fin Flutter?

Aeroelastic divergence, or fin flutter, is a phenomenon that occurs at high rocket speeds where airflow over the fin causes a structural resonance in the rocket fin. This leads to higher than usual aerodynamic loading and can lead to rocket fin failure and an unpredictable flight path. An example of fin flutter occurring may be seen in here:
https://www.youtube.com/watch?v=pyct1Pii_cg&t=31s

The fin flutter velocity or divergence velocity can be calculated using numerical methods (FEA-CFD coupled stability simulation) or analytic methods using fin geometry.

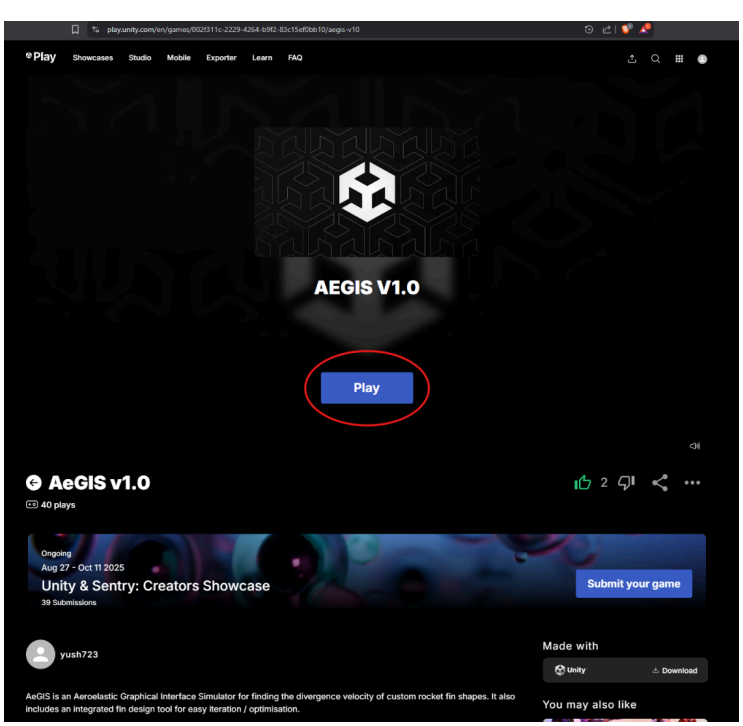
What does AeGIS do?

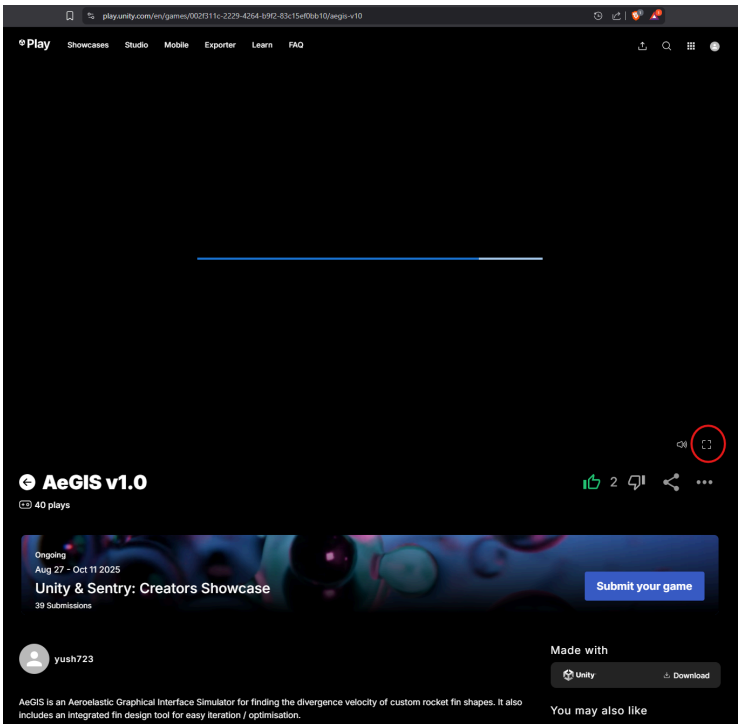
AeGIS calculates the fin flutter velocity analytically for polygonal fin shapes using the methods described by Apogee Rockets in Newsletter 617 and 615:
https://www.apogeerockets.com/Peak-of-Flight/Newsletter617
https://www.apogeerockets.com/Peak-of-Flight/Newsletter615

The software also includes an integrated fin designer (similar to OpenRocket) so the user can easily iterate fin designs optimising for the highest divergence velocity.

