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BOXER Tutorial:

Physics based Level-set morph

BOXER version 3.10.0

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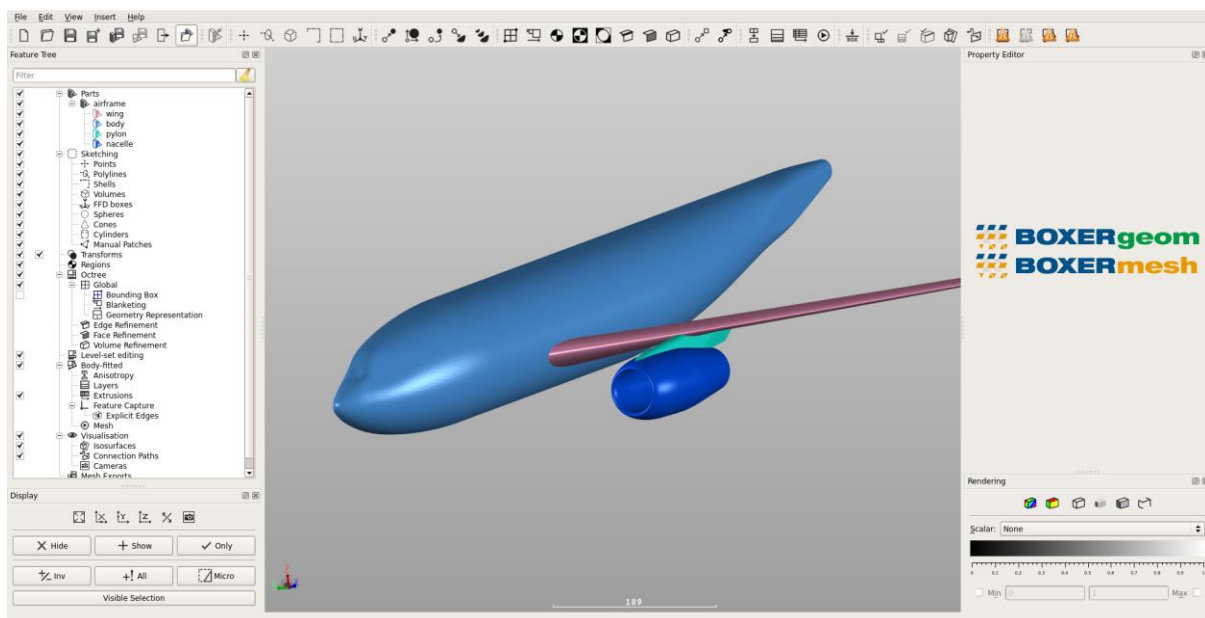
Physics based Level-set morph

In this example we will morph a source shape in response to a surface scalar using Level-set morphing functionality. This simulates ice build-up on a wing. The user has access to all the shapes that represent the time evolution of the surface in response to the scalar (amount of icing) and these shapes can be loaded into the BOXERmesh geometry register and sent to the normal meshing process.

This tutorial assumes that the user is familiar with the general method of the BOXERmesh GUI, and the operation of the various specifier panels. If this is not the case then please beginner BOXERmesh tutorial.

Import the geometry from airframe.btf

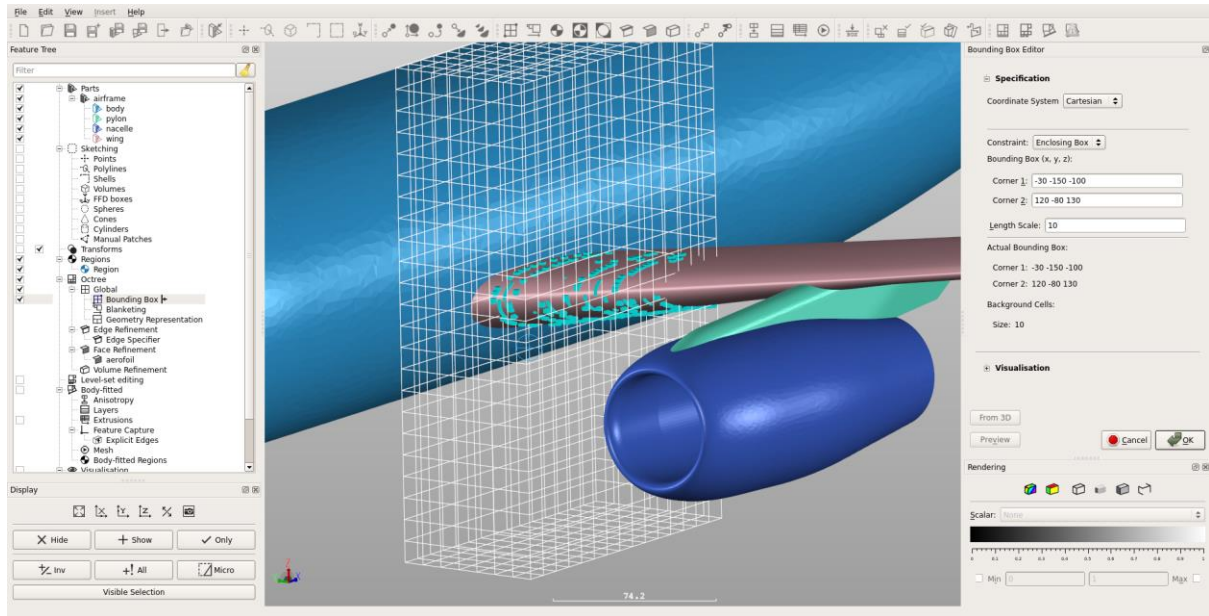
- File > Import Part from the menu bar, OR
- Click the Import Part toolbar button, OR
- Use the keyboard shortcut Ctrl-G
- Open `airframe.btf` from the file browser



