Turbulent Pipe Flow (LES) - Numerical Results

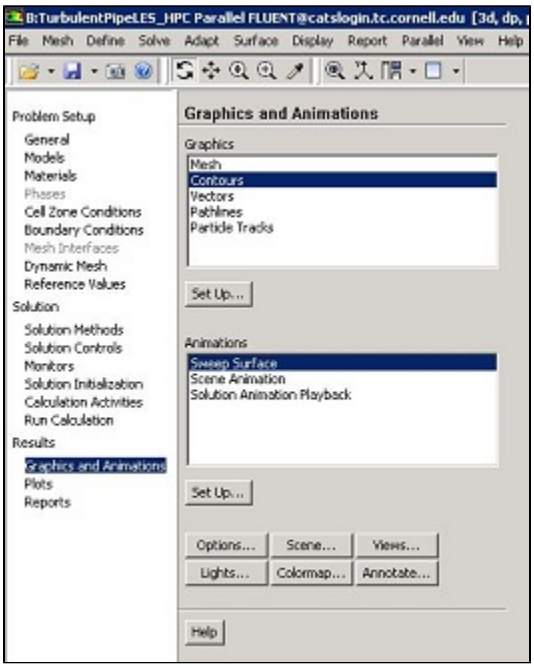
Author: Ranjith Tirunagari, Cornell University

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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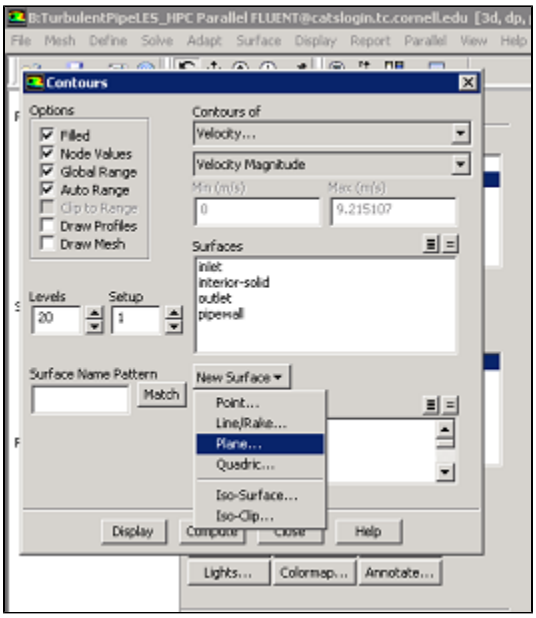
In the ***Contours*** window, click on ***New Surface > Plane...*** as shown below.



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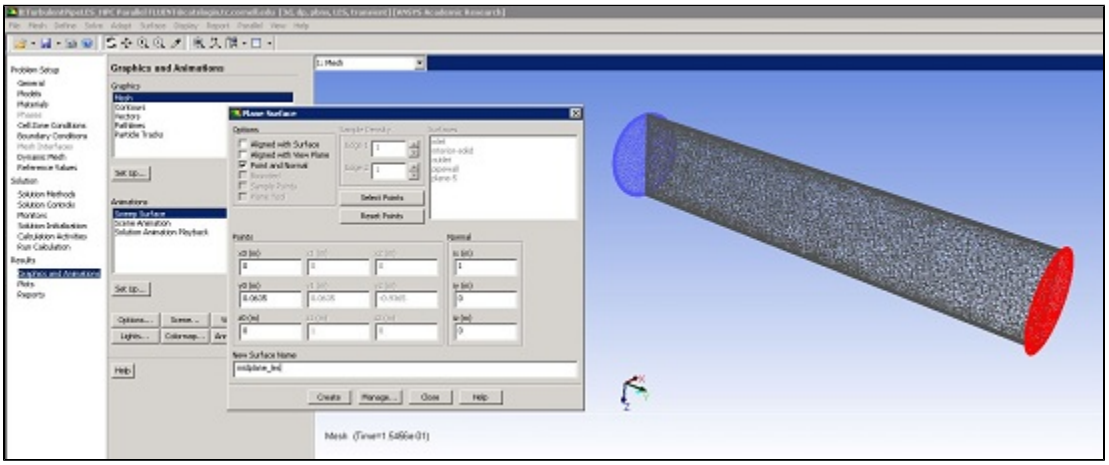
In the ***Plane Surface*** window, click ***Point and Normal***. Under ***Points***, choose ***(x0 (m), y0 (m), z0 (m)) = (0,0.0635,0)*** and under ***Normal*** choose ***(ix (m), iy (m), iz (m)) = (1,0,0)***. Name the surface as ***midplane_les*** under ***New Surface Name***. Click ***Create***. The plane can be viewed using ***Graphics and Animations > Mesh > Set Up...***.



