FLUENT - Flow over an Airfoil- Step 6

Step 6: Analyze Results

Lift Coefficient

The solution converged after about 480 iterations.

```
    476 1.0131e-06 4.3049e-09 1.5504e-09 6.4674e-01 2.4911e-03  0:00:48  524
!   477 solution is converged
    477 9.9334e-07 4.2226e-09 1.5039e-09 6.4674e-01 2.4910e-03  0:00:38  523
```
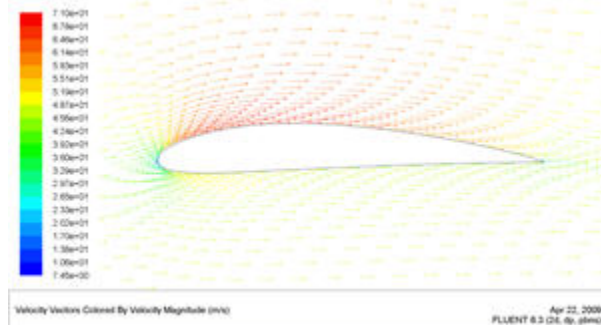
From FLUENT main window, we see that the lift coefficient is 0.647. This compare fairly well with the literature result of 0.6 from Abbott et al.

Plot Velocity Vectors

Let's see the velocity vectors along the airfoil.

Display > Vectors

Enter 4 next to *Scale*. Enter 3 next to *Skip*. Click *Display*.

Higher Resolution Image

As can be seen, the velocity of the upper surface is faster than the velocity on the lower surface.

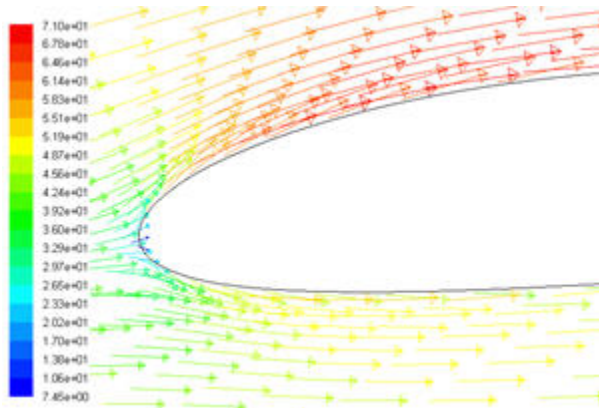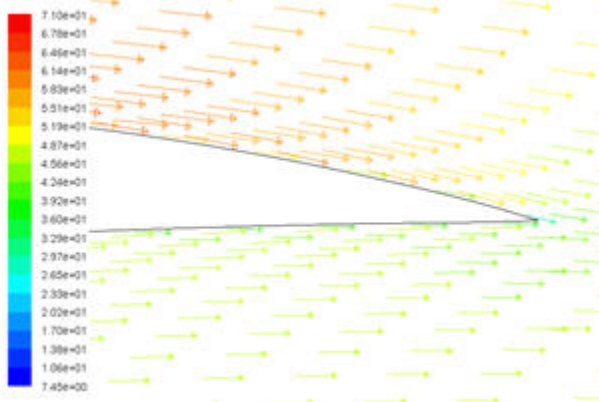> ✅ **White Background on Graphics Window**
>
> To get white background go to:
> **Main Menu > File > Hardcopy**
> Make sure that *Reverse Foreground/Background* is checked and select *Color* in *Coloring* section. Click *Preview*. Click *No* when prompted "*Reset graphics window?*"

7.10e+01
6.78e+01
6.46e+01
6.14e+01
5.83e+01
5.51e+01
5.19e+01
4.87e+01
4.56e+01
4.24e+01
3.92e+01
3.60e+01
3.29e+01
2.97e+01
2.65e+01
2.33e+01
2.02e+01
1.70e+01
1.38e+01
1.06e+01
7.45e+00

Higher Resolution Image

On the leading edge, we see a stagnation point where the velocity of the flow is nearly zero. The fluid accelerates on the upper surface as can be seen from the change in colors of the vectors.

7.10e+01
6.78e+01
6.46e+01
6.14e+01
5.83e+01
5.51e+01
5.19e+01
4.87e+01
4.56e+01
4.24e+01
3.92e+01
3.60e+01
3.29e+01
2.97e+01
2.65e+01
2.33e+01
2.02e+01
1.70e+01
1.38e+01
1.06e+01
7.45e+00

Higher Resolution Image

On the trailing edge, the flow on the upper surface decelerates and converge with the flow on the lower surface.

> ⓘ Do note that the time for fluid to travel top and bottom surface of the airfoil is not necessarily the same, as common misconception

Plot Pressure Coefficient

Pressure Coefficient is a dimensionless parameter defined by the equation

No Latex value

No preview is available, please have your Latex markup text selected when inserting the Latex macro or click edit on an existing Latex macro when text is present to preview the rendered result.

