

Xoptfoil-JX is a modified version of Xoptfoil version 1.11.1 – the airfoil optimizer by Daniel Prosser

## Xoptfoil-JX Reference

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- see 'Xoptfoil-JX Description' for more detailed information.

### Aerodynamic target values

With the new optimization types 'target-drag' and 'target-moment' one can define a certain 'target\_value' for an operating point. With this the Xoptfoil optimization tries to get to the value of the design variable as close as possible to the defined target value. As with the normal optimization types the gravitational force towards the target value is controlled by the weighting of the operating point.

<code>optimization_type(n)</code>	Additional types 'target-drag' and 'target-moment'
<code>target_value(n)</code>	Numerical value which should be achieved. A negative value will be taken to multiply the value of the seed airfoil to get the target value – so "-1.0" would mean: Achieve the value of the seed airfoil.

Example:

```
op_mode(7) = 'spec-cl'  
op_point(7) = 0.8  
optimization_type(7) = 'target-drag'  
target_value(7) = 0.0142  
reynolds(7) = 146E+03  
weighting(7) = 0.7
```

### Geometric target values

If there is the need that the final airfoil should have a certain thickness it is more natural for the optimization process to define the thickness as an optimization target instead being a constraint.

Another use case is to have control over a sometimes bad deformation of the surface on the upper or lower side of the airfoil especially towards the trailing edge.

<code>&amp;geometric_targets</code>	New namelist
<code>ngeotargets</code>	Number of geometric targets that shall be applied
<code>target_type(n)</code>	Type of geometric target – either 'zBot' z-value at the bottom side 'zTop' z-value on the top side 'Thickness' final thickness of the airfoil
<code>target_geo(n)</code>	Numerical value which should be achieved. A negative value will be taken to multiply the value of the seed airfoil to get the target value – so "-1.0" would mean: Achieve the value of the seed airfoil.
<code>x_Pos(n)</code>	X-Position along the chord for this geometric target. Only needed for 'zBot' and 'zTop'
<code>weighting_geo(n)</code>	Weighting of this target within the objective function. Same meaning as 'weighting(N)' for an operating point

Example

```
&geometric_targets  
ngeotargets = 1
```

```

x_Pos(1) = 0.7
target_type(1) = 'zBot'
target_geo(1) = 0.012
weighting_geo(1) = 0.5

```

## New shape\_functions 'camb-thick'

Beside the shape\_functions type 'naca' and 'hicks-henne' there is a new type implemented called 'camb-thick'. In this case the seed airfoil will be modified during optimization by the 4 airfoil parameters

- thickness
- x-location of max. thickness
- camber
- x-location of max. camber

The airfoil modification is done by the two xfoil routines THKCAM and HIPNT

&optimization options	high-level optimization and parameterization parameters are
shape_functions	= 'naca'
	= 'hicks-henne'
	= 'camb-thick' <b>new</b>

## Additional command line options options

-r xxxxxxxx	Allows the definition of a default reynolds number xxxxxxxx for the operating points. This value will be taken if reynolds() is not defined for an operating point. With this option a single inputs.txt can be used for different polar based optimizations.
-a airfoil_file	Define the filename of the seed airfoil. A 'airfoil_file' within inputs.txt will be overwritten.

## Additional display options

&optimization options	high-level optimization and parameterization parameters are
show_details	= .true. show more detailed information during optimization (default)
	= .false. do not show
echo_input_parms	= .true. echo all input parameter (default)
	= .false. suppress echoing

## Additional operating options

&operating_conditions	common parameters for all operating points
re_default	= xxxxxxxx Default value for reynolds number which is taken if a reynolds(i) for an operating point is not defined. This is useful if all operating points do have the same reynolds number – see also command line argument '-r' (equals to re_default)
re_default_as_resqrtcl	= .true. take re_default as the value of re*sqrt(cl) which equals to the Type 2 polar. This is convenient if you have Type 2 based operating points
	= .false. re_default is taken as it is (default)

## Airfoils surface quality and smoothing

Activate a simple smoothing algorithm to get rid off micro waves (spikes) in the surface of the (seed) airfoil.

```
&smoothing_options  
    do_smoothing  
    show_smoothing  
    highlow_treshold
```

```
    spike_threshold
```

```
    weighting_smoothing
```

#### New namelist

= .true. - activate smoothing of the surface

= .true. - show additional informations during the optimization process

Numerical value to detect highs and lows of the 2<sup>nd</sup> derivative of the surface curve. The number of high and lows is taken into account to assess the quality of the surface.

A good value to start is 0.05

Numerical value to detect highs and lows of the 3<sup>rd</sup> derivative called spikes. The number of spikes is taken into account to assess the quality of the surface.

