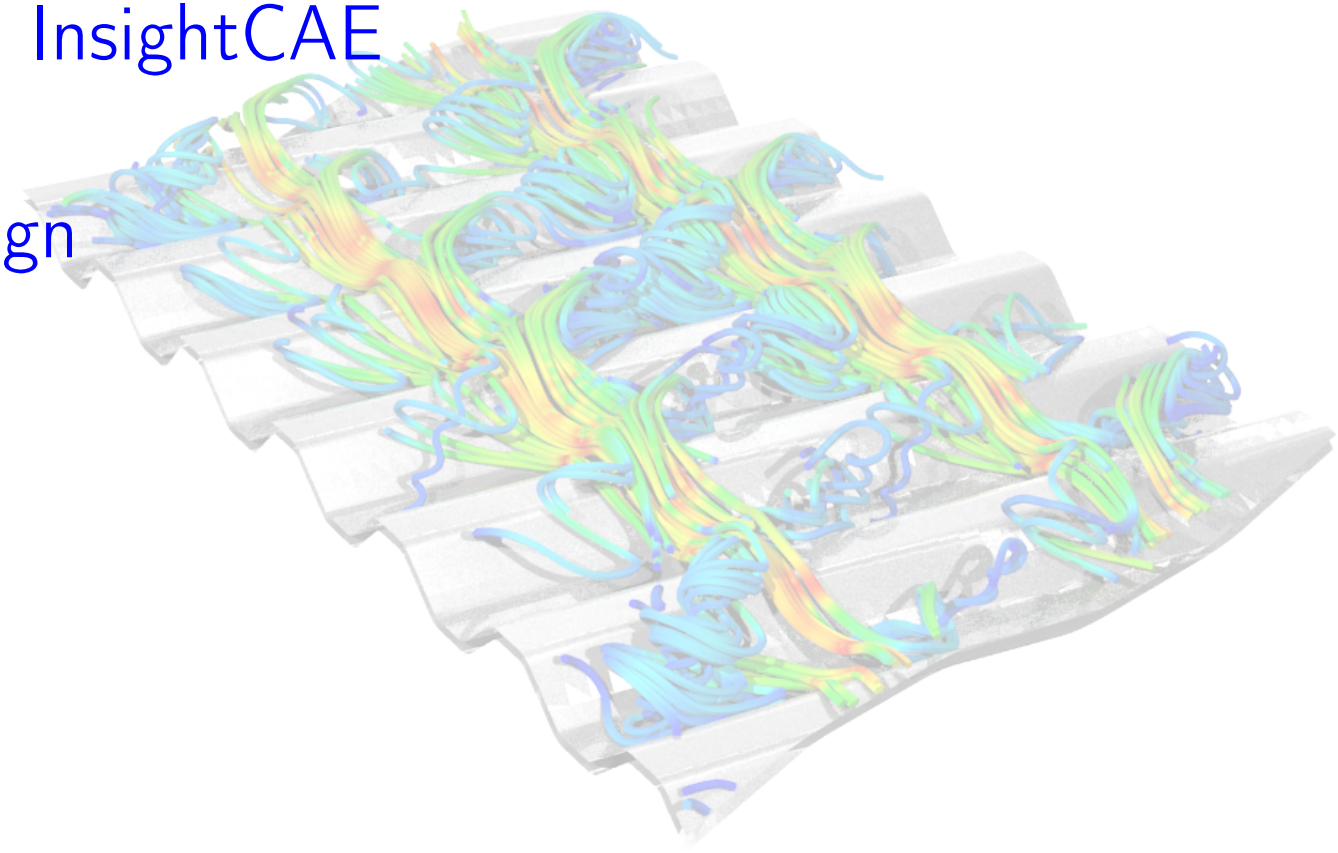
silentdynamics

Workbench InsightCAE
-
Airfoil Design



2020

Our Goal

Using FEA software *efficiently*

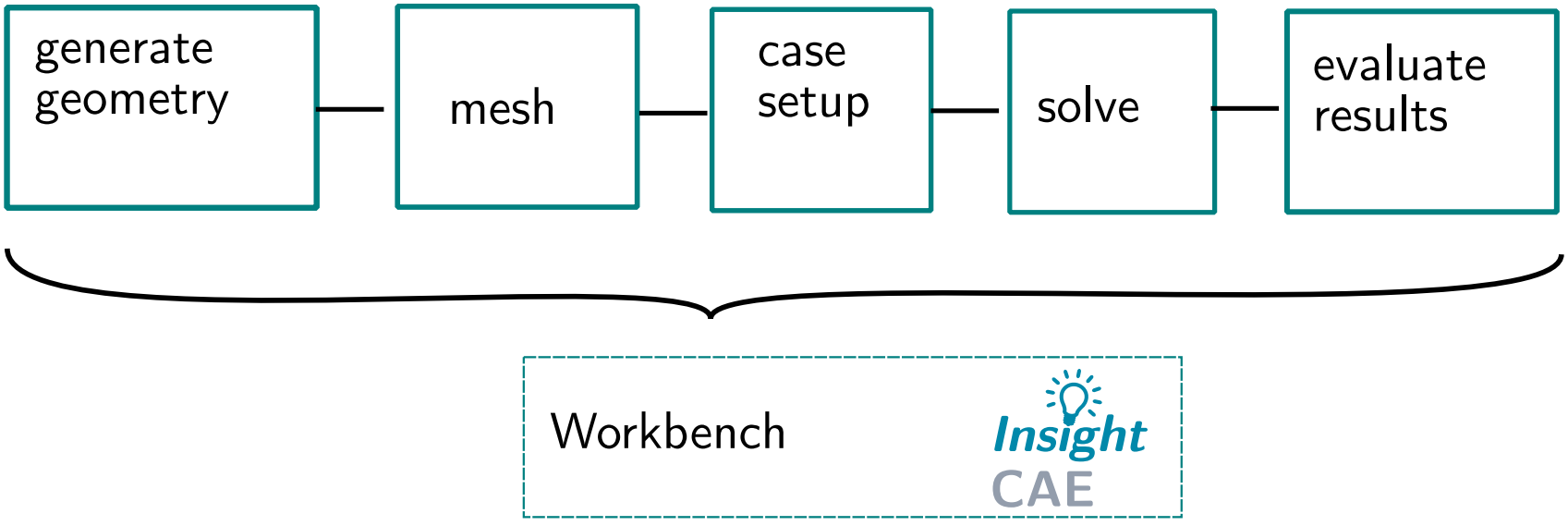
- Simple and quick setup of CFD and FEM analysis

- As much automated as possible

- Quick repetition of analysis after geometry or BC change
  $\Rightarrow$prerequisite for optimization

- Quick and reliable documentation of results

A software framework to bundle



InsightCAE provides:

- modular handling of input parameters and result sets
- GUI for parameter editing
- Automatic report generation

