FLUENT - Turbulent Flow Past a Sphere - Step 6

UNDER CONSTRUCTION

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Step 6: Analyze Results

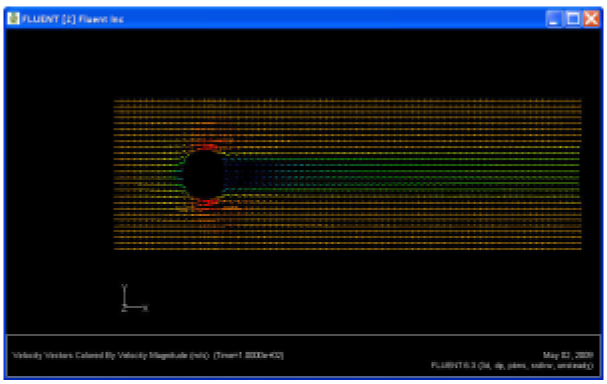
For all of our analysis we will be looking at the ***Sphere*** surface under ***Surfaces***, unless otherwise noted.

Plot Velocity Vectors

Let's plot the velocity vectors obtained from the FLUENT solution.

Display > Vectors

Set the ***Scale*** to 1 and ***Skip*** to 0. Click ***Display***.



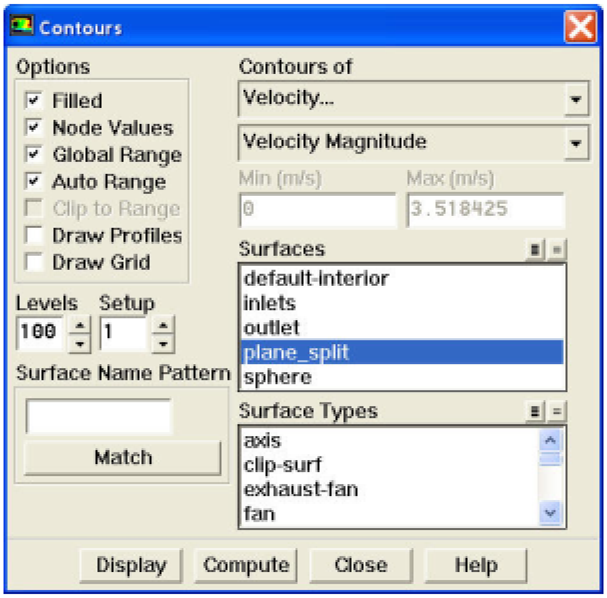
If we look closely at the sphere we can start to see where the separation occurs.

> **Zoom in the cylinder using the middle mouse button.**

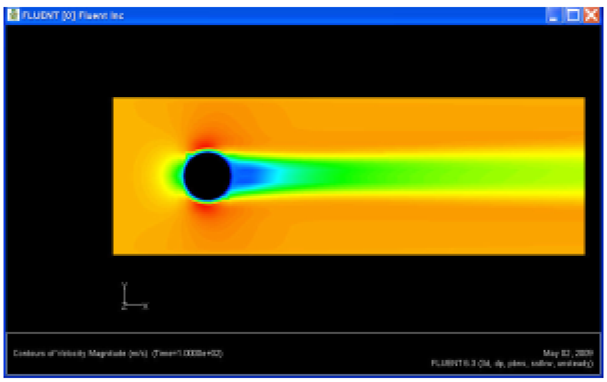
Now, let's take a look at the Contour of Velocity magnitude around the sphere.

Display > Contours

Under ***Contours of***, choose ***Velocity...*** and ***Velocity Magnitude***. Select the ***Filled*** option. Increase the number of contour levels plotted: set ***Levels*** to `100`.



Click ***Display***.



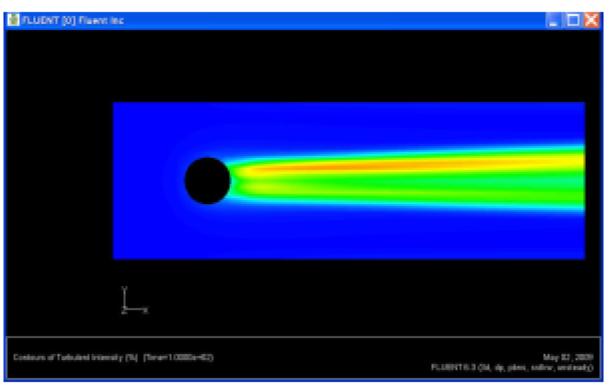
We see the flow is mostly what we would expect in this case.

