

Turbulent Pipe Flow (LES) - Numerical Results

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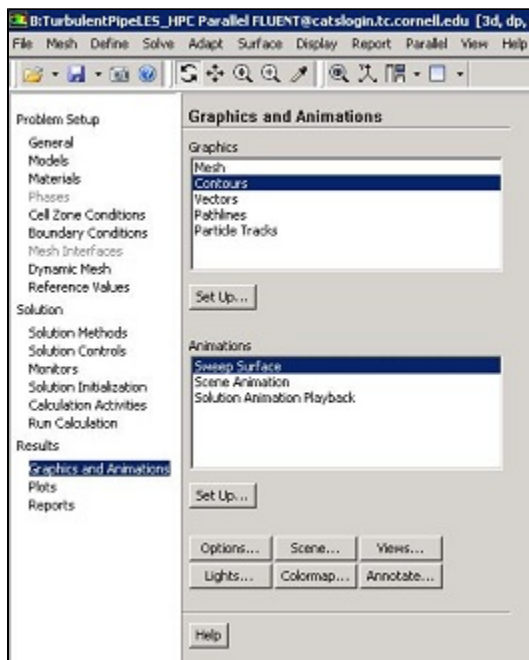
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Numerical Results

Contour plots of Axial Velocity

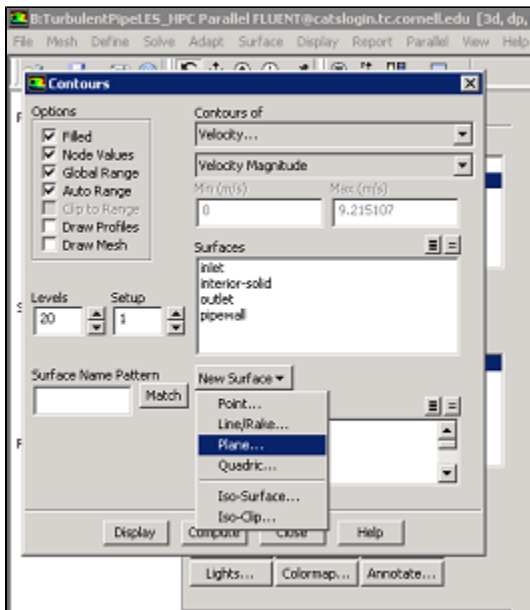
Note that there are two types of velocities in an LES simulation - instantaneous velocity and mean velocity. The instantaneous velocity is the actual velocity at any time instant in the domain. When we collect the statistics, the instantaneous velocity is time-averaged to obtain the mean velocity. Let us make a mid-plane in the domain to look at the contour plots of instantaneous axial velocity and the mean axial velocity.

(Click) [Graphics and Animation > Contours > Set Up..](#) as shown in the figure below.



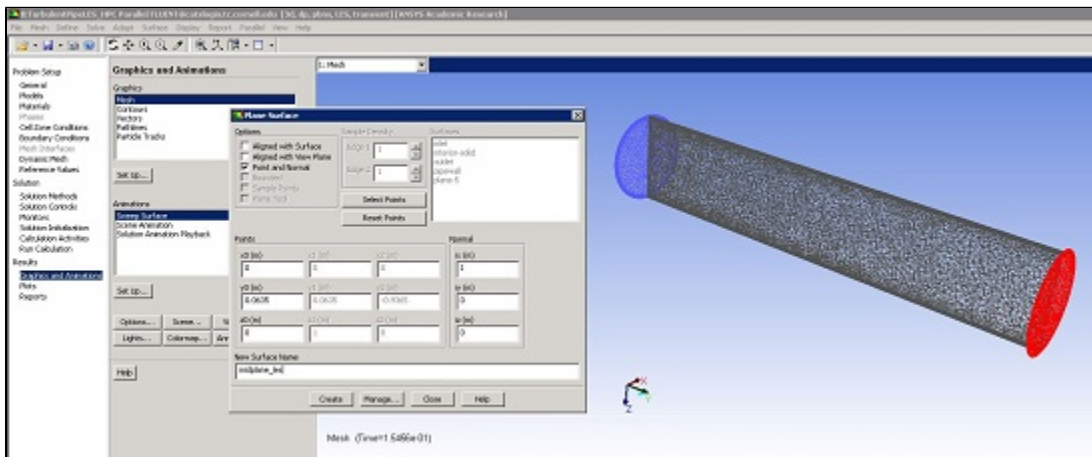
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In the [Contours](#) window, click on [New Surface > Plane...](#) as shown below.