InsightCAE is an **open source** project (GPL)
Source Code: `https://sourceforge.net/p/insightcae`

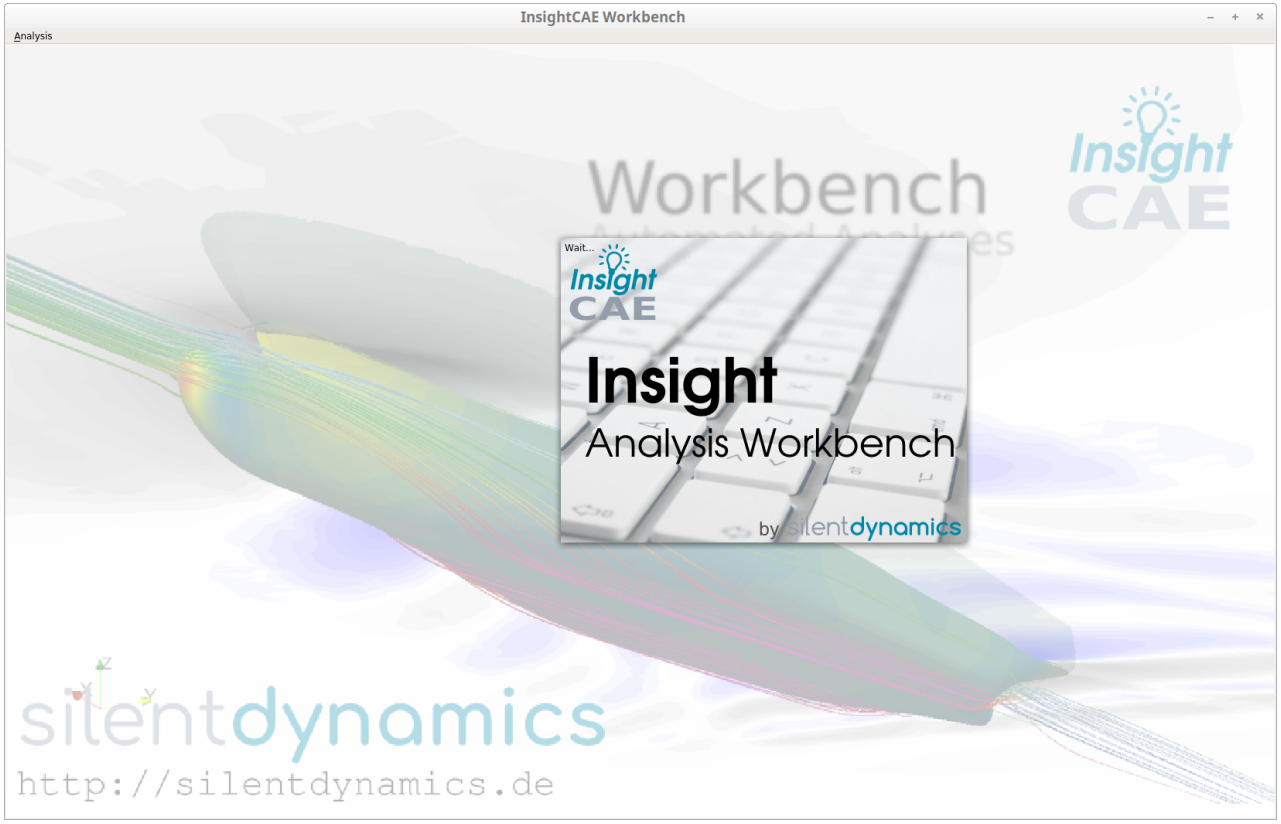
Install packages available. Install on current Ubuntu LTS:

```
$ sudo add-apt-repository http://downloads.silentdynamics.de/ubuntu
$ sudo apt-key adv --recv-key --keyserver keys.gnupg.net 79F5CBA4
$ sudo apt-get update
$ sudo apt-get install insightcae-ce
```

Build from sources:

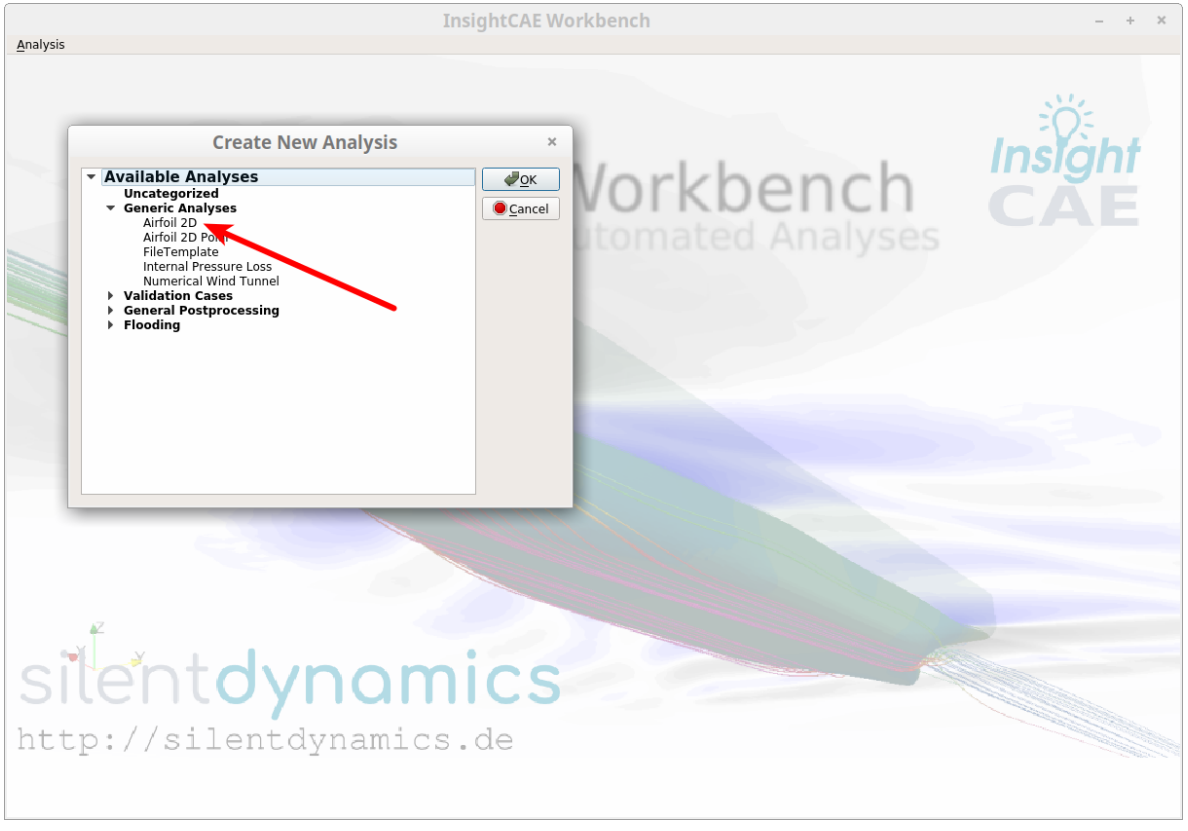
```
$ git clone git://git.code.sf.net/p/insightcae/code insight-src
$ mkdir insight && cd insight
$ ccmake ../insight-src
$ make
```

```
1       $ workbench
```



