Airfoil 2D

Result Report

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2020-03-06

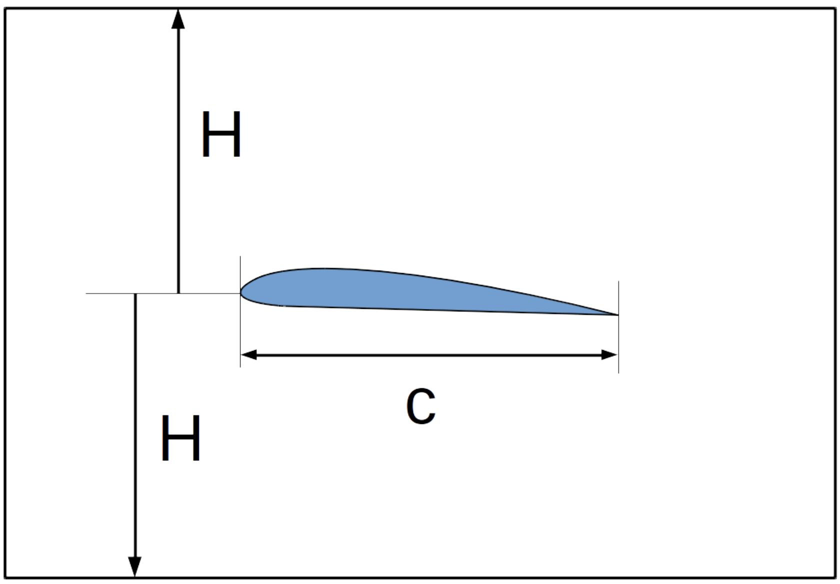
Contents

1 Introduction

Steady RANS simulation of a 2-D flow over an airfoil section

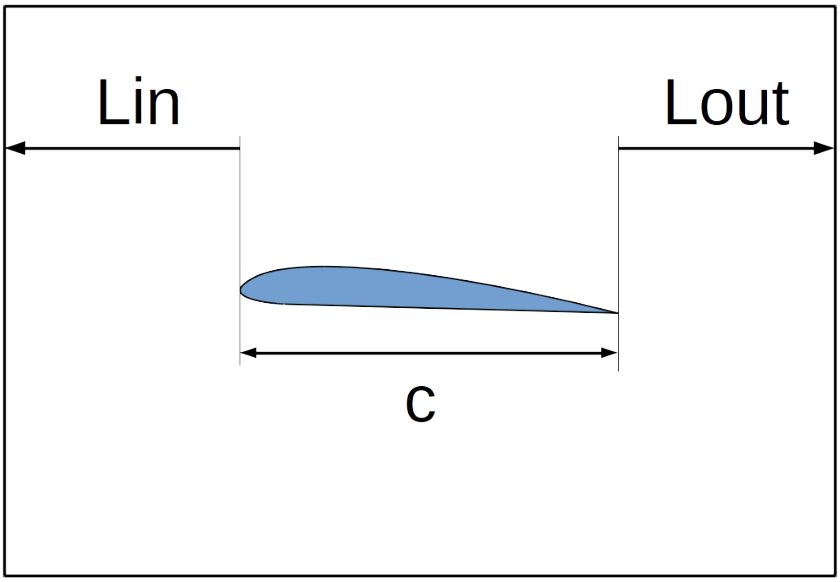
2 Input Parameters

1. Parameters for evaluation after solver run
   eval =
   1.1. Include dictionaries into report
   reportdicts = 1
   1.2. Check to exclude mesh check during evaluation
   skipmeshquality = 0
2. Parameters of the fluid
   fluid =
   2.1. [m^2/s] Viscosity of the fluid
   nu = 1.5e-05
   2.2. [kg/m^3] Density of the fluid
   rho = 1
   2.3. Turbulence model
   turbulenceModel = selected as "kOmegaSST"
3. Geometrical properties of the numerical tunnel
   geometry =
   3.1. [-] Height of the channel below and above the airfoil.
   The height is normalized by the chord length.