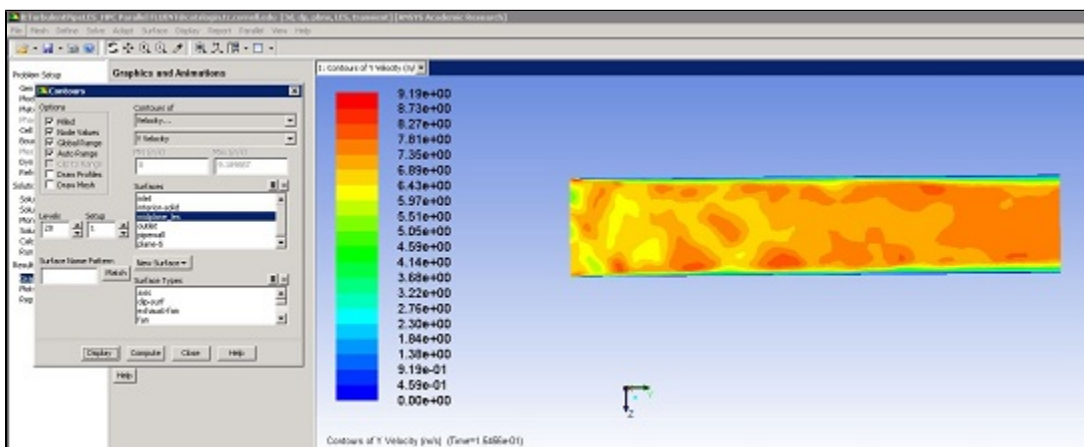
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In the **Plane Surface** window, click **Point and Normal**. Under **Points**, choose $(x_0 \text{ (m)}, y_0 \text{ (m)}, z_0 \text{ (m)}) = (0, 0.0635, 0)$ and under **Normal** choose $(i_x \text{ (m)}, i_y \text{ (m)}, i_z \text{ (m)}) = (1, 0, 0)$. Name the surface as **midplaneles** under **New Surface Name**. Click **Create**. The plane can be viewed using **Graphics and Animations > Mesh > Set Up...**



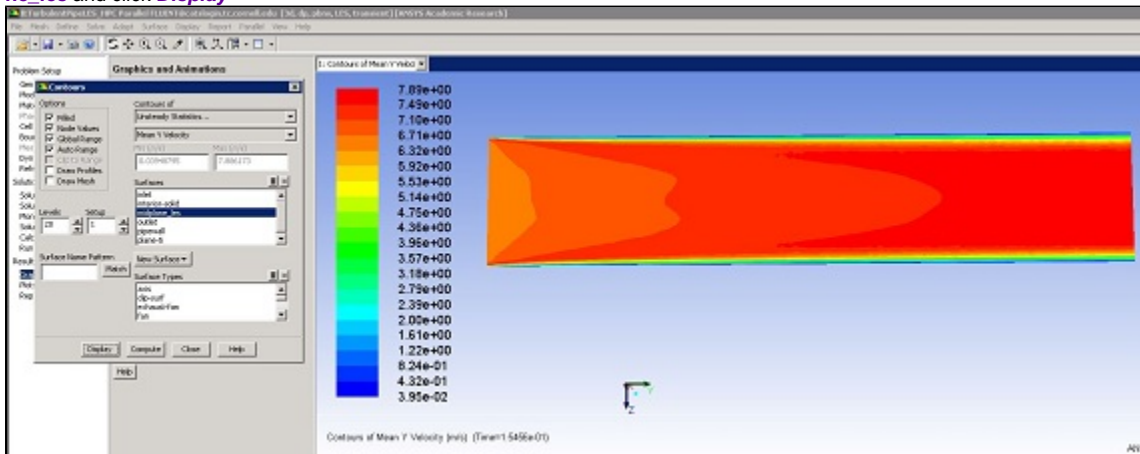
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Go back to **Contours** window and select **Velocity...** and **Y Velocity** under **Contours of** and under **Surfaces** choose **midplaneles** and click **Display**. The figure below shows the contour plot of instantaneous axial velocity.