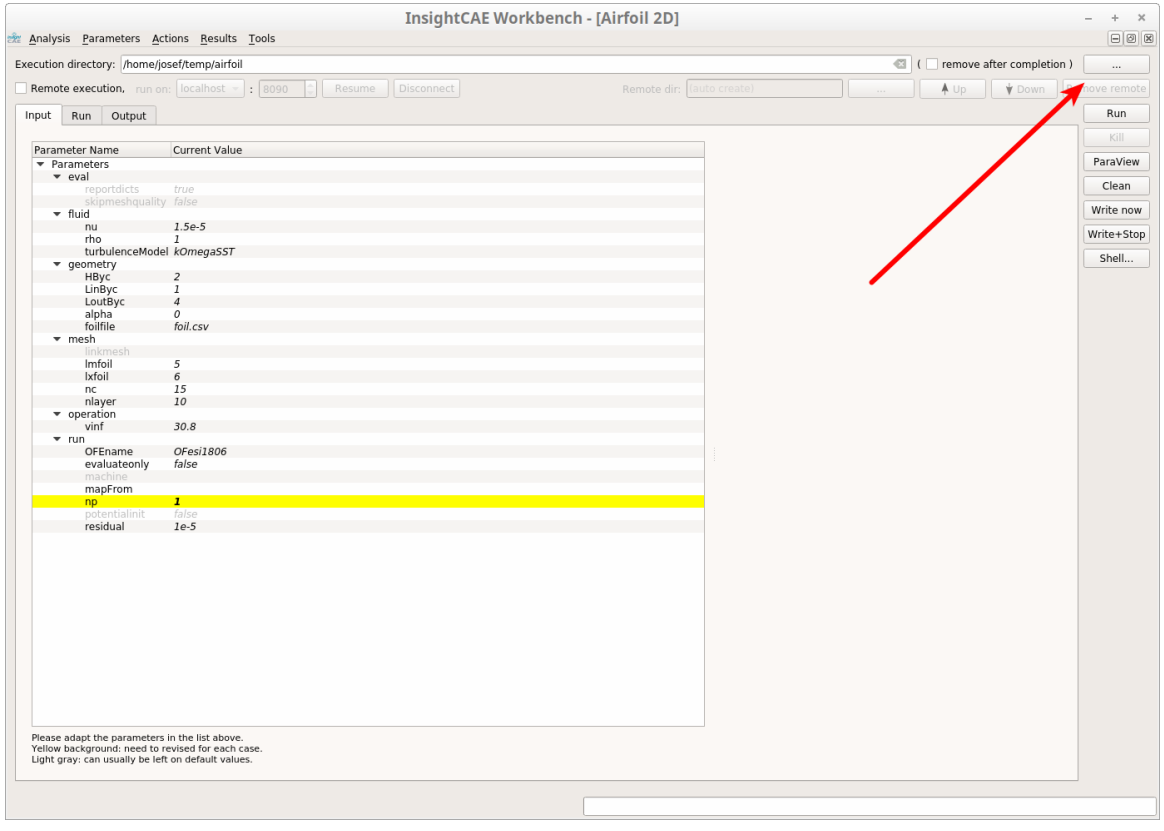
Airfoil 2D

- Select Generic Analysis → Airfoil 2D



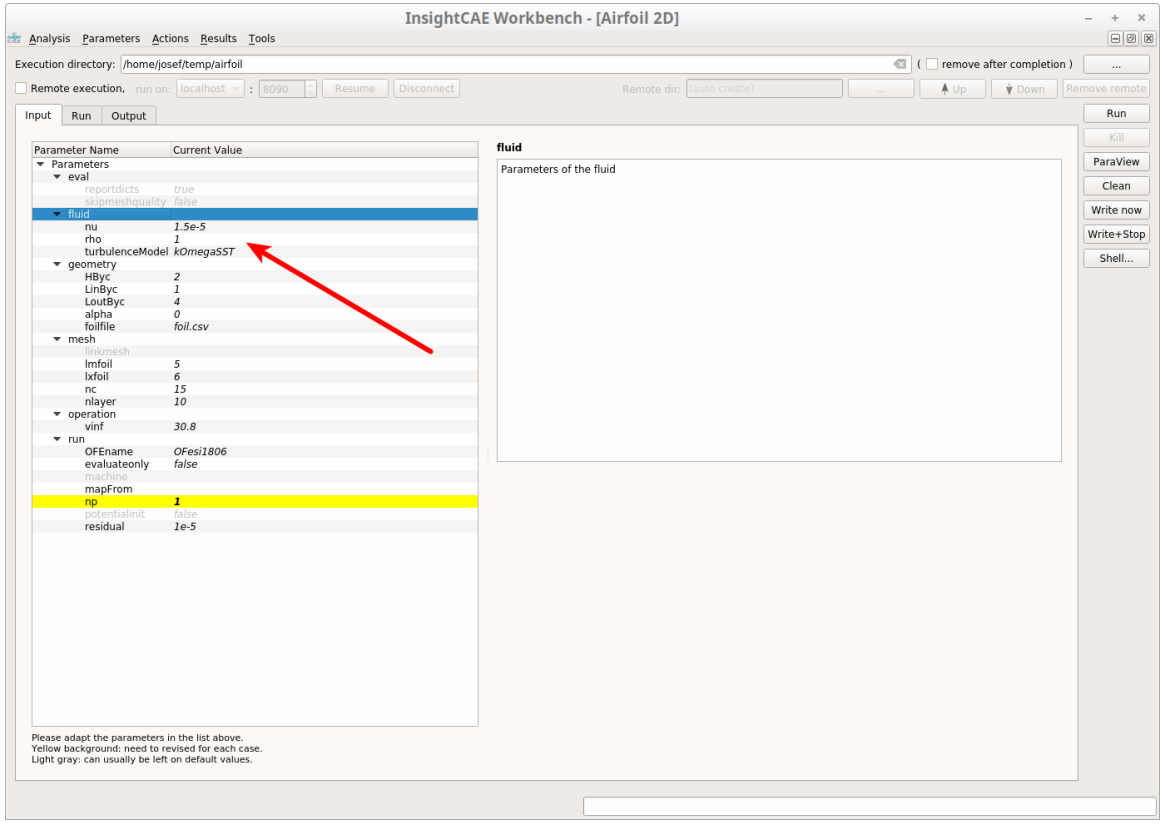
Parameter Set

- Select execution directory



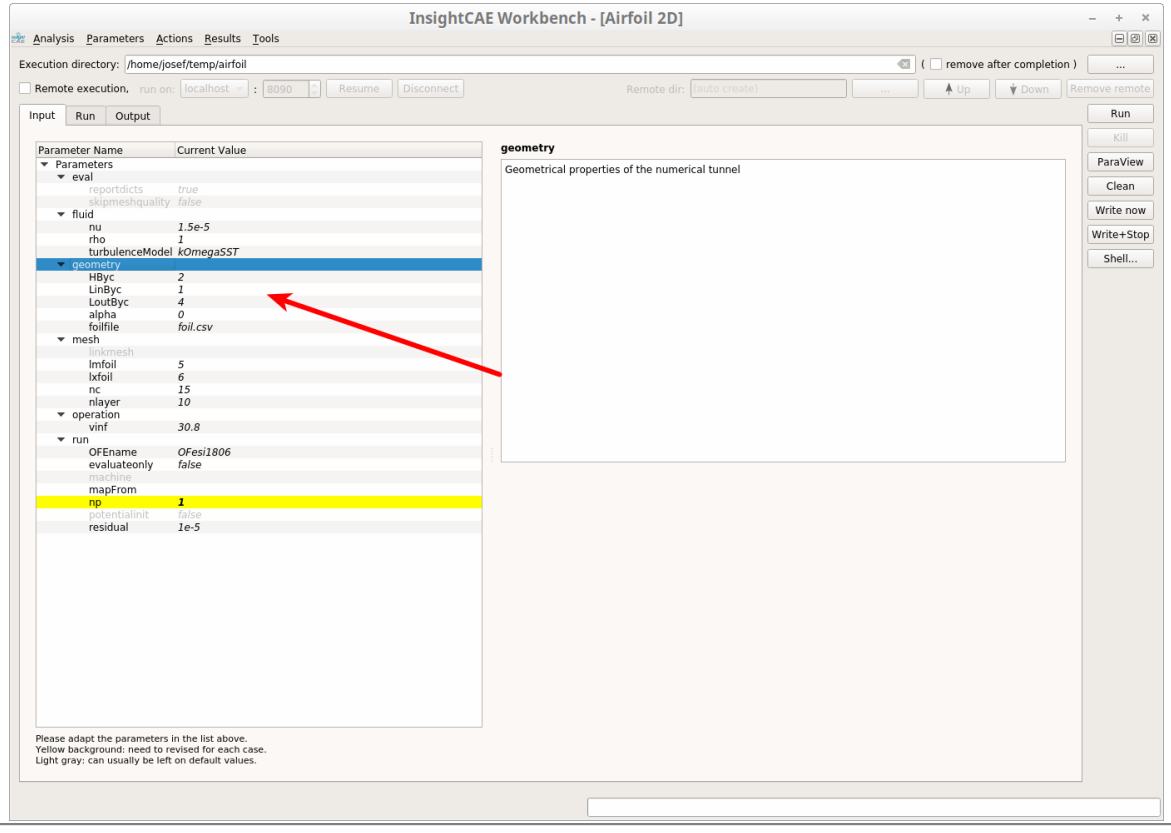
Parameter Set: Fluid parameters

- Select fluid properties and turbulence model



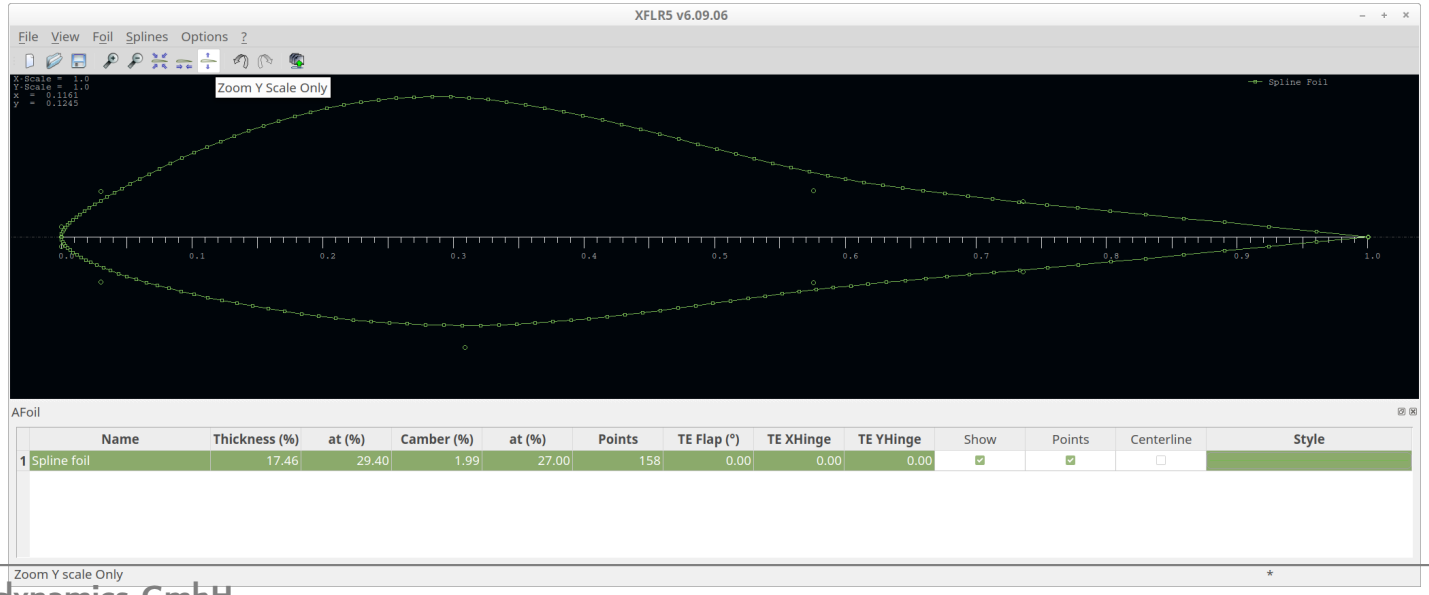