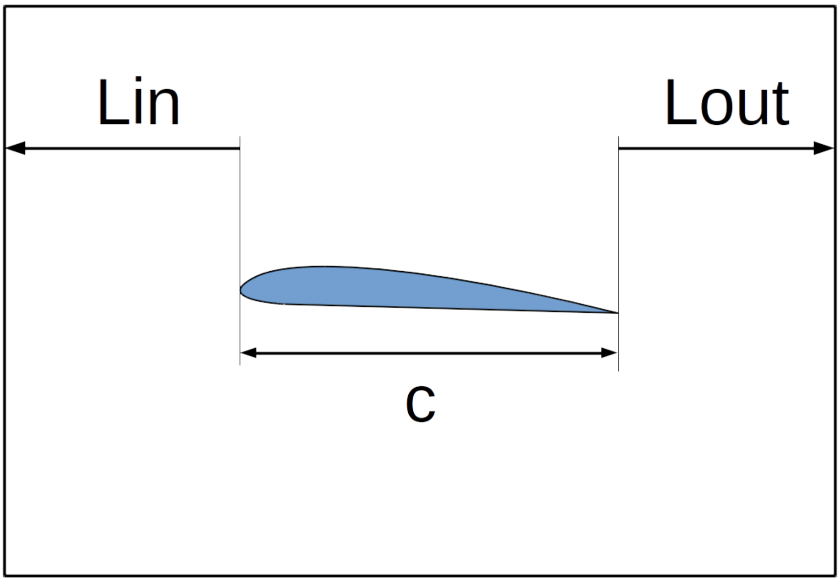
HByc = 2

3.2. [-] Upstream extent of the channel.
The length is normalized by the chord length.



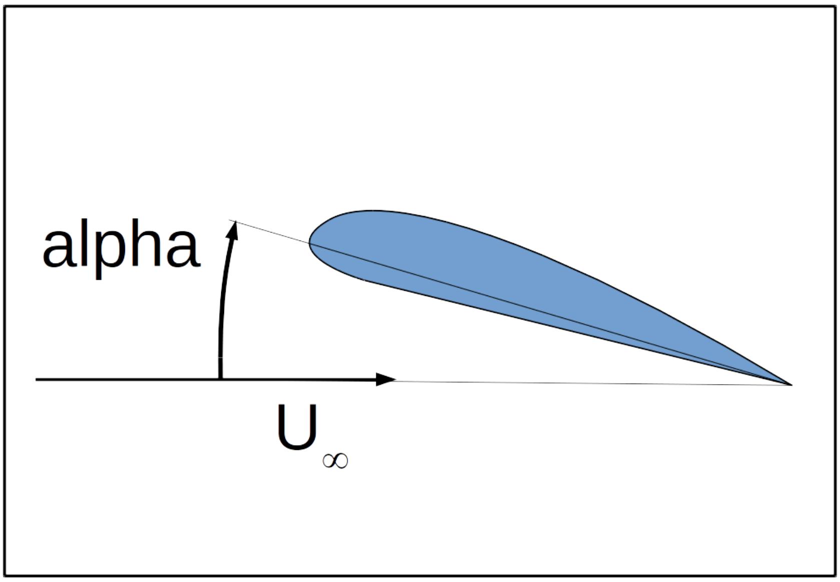
LinByc = 1

3.3. [-] Downstream extent of the channel
The length is normalized by the chord length.



LoutByc = 4

3.4. [deg] angle of attack

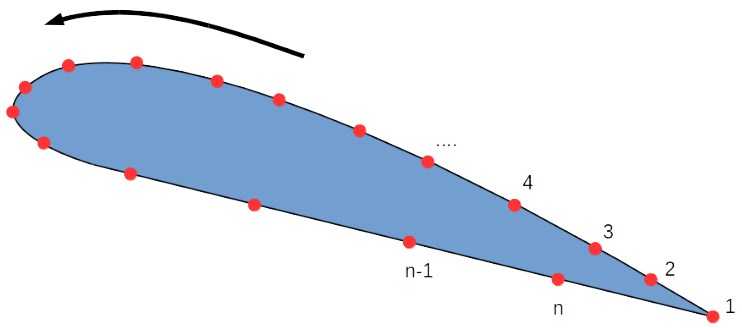


alpha = 0

3.5. File with tabulated coordinates on the foil surface.

If the extension is .dat, an XFLR compatible file is expected.