Example Markup

```
\begin{eqnarray}
    y&=&ax^{2}+bx+c \nonumber\\
    E&=&mc^2 \nonumber\\
    {\delta y \over \delta x}
        &=& {{a\over b}\over c}
\end{eqnarray}
```

Example Render

$$
\begin{eqnarray}
y &=& ax^2 + bx + c \nonumber\\
E &=& mc^2 \nonumber\\
\frac{\delta y}{\delta x} &=& \frac{\frac{a}{b}}{c}
\end{eqnarray}
$$

(1)

For more information about **Latex**, you can find in the following documentation LaTeX Plugin

where p is the static pressure,

P_{ref} is the reference pressure, and

q_{ref} is the reference dynamic pressure defined by

No Latex value

No preview is available, please have your Latex markup text selected when inserting the Latex macro or click edit on an existing Latex macro when text is present to preview the rendered result.

Example Markup

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(1)

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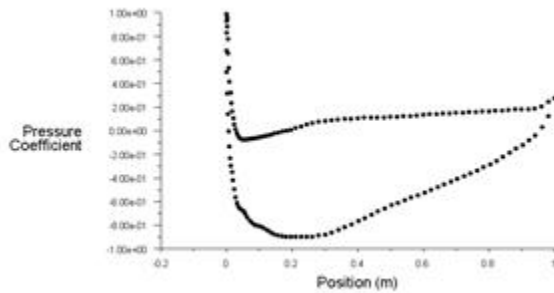
The reference pressure, density, and velocity are defined in the **Reference Values** panel in . Please refer to FLUENT's help for more information. Go to *Help > User's Guide Index* for help.

Plot > XY Plot...

Change the *Y Axis Function* to *Pressure*..., followed by *Pressure Coefficient*. Then, select *airfoil* under *Surfaces*.
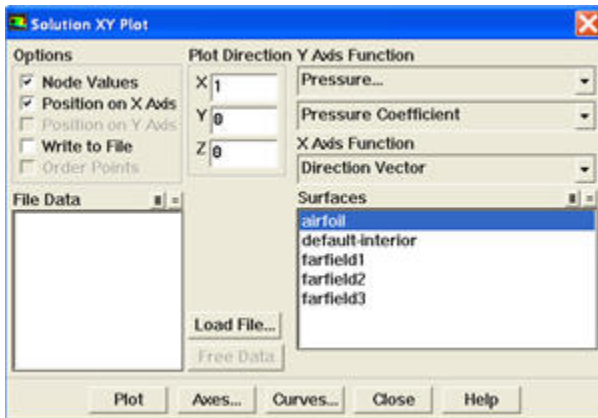

Click *Plot*.

Higher Resolution Image

The lower curve is the upper surface of the airfoil and have a negative pressure coefficient as the pressure is lower than the reference pressure.
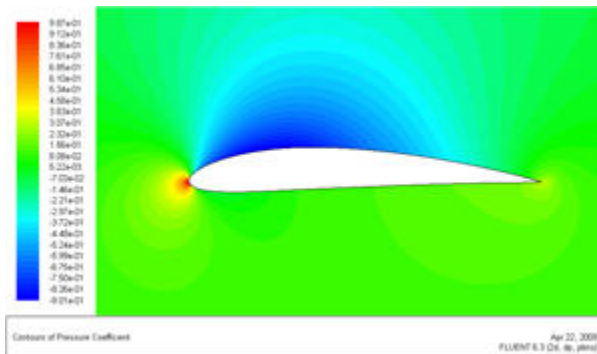
Plot Pressure Contours

Plot static pressure contours.

Display > Contours...

Select **Pressure...** and **Pressure Coefficient** from under **Contours Of**. Check the **Filled** and **Draw Grid** under **Options** menu. Set Levels to 50.
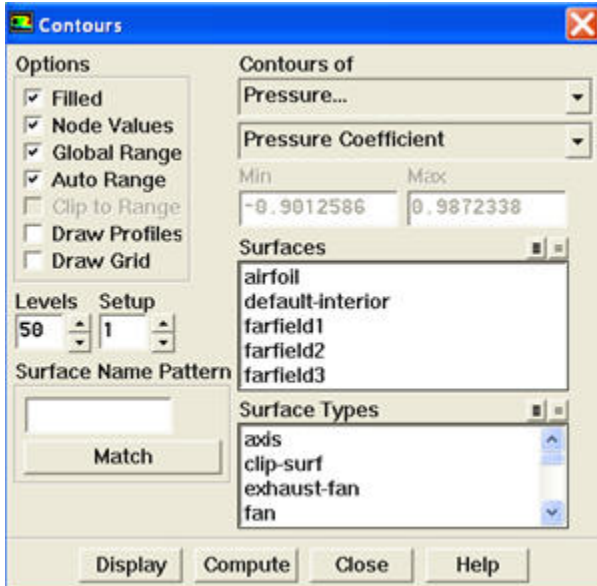
Click **Display**.

From the contour of pressure coefficient, we see that there is a region of high pressure at the leading edge (stagnation point) and region of low pressure on the upper surface of airfoil. This is of what we expected from analysis of velocity vector plot. From Bernoulli equation, we know that whenever there is high velocity, we have low pressure and vise versa.

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