Parameter Set: Geometry

- Select geometry properties
  - Bounding boxes
  - angle of attack α



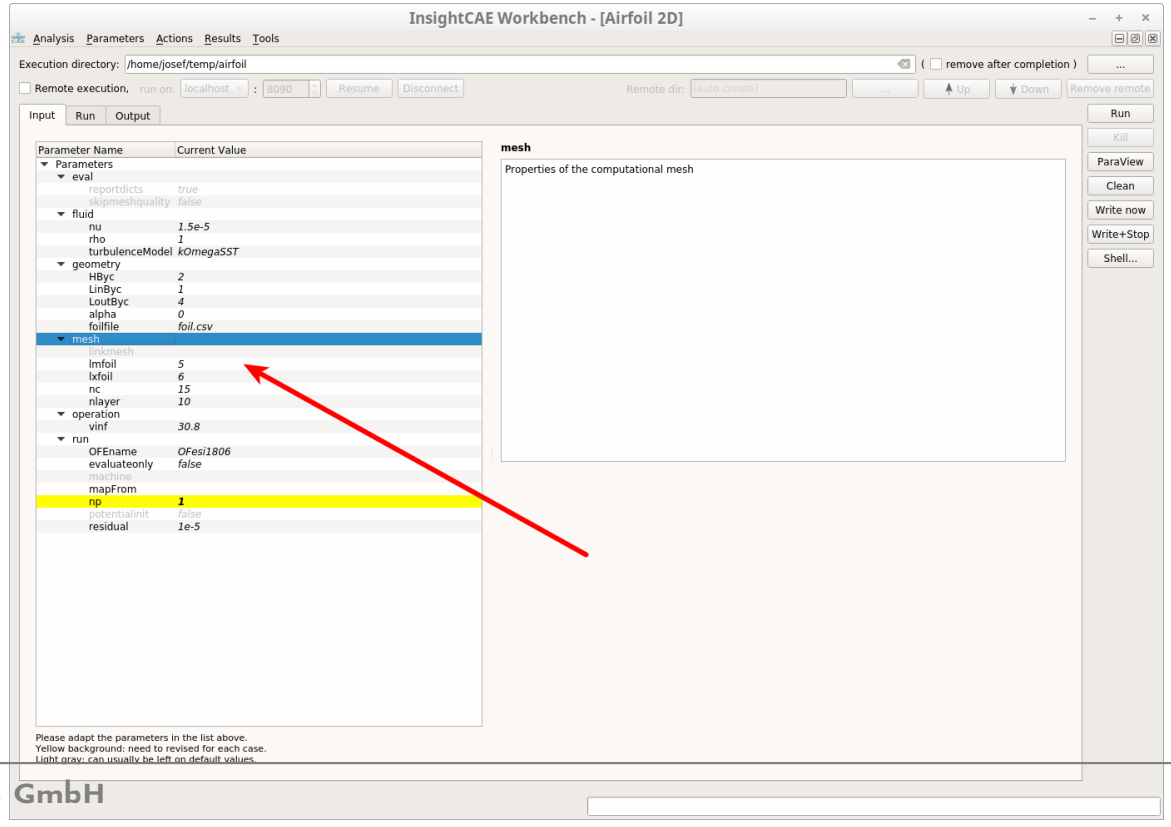
Parameter Set: Foil Geometry

- Define Airfoil Geometry providing 2D points on the foil contour.
- X-coordinate is in the first column
- Y-coordinate in the second column
- Use simple airfoil program: **XFLR5**