Now, let's take a look at the Contour of Turbulent Intensity around the sphere. This will give us a picture of the turbulence that is occurring around the sphere.

Display > Contours

Under ***Contours of***, choose ***Turbulence...*** and ***Turbulent Intensity***. Select the ***Filled*** option. Increase the number of contour levels plotted: set ***Levels*** to `100`.

Click ***Display***.



Pressure Coefficient

Pressure coefficient is a dimensionless parameter defined by the equation ? Unknown Attachment where p is the static pressure, p_{ref} is the reference pressure, and q_{ref} is the reference dynamic pressure defined by

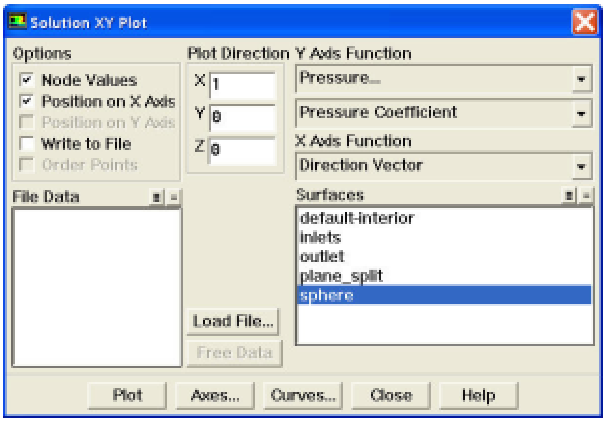
$$q_{ref} = \frac{1}{2}\rho_{ref} v_{ref}^2$$

The reference pressure, density, and velocity are defined in the **Reference Values** panel in Step 5.

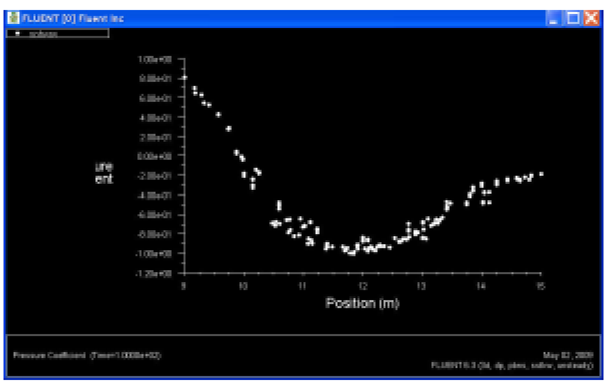
Let's plot pressure coefficient vs x-direction along the cylinder.

Plot > XY Plot...

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



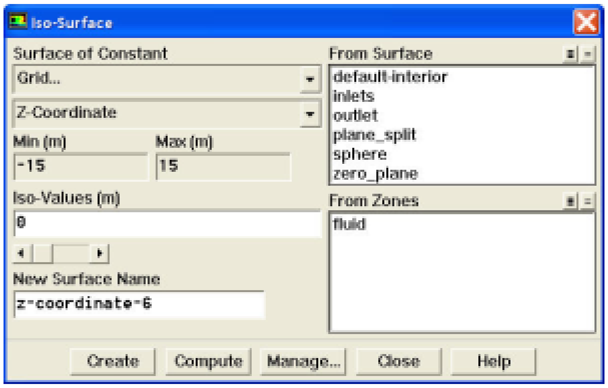
Click ***Plot***.



We see that there is a lot of scatter in our data, so we will be creating a line along the sphere to try and get a better picture of the pressure coefficient. To accomplish this we will create a surface of Z-axis position zero, and plot the line *y^2+(x-12)^2-9*, which is the equation of a ring around the sphere in the x-y plane.

Surface > Iso-Surface

Under ***Surface of Constant*** choose ***Grid...*** and ***Z-Coordinate***. Under ***Iso-Values*** input *0*. This will create a plane in our flow in which the Z coordinate is zero everywhere.



Call this *Zero_Plane* and click ***Create***.