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For the contour plot of the mean axial velocity, select **Unsteady Statistics...** and **Mean Y Velocity** under **Contours of** and under **Surfaces** choose **midplane** and click **Display**



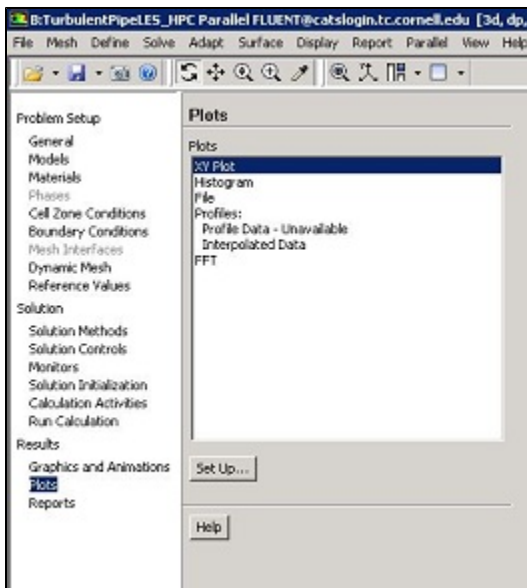
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From the two plots we can clearly see the difference between the two velocities.

XY plot of Axial Velocity

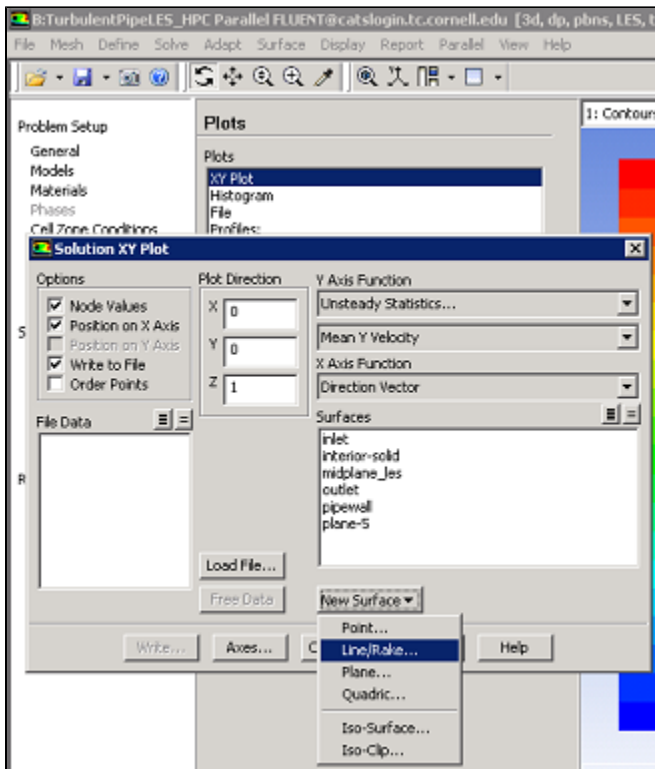
Let us make a line across the pipe at the center of the domain to look at the mean axial velocity and compare it with the solution from k-e model in the next section.

(Click) **Plots > XY Plot > Set Up...** as shown in the figure below.



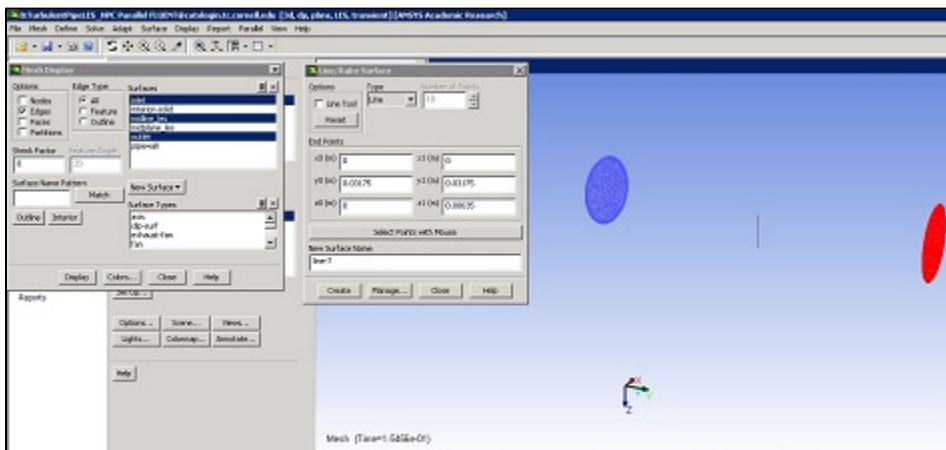
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In the **Solution XY Plot** window, click on **New Surface > Line/Rake...** as shown below.