How to use AeGIS to calculate fin flutter velocity

To use AeGIS, head to this link hosted on Unity Play:
https://play.unity.com/en/games/002f311c-2229-4264-b9f2-83c15ef0bb10/aegis-v10

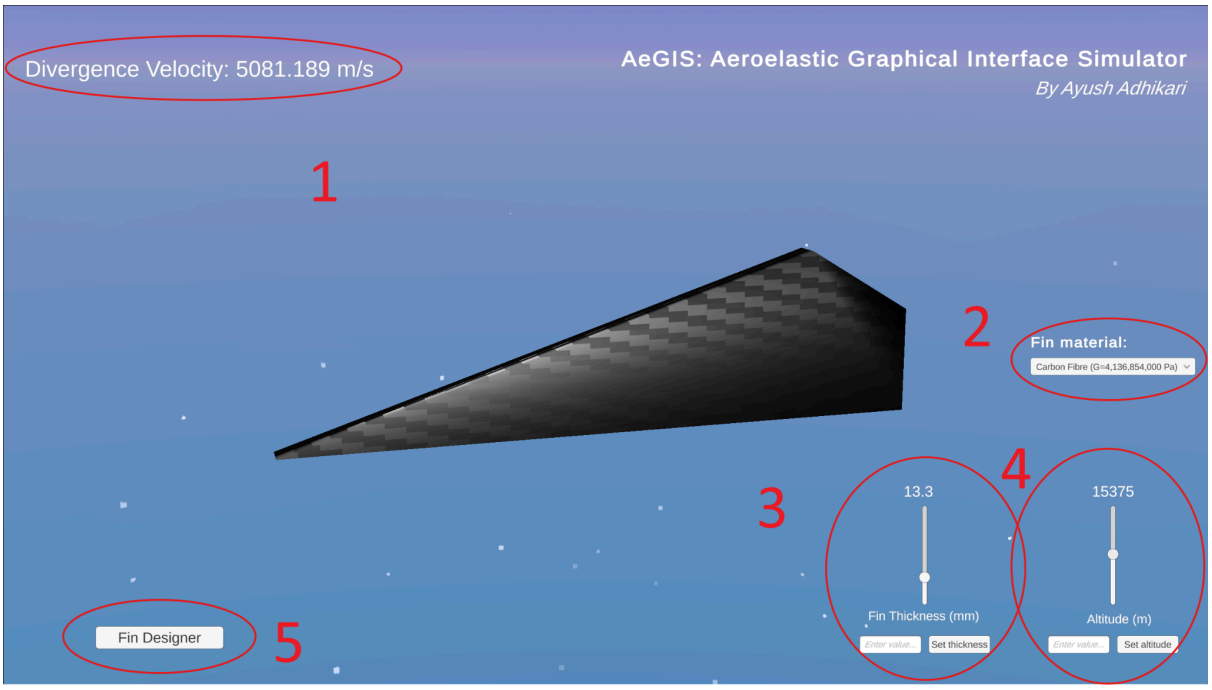




Then press the ‘Play’ and fullscreen buttons (highlighted in red).