Otherwise, the file is expected to be a simple text file with the 2D points on the foil contour. X-coordinate is in the first column and Y-coordinate in the seconed column. The X axis is aligned with the chord.
The points need to be ordered but neither the direction along the contour nor the location of the starting point is important. The contour will be automatically closed so the first and last point must no coincide.

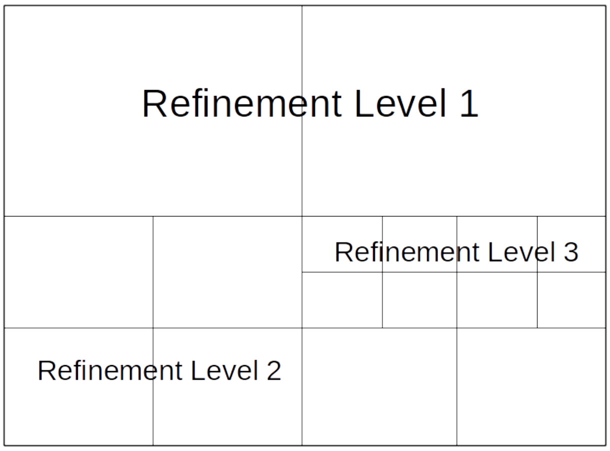


foilfile = "/home/josef/temp/foil/foil.csv"

4. Properties of the computational mesh
mesh =

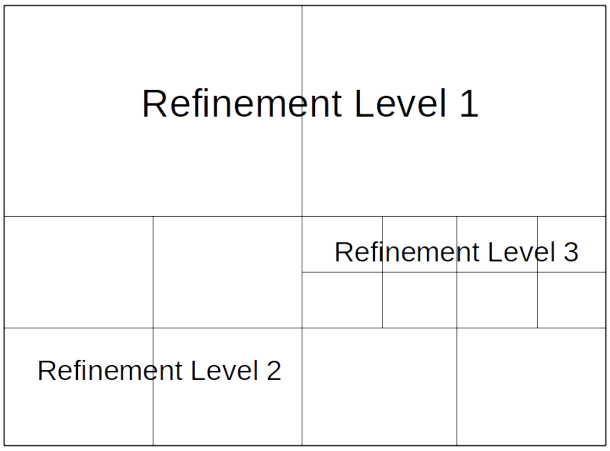
4.1. If not empty, the mesh will not be generated, but a symbolic link to the polyMesh folder of the specified OpenFOAM case will be created.
linkmesh = ""

4.2. minimum refinement level at foil surface



lmfoil = 5

4.3. maximum refinement level at foil surface



lxfoil = 6

4.4. # cells along span
nc = 5

4.5. number of prism layers
nlayer = 10

5. Definition of the operation point under consideration
operation =

5.1. [m/s] inflow velocity
vinf = 30.800000000000001

6. Execution parameters
run =

6.1. Identifier of the OpenFOAM installation, that shall be used
OFEname = OFesi1806

6.2. Whether to skip solver run and do only the evaluation
evaluateonly = 0

6.3. Machine or queue, where the external commands are executed on. Defaults to 'localhost', if left empty.
machine =

6.4. Map solution from specified case, if not empty. potentialinit is skipped if specified.
mapFrom = ""

6.5. Number of processors for parallel run (less or equal 1 means serial execution)
np = 1

6.6. Whether to initialize the flow field by potentialFoam when no mapping is done
potentialinit = 0

6.7. The required relative change in forces for considering the solution as converged.

Basis is the moving average of the forces over the last half of the acquired samples.
The maximum relative change between the last 15 average values needs to stay below this limit.
residual = 1.0000000000000001e-05