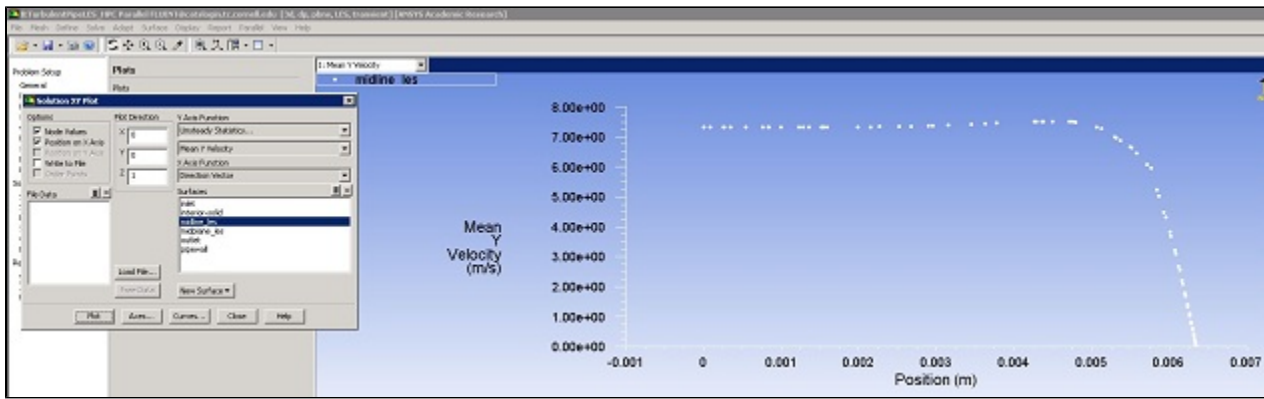
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In the **Line/Rake Surface** window, under **End Points** choose $(x_0 (m), y_0 (m), z_0 (m)) = (0, 0.03175, 0)$ and $(x_1 (m), y_1 (m), z_1 (m)) = (0, 0.03175, 0.00635)$. Name the surface as **midline_jes** under **New Surface Name**. Click **Create**. The line can be viewed using **Graphics and Animations > Mesh > Set Up...**



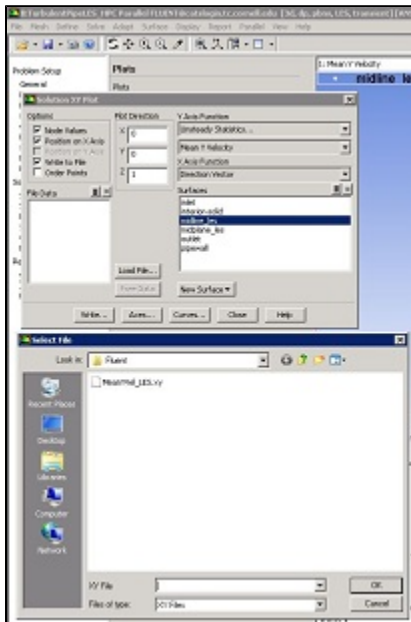
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Go back to **Solution XY Plot** window and select **Unsteady Statistics...** and **Mean Y Velocity** under **Y Axis Function** and under **Plot Direction** choose $(X, Y, Z) = (0, 0, 1)$. Choose **midline_jes** under **Surfaces** and click **Plot**. The figure below shows the contour plot of instantaneous axial velocity.



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To save the line plot, select **Write to File** in the **Solution XY Plot** window and click **Write**. Select a location and save the file as **MeanYVel_LES.xy**.



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Save the project and close FLUENT.

Go to Step 7: Verification & Validation

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