Set up the Octree domain as if for meshing

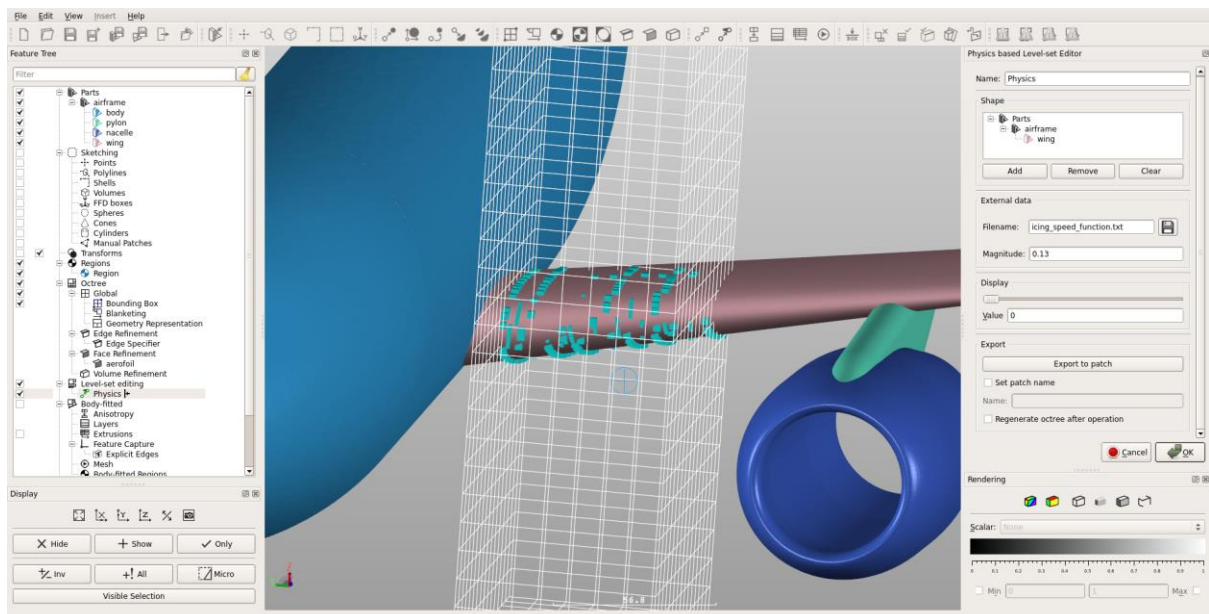
The physics-based level-set morphing operates in the same domain (bounding box) and with the same resolution as the octree mesh. Therefore, setting up a case for physics-based level-set morphing is just like setting up a case for meshing.