A good value to start is 2

Out of the number of highs, lows and spikes a "perturbation value" is calculated which can be an indication for the surface quality: '0' is excellent, a value greater '1' indicate some problems...

If this value should be part of the objective function 'weighting\_smoothing' should have a value > 0.0.

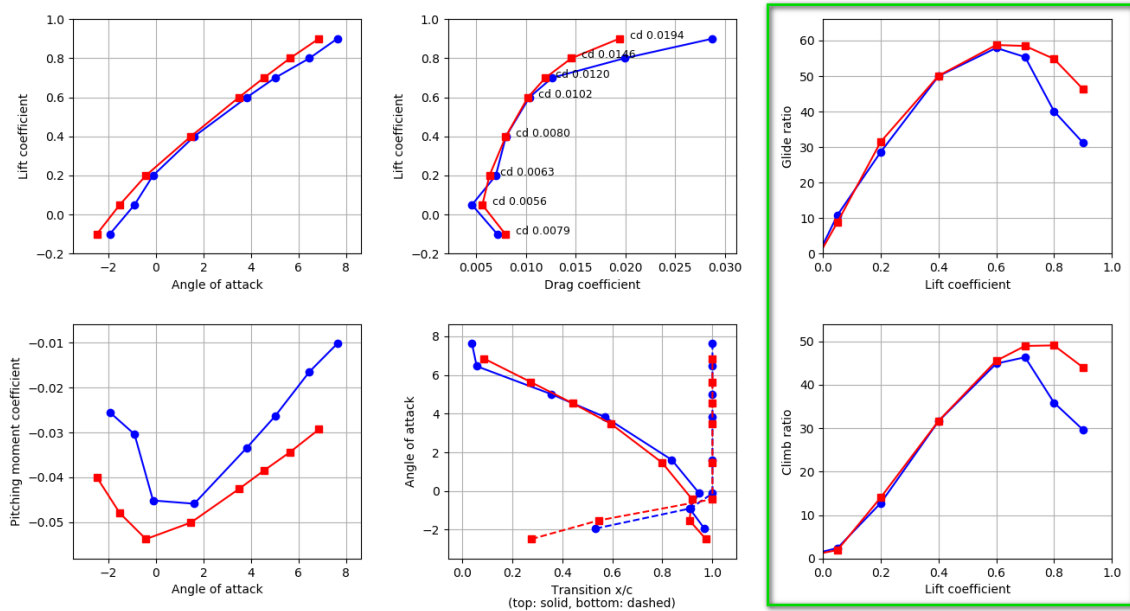
#### Example

```
&smoothing_options  
  
    do_smoothing      = .true.  
    show_smoothing    = .true.  
    highlow_treshold  = 0.04  
    spike_threshold    = 1.5  
    weighting_smoothing = 0.1
```

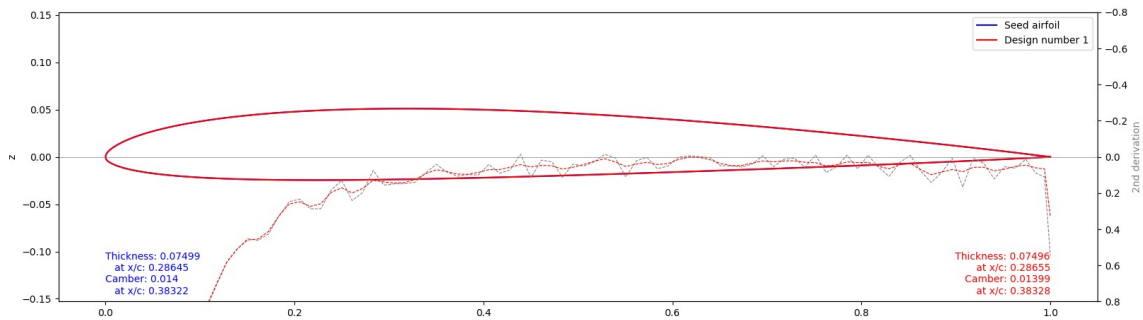
## xoptfoil\_visualizer-jx.py - Modifications of the Visualizer -

To get an earlier indication whether the optimized airfoil will have the desired aerodynamic properties the polar window of the visualizer is complemented by two sub views for glide ratio and climb ratio.

The layout is optimized for a monitor resolution of 1920 x 1080.



To visualize the smoothing process and to get information about the surface quality additional information can be displayed in the airfoil window:



- 2<sup>nd</sup> derivation of the airfoil surface
- 3<sup>rd</sup> derivation of the airfoil surface
- z-values applied by xoptfoil (sum of all shape functions)

This is done by setting these variables in the Python script

```
490 plot_2nd_deriv = True
491 plot_3rd_deriv = False
492 plot_delta_y   = True
```

Have fun!