  - E.g. direct foil design
  - Splines → Export Splines to file
  - Import to InsightCAE Workbench



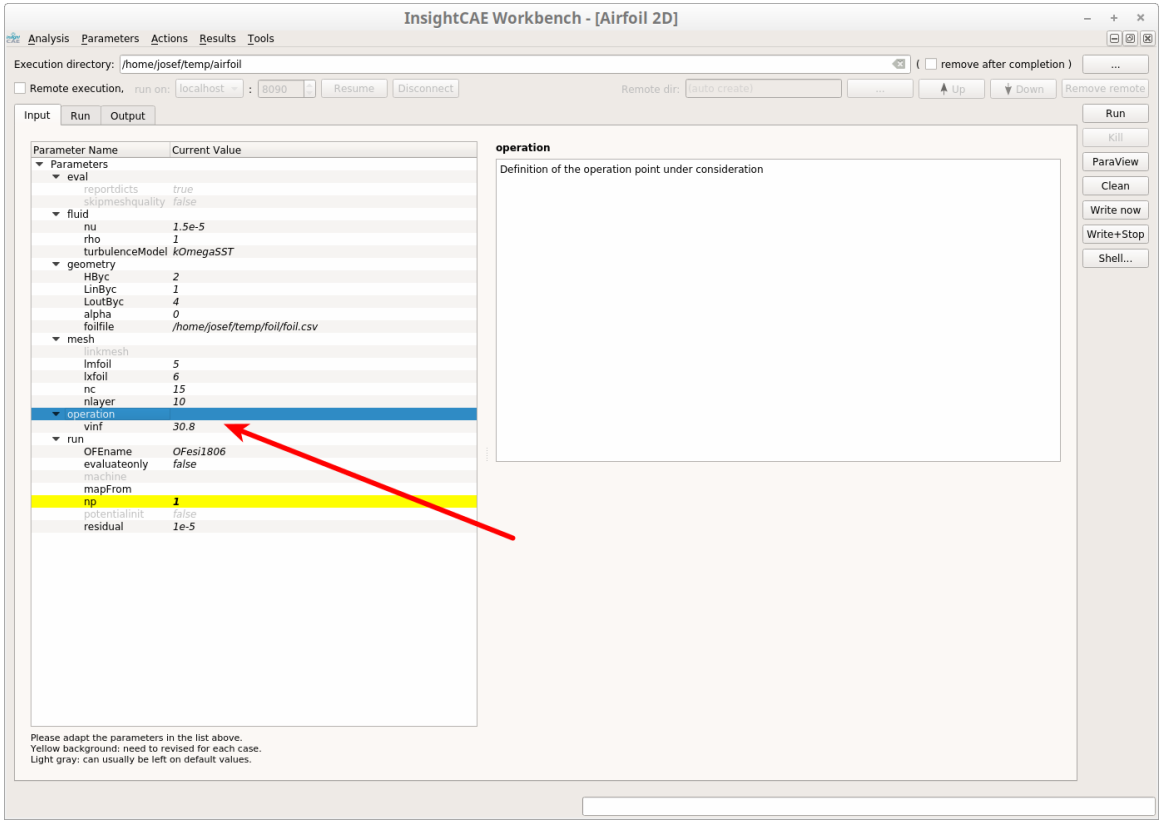
Parameter Set: Mesh

- Meshing parameters
  - Cells along the span *nc*
  - Set the minimum and maximun refinement level *lmfoil*, *lxfoil*
  - Number of prism layers *nlayer*