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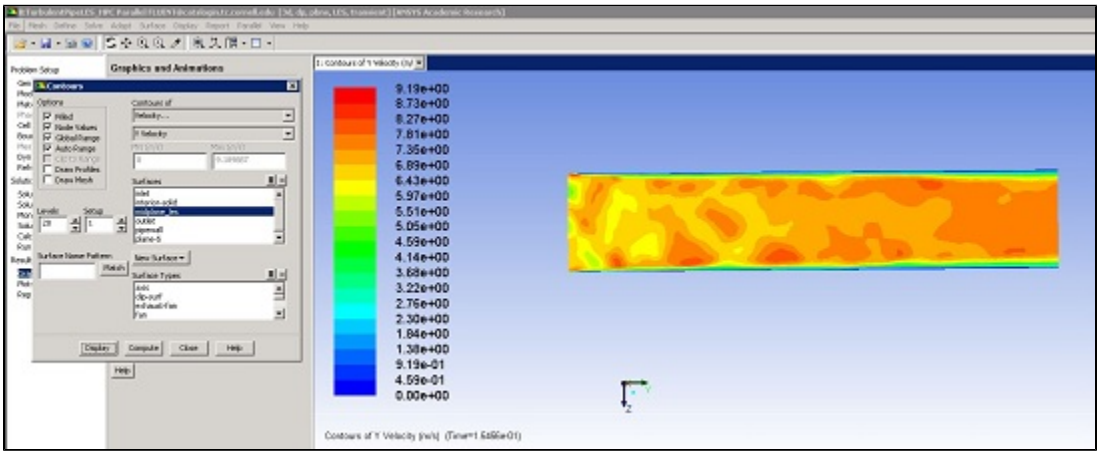
Go back to ***Contours*** window and select ***Velocity...*** and ***Y Velocity*** under ***Contours of*** and under ***Surfaces*** choose ***midplane_les*** and click ***Display***. The figure below shows the contour plot of instantaneous axial velocity.



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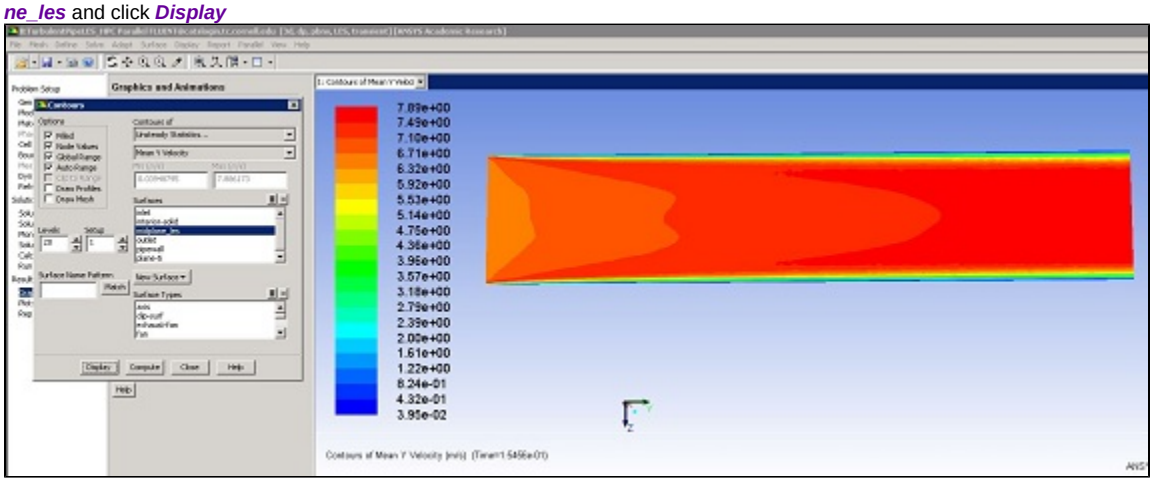
For the contour plot of the mean axial velocity, select ***Unsteady Statistics...*** and ***Mean Y Velocity*** under ***Contours of*** and under ***Surfaces*** choose ***midplane_les*** and click ***Display***