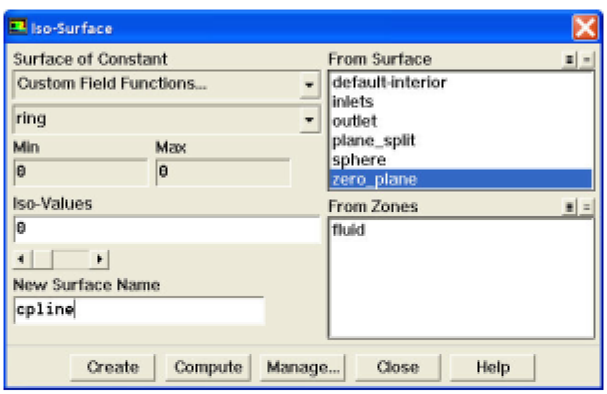
Define > Custom Field Functions

Here we input our formula *y^2+(x-12)^2 - 9* under ***Definition***. To do use the ***Field Functions*** section and choose ***Grid...*** and choose ***X-Coordinate*** and ***Y-Coordinate*** for the "x" and "y" in the above formula.

Call this *Ring* and click ***Define***.

Surface > Iso-Surface

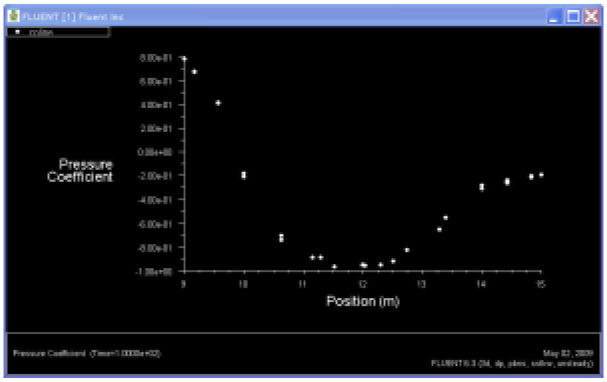
Now under ***Surface of Constant*** choose ***Custom Field Functions*** and choose our function ***Ring***. Keep the default ***Iso-Values*** to *0*. Then, within ***From Surfaces*** select ***Zero_Plane***.



Call this *CpLine* and click ***Create***.

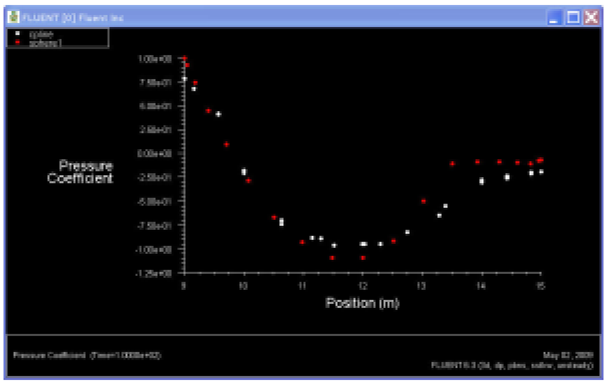
We have now created the necessary line around the sphere to view the data better. Follow the same steps as before to plot the Pressure Coefficient, except that under ***Surfaces*** choose ***CpLine***.

We now see that the data is has less scatter (this effect, however, is far more significant on a more refined mesh).



Comparison

With our simulation data, we can now compare the Fluent with experimental data. Click HERE to download the experimental data. The two sets of data for Pressure Coefficients are shown here:

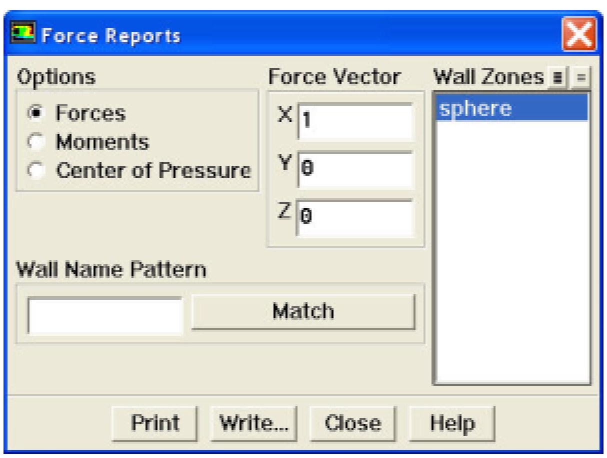


The Red dots are the experimental data (labeled "sphere1"), while the white dots are our data (labeled CPline).

Lets display the coefficient of drag:

Report > Forces

Make sure that under ***Force Vector*** the ***X*** has a 1 by it (this represents the drag on the sphere), and that under ***Wall Zones***, ***sphere*** is highlighted.



Click ***Print***.

The two sets of data for drag coefficient are shown here:

Experimental	0.1
Simulation	0.4485

Go to Step 7: Refine Mesh

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