3 Numerical Result Summary

3.1 Derived Input Data

Derived Input Data

Numerical Result Summary

c [m] Chord length
1m

3.2 Aref

Reference area
$1m^2$

3.3 Mesh quality at time 1208

Mesh Quality

Attribute	Value
Number of cells	15527
thereof hexahedra	14834
prisms	63
tetrahedra	0
polyhedra	630
Number of mesh regions	1
Domain extent (X)	6
Domain extent (Y)	4
Domain extent (Z)	1
Max. aspect ratio	39.4666
Min. face area	1.7186165e-07
Min. cell volume	1.7186165e-07
Max. non-orthogonality	47.1695
Avg. non-orthogonality	4.81586
Max. skewness	-1
No. of severely non-orthogonal faces	0
No. of negative face pyramids	0
No. of severely skew faces	0

3.4 Re

Reynolds number
2.05333e+06

3.5 cd

Drag coefficient
0.0152824

3.6 chartCoefficientConvergence

Convergence history of coefficients
See figure below.

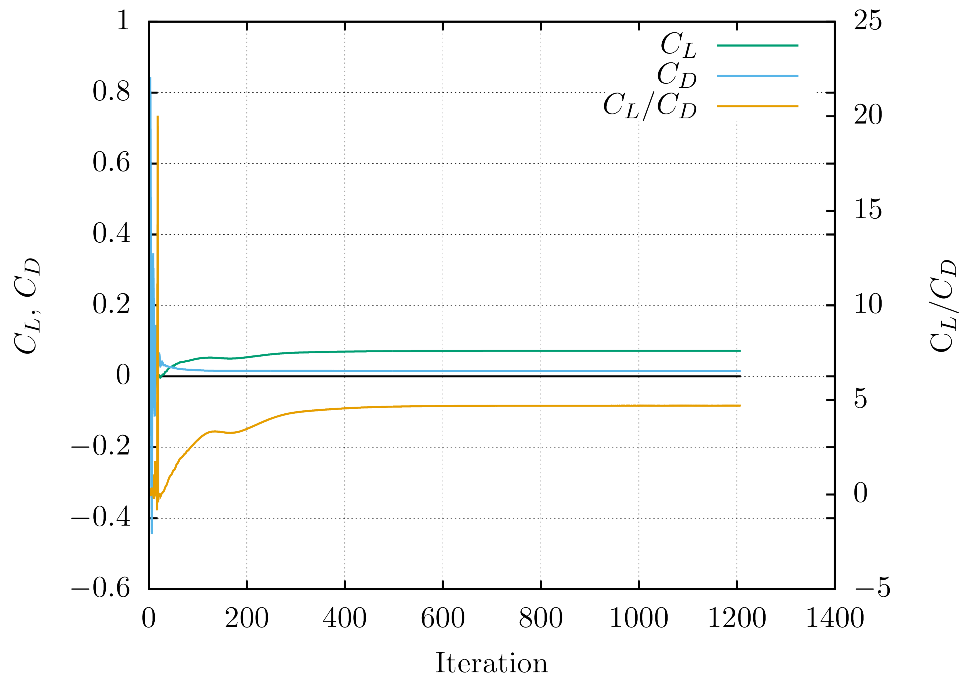


Figure 1: Convergence history of coefficients

3.7 cl

Lift coefficient
0.0718165

3.8 cpmin

Minimum pressure
-1.10121

3.9 eps

Lift-to-drag ratio
4.6993

3.10 foilflow

Relative velocity (angle of attack 0deg)

See figure below.

