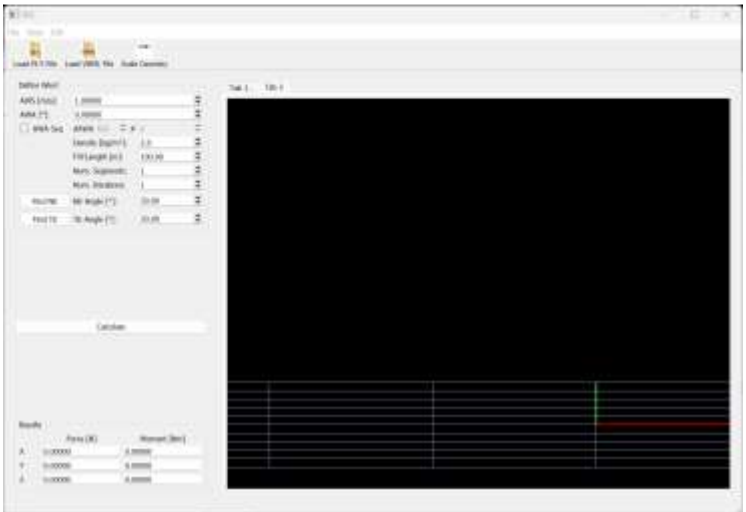
VLC Vortex lattice code short user manual

1 Installation

No installation procedure is necessary to use VLC. Place the deployed two folders „BIN64“ and „Example Files“ in a parent folder of your choice. Double clicking „.\BIN64\vlc.exe“ will fire the program. That’s it.



2 Sail model file

Sails and sail sets are described using the .ply – file format. It describes a sail with a set of panels. This is done by a large set of vertices and a consecutive set of vertex indices, describing a panel , defined by 3, 4 or 5 vertices.

A simple example of a .ply-file for a rectangular flat sail, defined by two pnales is shown here.

```
ply
format ascii 1.0
comment File exported by Rhinoceros Version 4.0
element vertex 6
property float x
property float y
property float z
element face 2
property list uchar uint vertex_index
end_header
0.000000 0.000000 0.000000
0.000000 0.000000 1.000000
0.000000 0.000000 2.000000
1.000000 0.000000 0.000000
1.000000 0.000000 1.000000
1.000000 0.000000 2.000000
4 4 1 0 3
4 5 2 1 4
```

Common .ply-files for sail sets usually define 1000 or more panels and are hard to generate from scratch by hand. A common way to generate a .ply-file is the use of a CAD-program or a surface modeler. Rhinoceros 3D © is an excellent program to generate .ply-files of sail sets of arbitrary shape. Make sure to save the .ply-file in readable ASII mode.

3 VLC by example

After firing the program as described above load the “imoca.ply” file from the example’s directory. A message box will tell you that this ply-file consists of about 1000 panels. You should see an Imoca sail set in the graphics window.

Use the middle mouse button to rotate the graphic, use SHIFT-middle mouse button to pan and CTRL-middle mouse button or the mouse wheel to zoom the graphic.

Now define some calculation parameters. Define the apparent wind speed AWS and apparent wind angle AWA in the respective input fields. Remember that SI-units are used (m, s, kg) and the right-hand coordinate system shown on the grid (red axis denotes x-axis, green axis denotes y-axis, z-axis is upright. Intersection of red and green axis is the origin). Set AWS= 8m/s and AWA=150°.

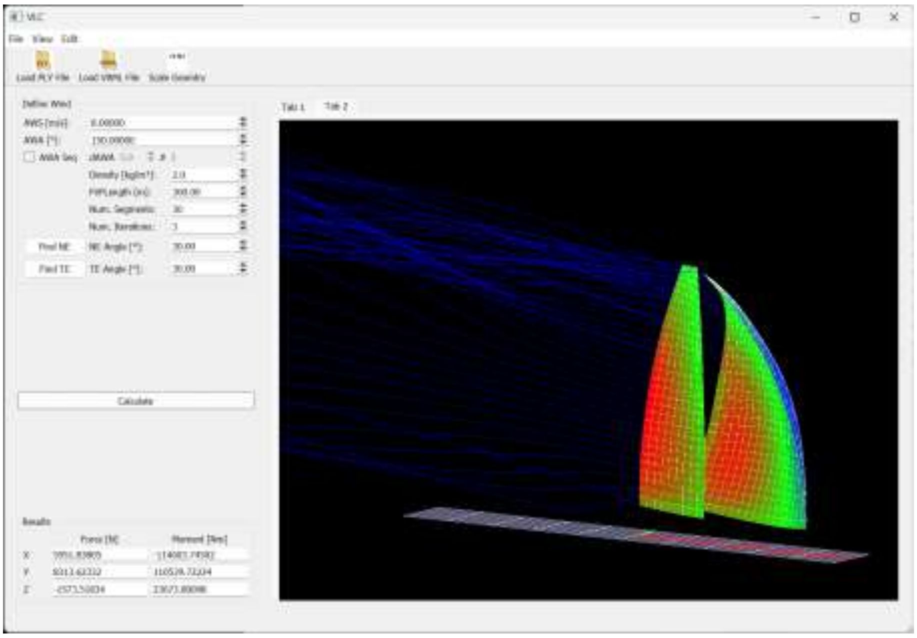
Naked edges: Push the [Find NE] button. The free edges of the sail will turn yellow. Check that only outside boundaries of the sail turn yellow (leech, luff, foot, maybe headboard). If panel edges within the sail turn yellow, your ply-file is erroneous. Presumably there are gaps between two panels in the sail. You have to correct that.