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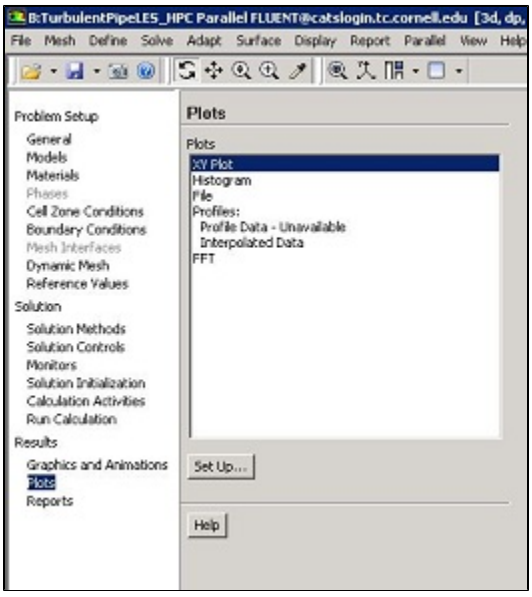
From the two plots we can clearly see the difference between the two velocities.

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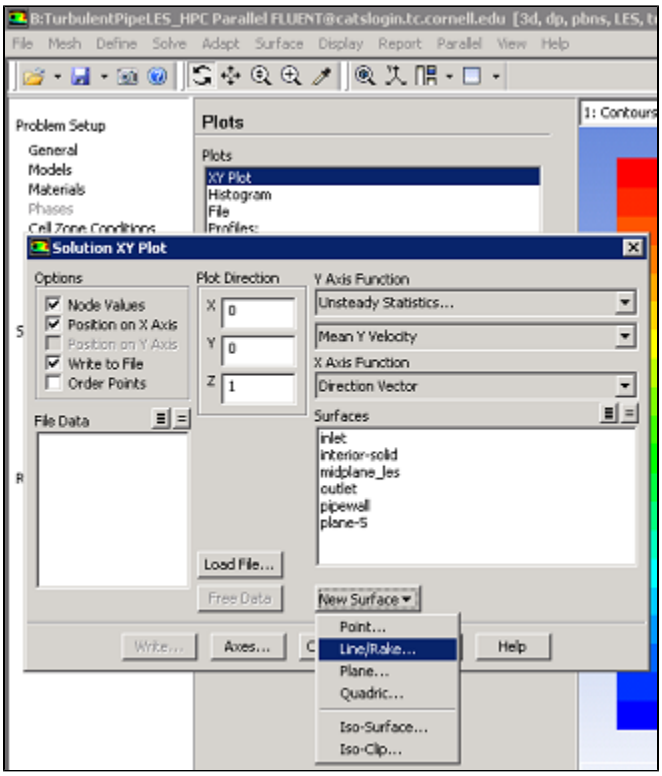
In the ***Solution XY Plot*** window, click on ***New Surface > Line/Rake...*** as shown below.