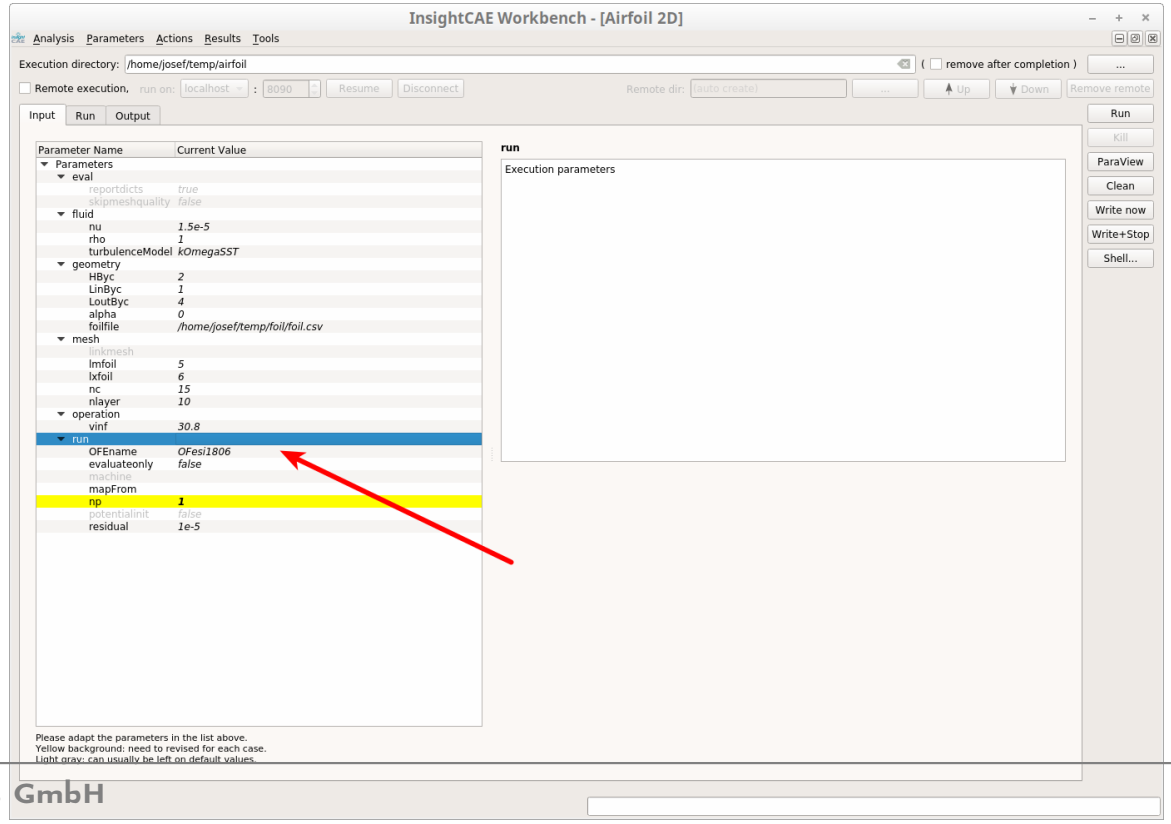
Parameter Set: Operation Point

- Select infinite velocity



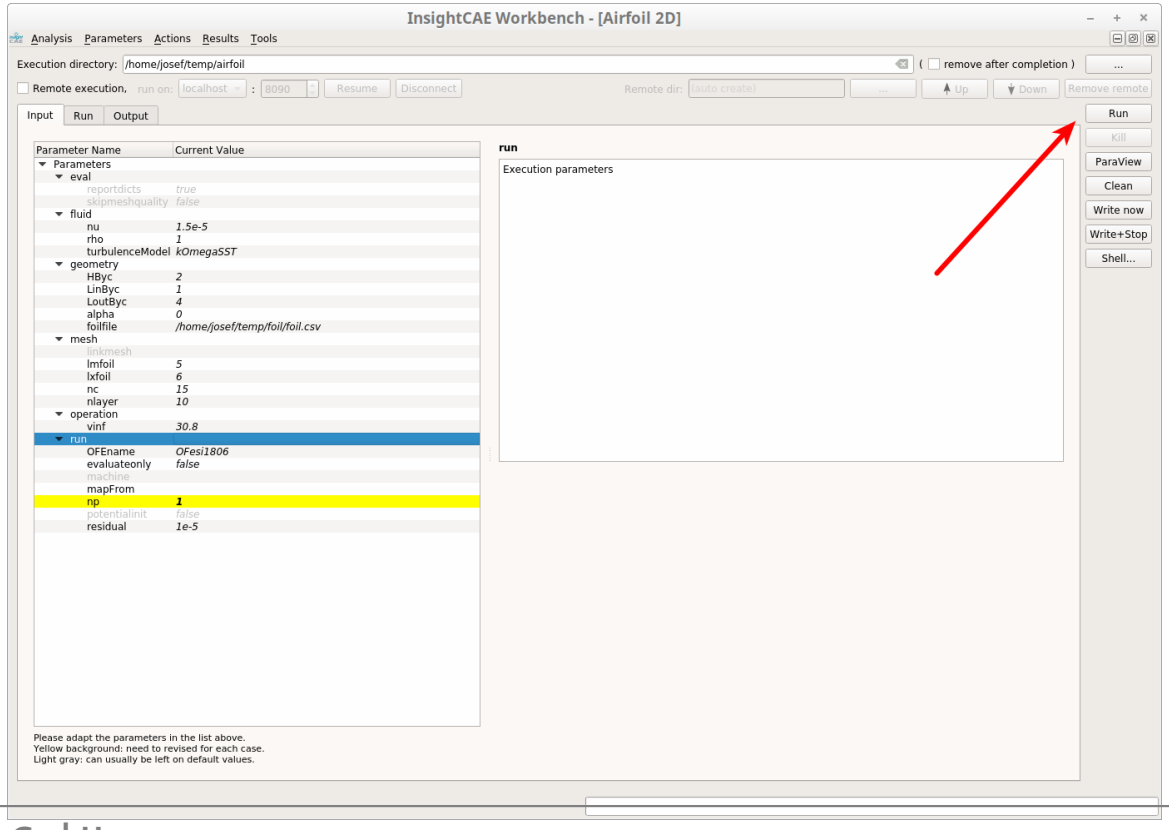
Parameter Set: Simulation

- Select OpenFOAM Version
  - Number of processors *np*
  - Residual limit *residual*
  - Optional: potential init to enhance convergence