Main Page

This should take you to the main page as seen below:



Controls

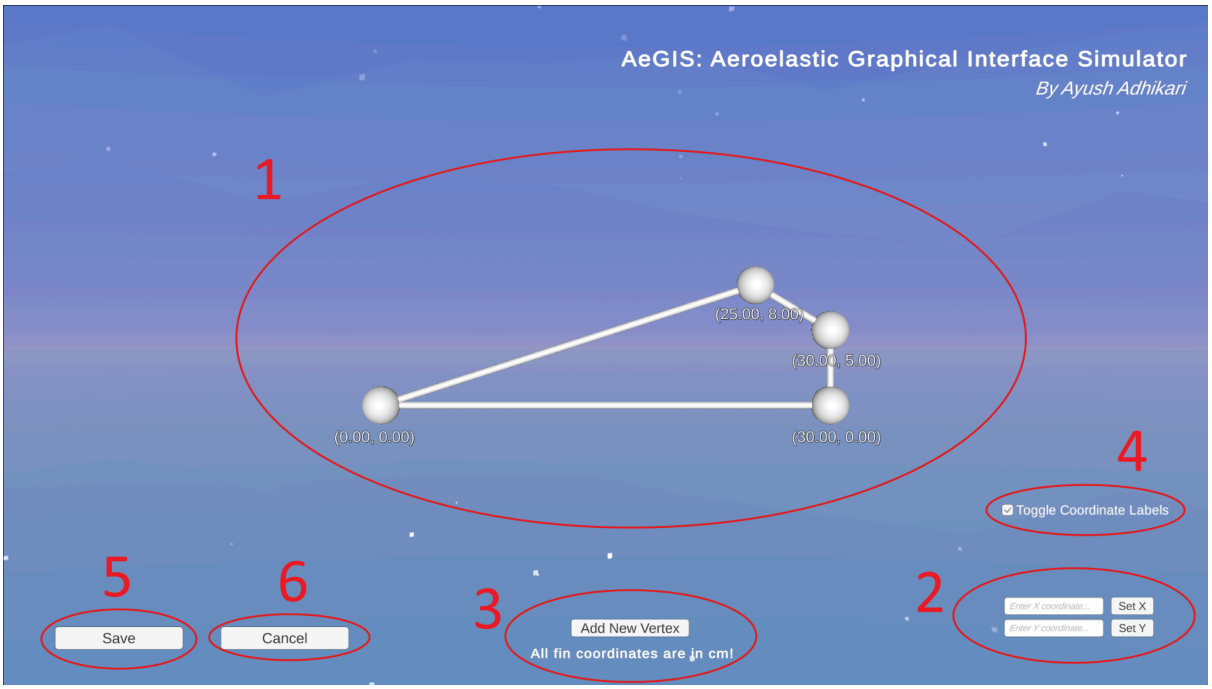
- **RIGHT CLICK:** Hold right click and move the mouse to roll the view around the fin model.
- **LEFT CLICK:** Use left click to press buttons.

Labels

1. Divergence velocity / fin flutter velocity for current fin configuration
2. Dropdown for selecting fin material
3. Slider for changing the fin thickness. You can also input a custom thickness and click set thickness.
4. Slider for changing the current altitude. You can also input a custom altitude and click set altitude.
5. Fin Designer page

Fin Designer Page

By pressing the 'Fin Designer' button, you can change the fin's 2D profile. In this fin designer, the vertex at (0,0) is fixed in space and the adjacent vertex (initially at 30,0) is constrained to the x axis. Think of the line between those vertices as the root chord.



Controls

- **LEFT CLICK**: Drag and drop a vertex using left click to change the fin shape
- **CTRL+LEFT CLICK**: Hold control and click left click to delete a vertex
- **RIGHT CLICK:** Select a vertex by right clicking it. A selected vertex will turn green.

Labels

1. **The 2D fin model.** This region is drag and droppable with the left click and other controls.
2. **Manually set fin coordinate.** To precisely set a vertex's coordinate, select the vertex using the right click. Then you can type an x coordinate or y coordinate into the associated fields and press 'Set X' or 'Set Y' to set them.
3. **Add new vertex button.** Click this to add a new vertex to the fin shape.
4. **Toggle Coordinate Labels**. Click to toggle coordinate label visibility on and off.
5. **Save button.** Click to save current fin design and return to the main page. Will not save fin design if the geometry is not valid.
6. **Cancel button.** Returns to the main page without saving the fin design