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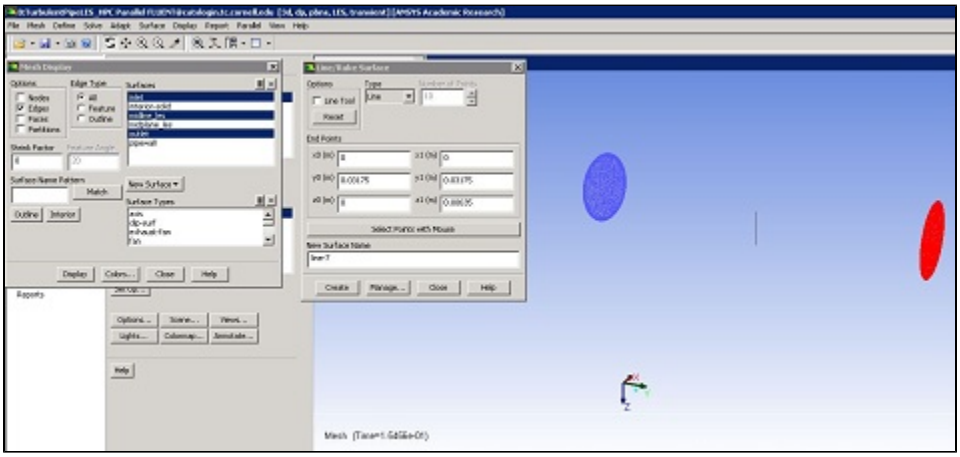
In the ***Line/Rake Surface*** window, under ***End Points*** choose ***(x0 (m), y0 (m), z0 (m)) = (0,0.03175,0)*** and ***(x1 (m), y1 (m), z1 (m)) = (0,0.03175,0.00635)***. Name the surface as ***midline_les*** under ***New Surface Name***. Click ***Create***. The line can be viewed using ***Graphics and Animations > Mesh > Set Up...***.



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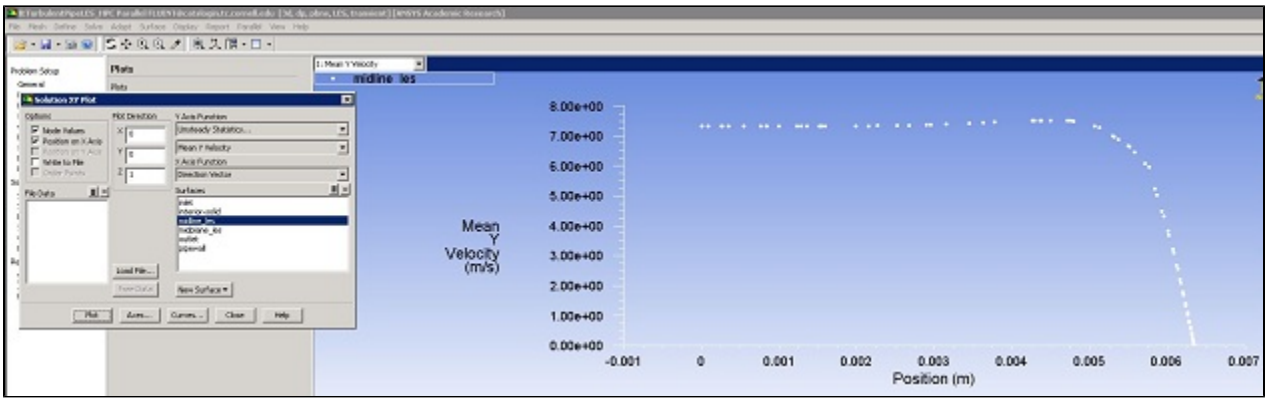
Go back to ***Solution XY Plot*** window and select ***Unsteady Statistics...*** and ***Mean Y Velocity*** under ***Y Axis Function*** and under ***Plot Direction*** choose ***(X ,Y,Z) = (0,0,1)***. Choose ***midline_les*** under ***Surfaces*** and click ***Plot***. The figure below shows the contour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



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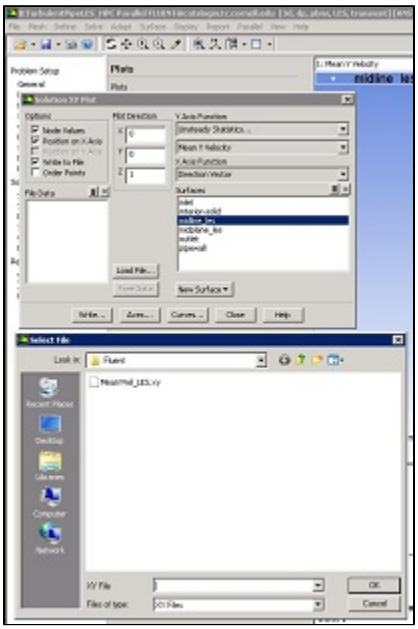
To save the line plot, select ***Write to File*** in the ***Solution XY Plot*** window and click ***Write***. Select a location and save the file as ***MeanYVel_LES.xy***.



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Save the project and close FLUENT.

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