- Create a bounding box around the geometry with constraint: Enclosing Box and the length scale = 10
corner 1 : (-30 -150 -100)
corner 2: (120 -80 130)
- Create a Region, with a seed point at (0 -130 0)
- Create a Face Refinement specifier for the patch 'wing' at Octree level 2
- Create an Edge Refinement specifier for a Maximum Radius of Curvature of 20 on patch 'wing' at Octree level 3
- Turn on Octree Preview to see the size of the surface cells relative to the geometry



Create a Physics based Level-set morph Specification

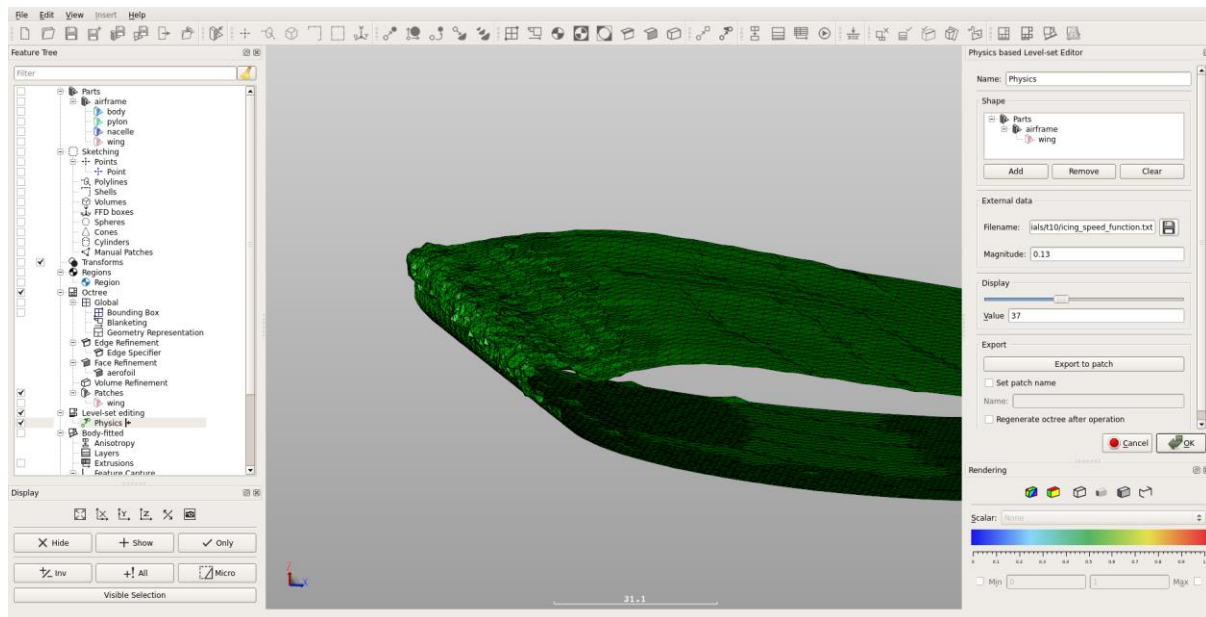
- Insert > Level-set editing > Physics from the menu bar, OR
- Click the “Create new physics based level-set editing specifier” toolbar button
- The Physics based Level-set Editor appears
- Drag-drop wing from the Feature Tree to Shape field on the Editor
- Open the External Data file browser to select a surface based scalar file
 - select `icing_speed_function.txt` as the data file
- Set the magnitude to a value of 0.13
- Uncheck the 'Regenerate octree after operation' checkbox
- Click OK





Generate the Physics Based Level-set morph

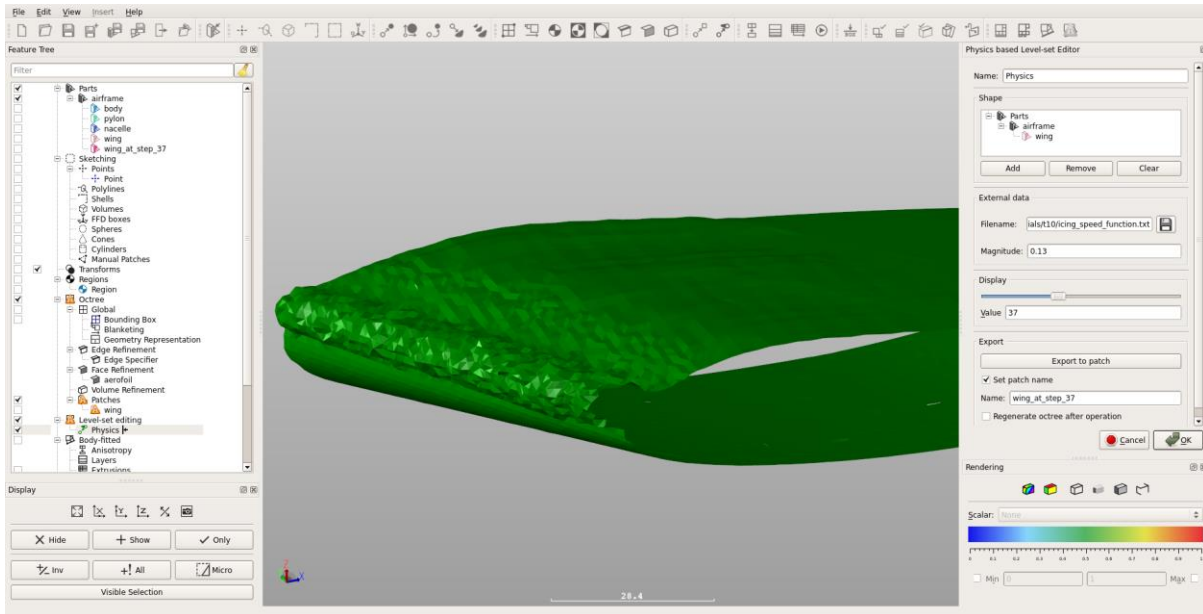
- Press the 'Generate Level-set' button on the toolbar (*the button goes orange to indicate that BOXERgeom is busy*)
- When the Level-set calculation is complete, the Generate Level-set button goes grey and its action is disabled to indicate that the Level-set is up-to-date.
- The Level-set surface appears in the scene