Trailing edges: Push the [Find TE] button. This will find the subset of naked edges which are trailing edges (usually the leech of the sail). Free vortex filaments will start here, depicted by blue lines. The “FVFLength” input field defines the length of the free vortex filaments. It should be set to at least 10 times the span (height) of the sail set. VLC has a linear and a non-linear mode. If the input fields “Num. Segments” and “Num. iterations” are set to 1, the linear mode is used, where the free vortex filaments will not change their shape.

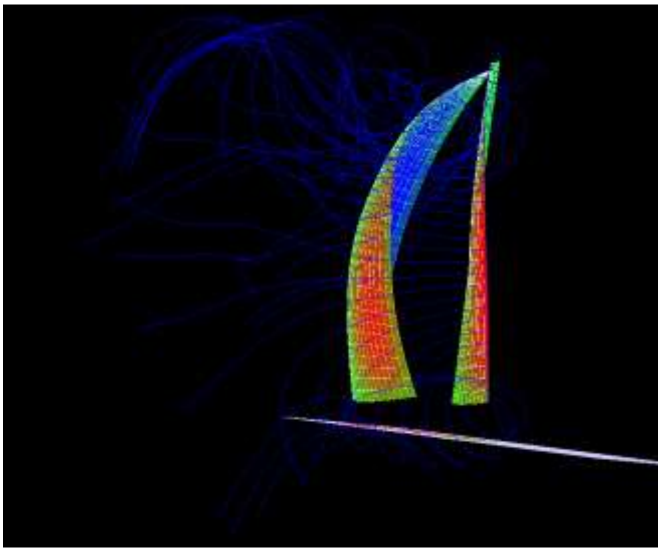
Try linear mode first by pushing the [Calculate] push button. It will take a few seconds on a modern PC to get a solution. Calculated forces are shown in the output fields at the lower left corner of the window. You also may use the Tab1 tab to see a text window showing the output. Remember that no viscous forces are calculated and the sail set is assumed to be rigid.

Set “Num. Segments” to 30 and “Num. Iterations” to 2 to use non-linear mode, where the free vortex filament are oriented along the local effective wind direction. Push the [Calculate] button again. You have to wait a little longer and will get slightly different results.

Use the “View” menu to activate “Plot Color Map”. Remember to redraw by using the respective menu entry. You will get a view like this:



Rotate the graphics so that you have a look from behind (AWA is blowing into your face). You may detect the free vortex filament roll up:



Calculating a sequence of apparent wind angles: check the “AWAS Seq” check box to define a sequence of AWAs for which the calculation is done. Set “AWA” to 140°, “dAWA” to 5° and number of AWAs “#” to 5 to calculate forces for the AWAs. The result can be seen in the Tab 1 text tab.

HINT: There is an experimental method to consider stall condition. The largest angle between the free vortex filament and the tangent at the sail’s leech can be used to control stall behavior. Set the “AWA” value to 160° and the “TE Angle” input field to 30° and push the [Find TE] button and you will see free vortex filaments along both sail leeches. Change the “TE Angle” input field to 15° and push [Find TE] again and you will see that there are no free vortex filaments close to the top of the main sail and over almost the entire genoa leech. At stall condition no vortex filaments are generated, usually indicated by tell tales pointing against the wind direction. Use this feature carefully.

HINT2: If you want to model a deck which prevents generation of free vortex filaments at the foot of the sail (to mimic a decks-sweeper jib for example) you can either generate a mirror plane with some panles or generate a mirrored sail.