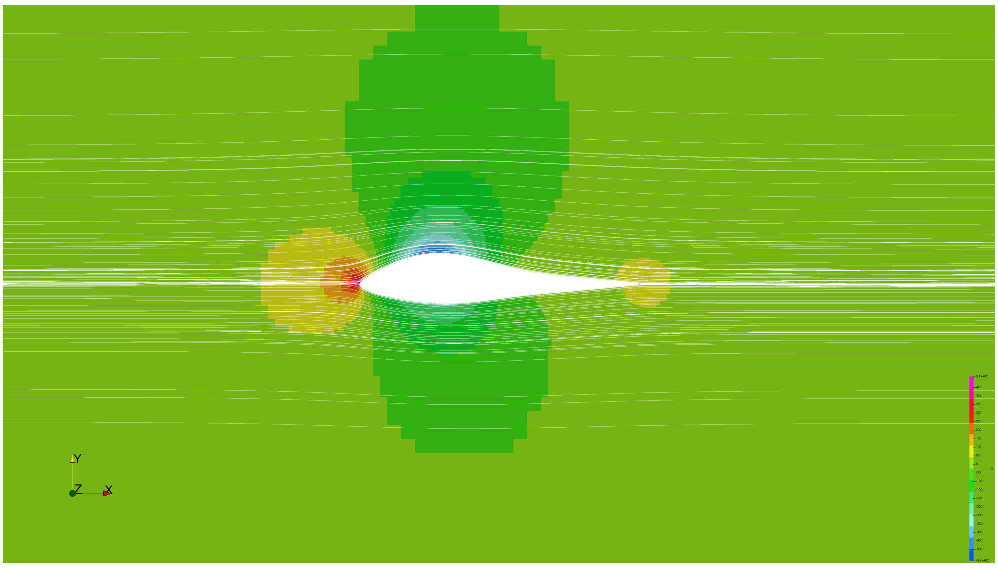


Figure 2: Relative velocity (angle of attack 0deg)

3.11 dictionary_system_controlDict

Contents of system/controlDict

```
{
 application simpleFoam;
 deltaT 1;
 endTime 5000;
 functions
 {
  faceQualityMarker
  {
   lowerNonOrthThreshold 35;
   type faceQualityMarker;
   upperNonOrthThreshold 60;
  }
  foilForces
  {
   CofR ( 0 0 0 );
```

```
   U U;
   functionObjectLibs ( "libforces.so" );
   log 1;
   outputControl timeStep;
   outputInterval 10;
   p p;
   patches ( "foil.*" );
   rho rhoInf;
   rhoInf 1;
   type forces;
  }
  writeData
  {
   fileName "wnow";
   fileNameAbort "wnowandstop";
   outputControl timeStep;
   outputInterval 1;
   type writeData;
  }
 }
 libs ( "libwriteData.so" "libconsistentCurveSampleSet.so" "liblocalLimitedSnGrad.so" "libnum
 maxCo 0.5;
 purgeWrite 2;
 runTimeModifiable 1;
 startFrom latestTime;
 startTime 0;
 stopAt endTime;
 timeFormat general;
 timePrecision 6;
 writeCompression on;
 writeControl timeStep;
 writeFormat ascii;
 writeInterval 100;
 writePrecision 8;
}
```

3.12 dictionary_system_fvSchemes

Contents of system/fvSchemes

```
{
 ddtSchemes
 {
  default steadyState;
```

```
}
divSchemes
{
 default none;
 div((nu*dev2(T(grad(U))))) Gauss linear;
 div((nuEff*dev(grad(U).T()))) Gauss linear;
 div((nuEff*dev2(T(grad(U))))) Gauss linear;
 div(R) Gauss linear;
 div(phi,R) Gauss upwind;
 div(phi,U) bounded Gauss linearUpwindV grad(U);
 div(phi,epsilon) Gauss linearUpwind grad(epsilon);
 div(phi,k) Gauss linearUpwind grad(k);
 div(phi,nuTilda) Gauss linearUpwind grad(nuTilda);
 div(phi,omega) Gauss linearUpwind grad(omega);
}
fluxRequired
{
 default no;
 p ;
}
gradSchemes
{
 default cellLimited pointCellsLeastSquares 1;
 grad(p) cellLimited Gauss linear 1;
}
interpolationSchemes
{
 default linear;
}
laplacianSchemes
{
 default Gauss linear localLimited UBlendingFactor 1;
 laplacian(1,Phi) Gauss linear limited 0.66;
}
patchDist
{
 method meshWave;
}
snGradSchemes
{
 default localLimited UBlendingFactor 1;
}
wallDist
{
 method meshWave;
```

```
 }
}
```

3.13 dictionary_constant_RASProperties

Contents of constant/RASProperties

```
{
}
```

3.14 dictionary_constant_LESProperties

Contents of constant/LESProperties

```
{
}
```

3.15 dictionary_constant_transportProperties

Contents of constant/transportProperties

```
{
 nu nu [ 0 2 -1 0 0 0 0 ] 1.5e-05;
 transportModel Newtonian;
}
```