Turn off the visibility of everything else to leave just the physics based Level-set morph ('Physics') envelope on screen.

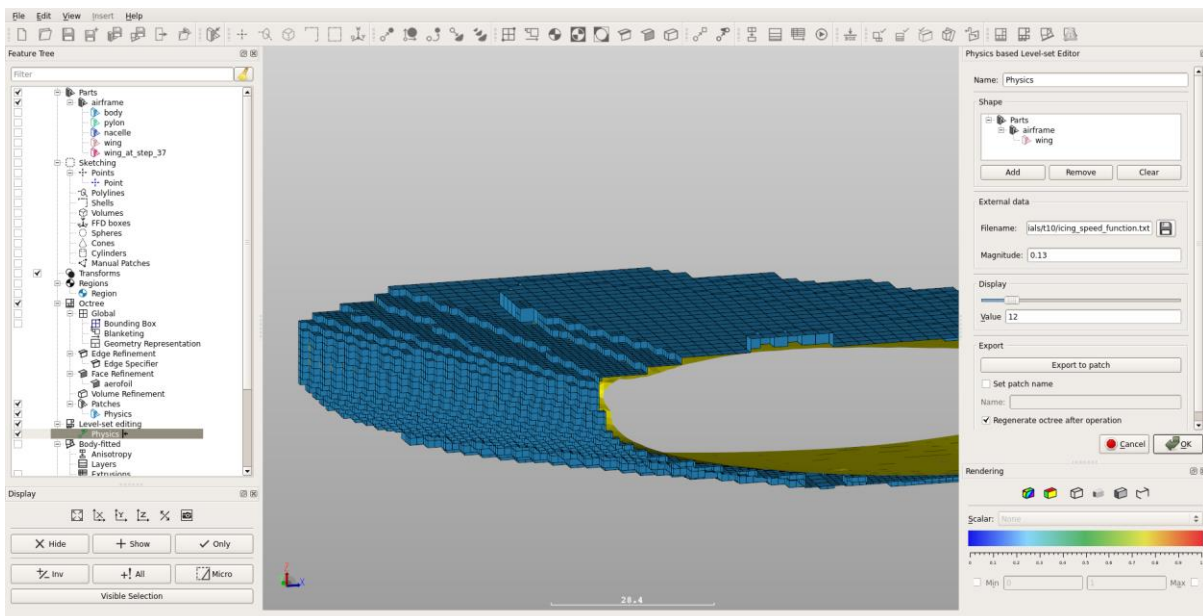
Now move the 'Display' slider to some non-zero value and observe how the physics based level-set evolves through time (increasing "ice" build-up)

At any point press 'Export to Patch' and note then the current morph state is exported to the geometry register of BOXERmesh – you can choose your own name for the exported geometry by enabling Set patch name.



Generate a mesh around an intermediate physics-based morph shape

- Double click on the 'Morphing' node in the Feature Tree to re-activate the Morphing Editor
- Move the Display Slider value to 12
- Check the 'Regenerate octree after the operation' button
- Click OK to update the Morphing specification
- Press the 'Generate Level-set' button on the toolbar
- The Octree mesh is generated around the Level-set shape at slider value 12



- Press the 'Generate Inviscid Mesh' button
 - BOXERmesh generates a volumetric body-fitted mesh around the Level-set shape at slider value 12 in the normal way.
 - This mesh can have layers added/be extruded/be exported for analysis in the normal way