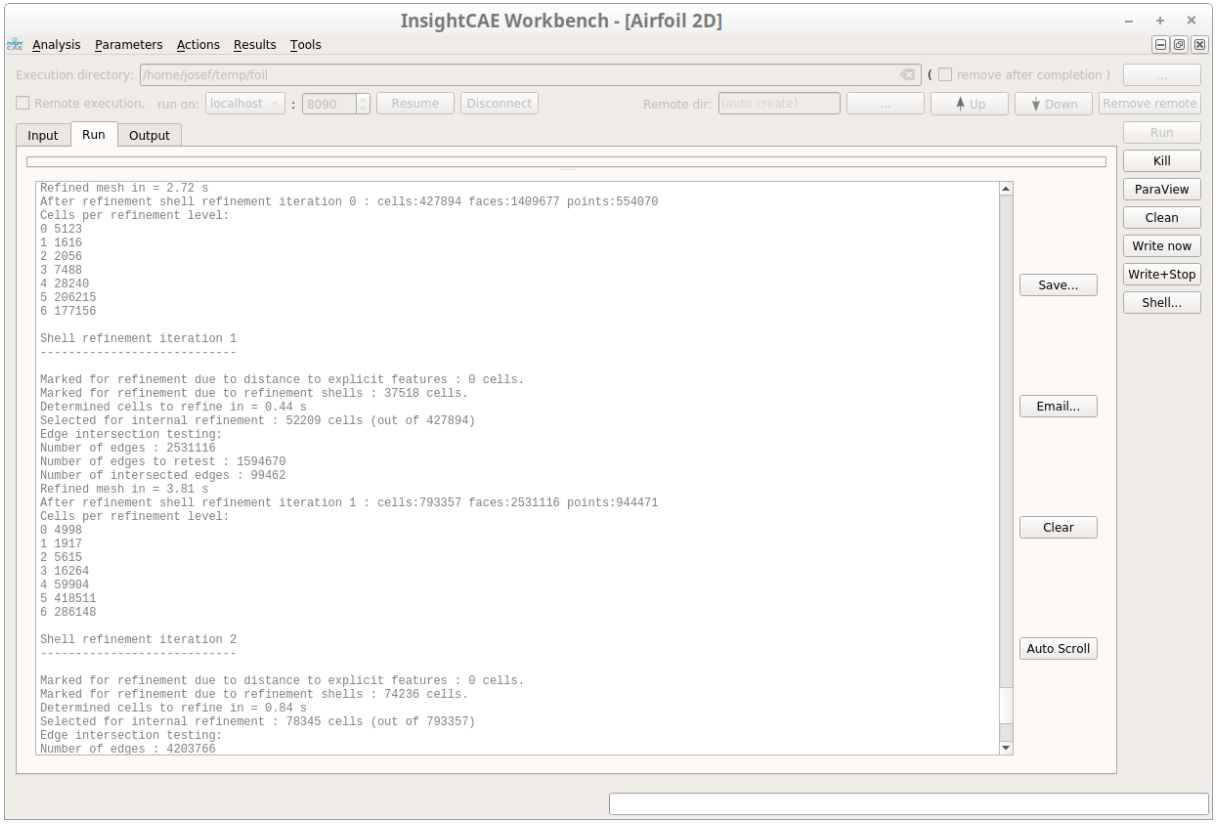
Running the simulation

- Hit the RUN Button
- Meshing (snappyHexMesh/extrudeMesh), Solving (simpleFoam) processes using OpenFOAM will run in background



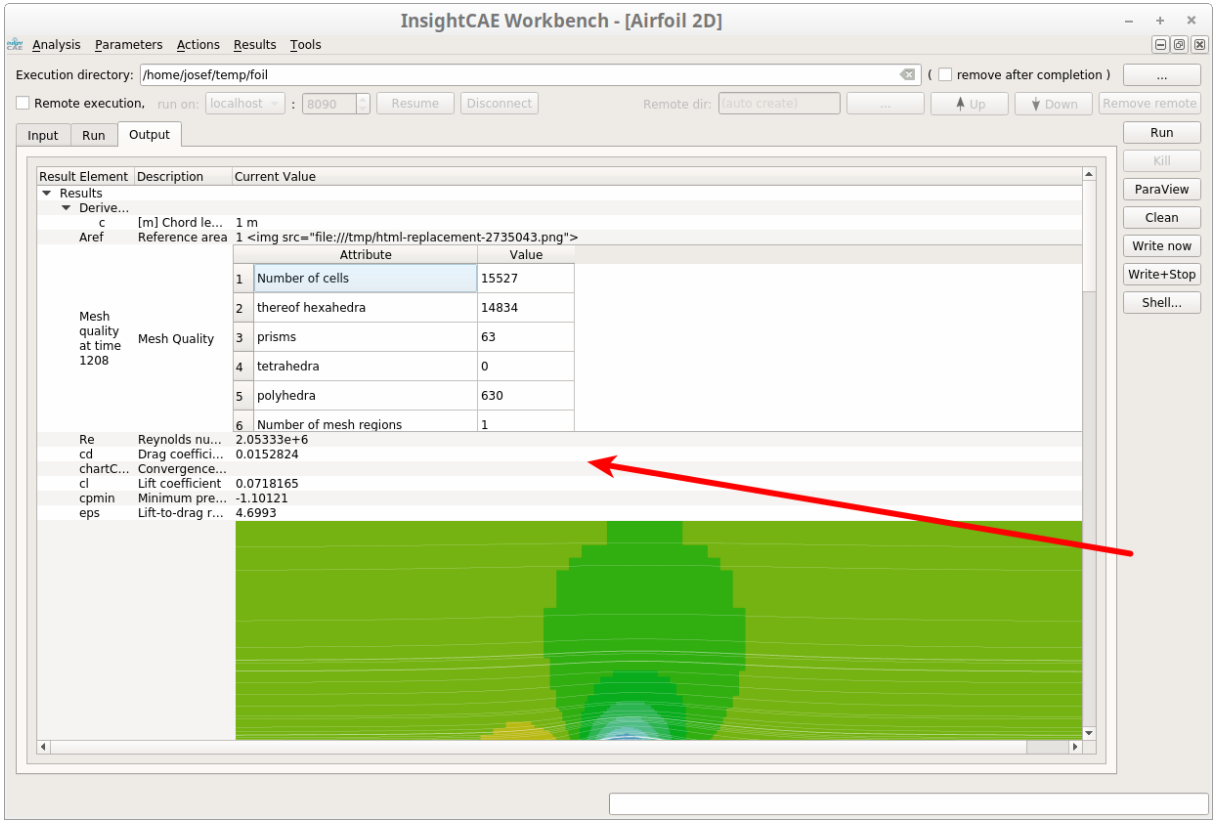
Running the simulation

- Tab *Run* displays actual commands/processes
- OpenFOAM data is written to disk



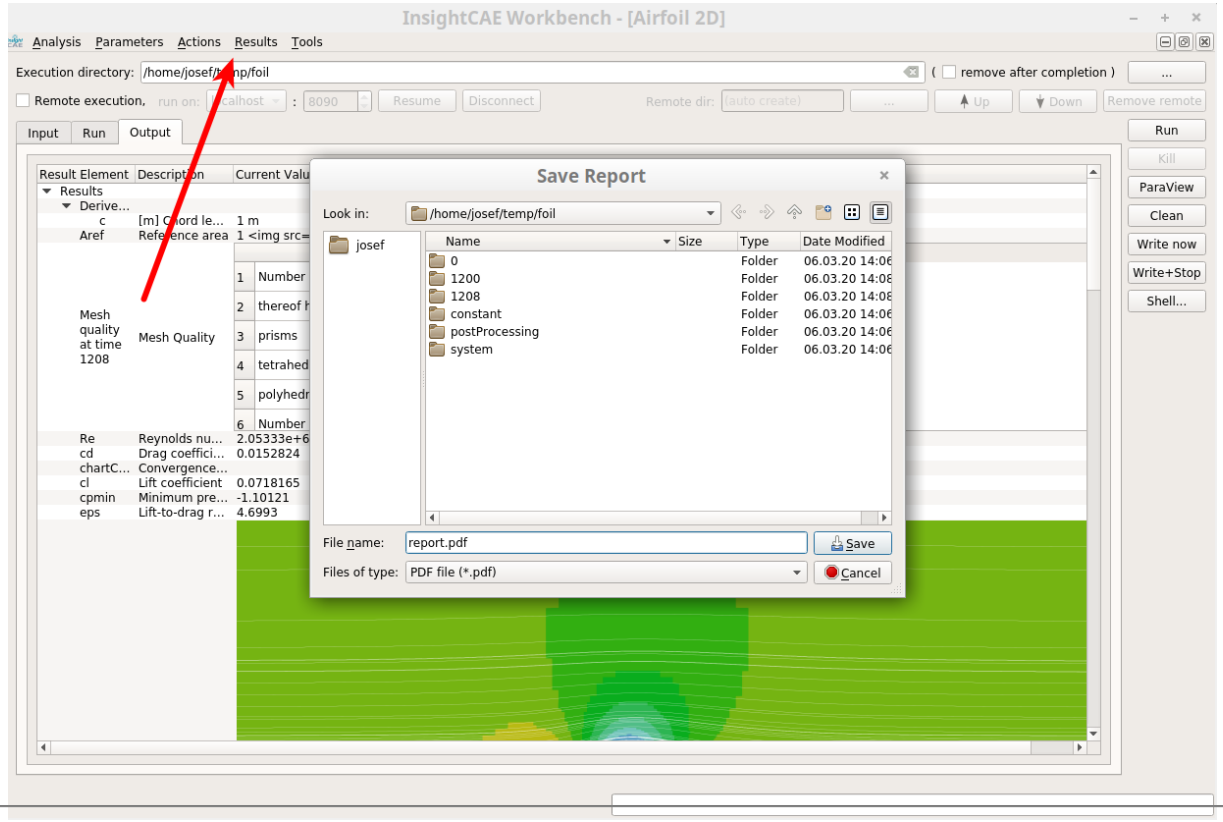
Postprocessing

- Tab *Output* displays the results for the selected airfoil



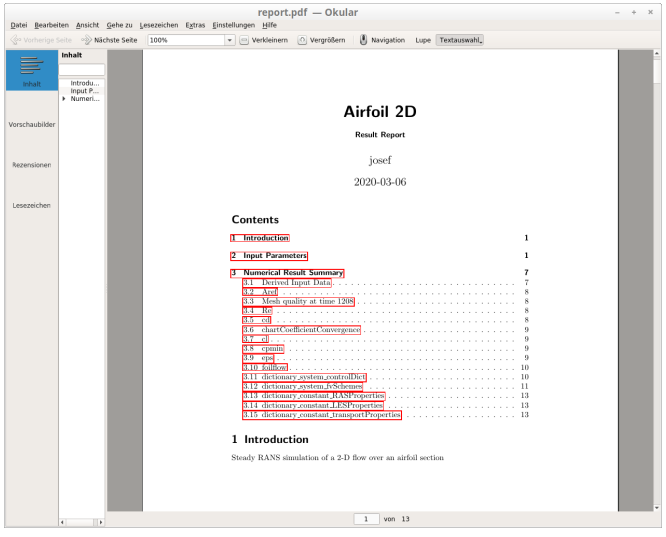
Postprocessing

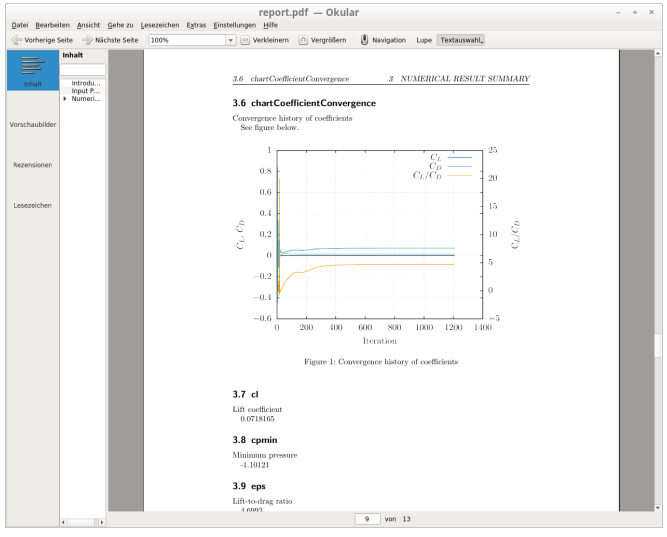
- Click on "Paraview" to view results directly
- Click on "Shell" to view data directory using bash
- Go to "Results" to create PDF report



Postprocessing

- Report includes all simulation data





Download report

Remote execution

- Save case as *airfoil.ist*
- Pack all files (including geometry) into *airfoil.ist* for easy exchange
- Run on remote shell by

```
analyze airfoil.ist
```

- Simple run a parameter variation by (Velocity vinf=50m/s)

```
analyze airfoil.ist --double operation/vinf:50
```

- Or mesh study by changing refinement levels

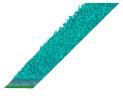
```
analyze airfoil.ist --int mesh/lxfoil:7 --int mesh/
    lmfoil:6
```

- See help

```
analyze --help
```

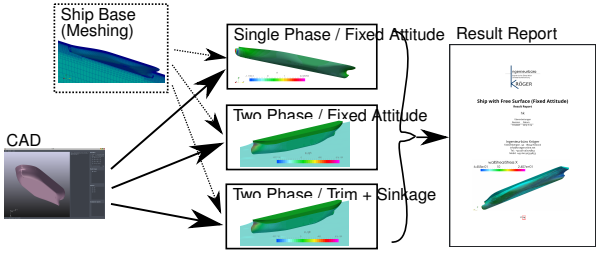
Download file

simple generic analyses for validation

- channel flow 
- flat plate 
- 2D airfoil 
- ...

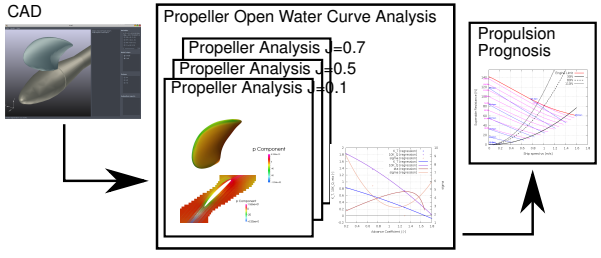
CFD of ship resistance

- single phase
- two phase fixed
- two phase with trim and sinkage



propeller and turbomachinery analyses

- free propeller
- ducted propeller
- axial pump
- optimal diameter, optimal rpm, propulsion prognosis



Thank you

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silentdynamics GmbH
https://silentdynamics.de