Turbulent Pipe Flow (LES) - Numerical Results

Author: Ranjith Tirunagari, Cornell University Problem Specification 1. Pre-Analysis & Start-Up 2. Geometry 3. Mesh 4. Physics Setup 5. Numerical Solution 6. Numerical Results 7. Verification & Validation Exercises Comments

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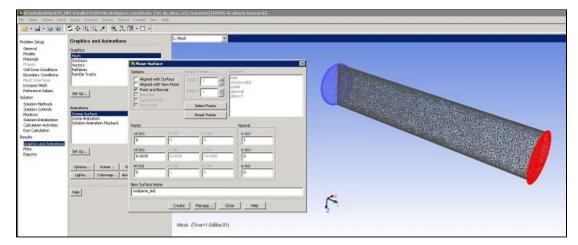
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In the Contours window, click on New Surface > Plane ... as shown below.

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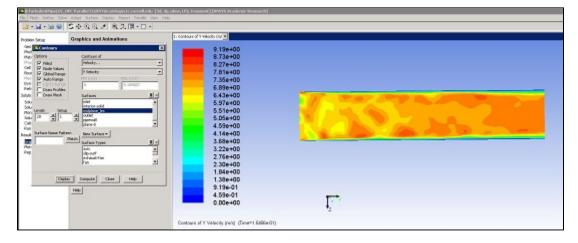
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In the *Plane Surface* window, click *Point and Normal*. Under *Points*, choose (x0 (m), y0 (m), z0 (m)) = (0,0.0635,0) and under *Normal* choose (ix (m), iy (m), iz (m)) = (1,0,0). Name the surface as *midplane_les* under *New Surface Name*. Click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



Click Here for Higher Resolution

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 midpla ne_les and click Display

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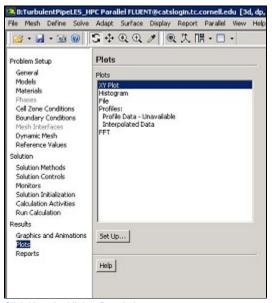
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From the two plots we can clearly see the difference between the two velocities.

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.



Click Here for Higher Resolution

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

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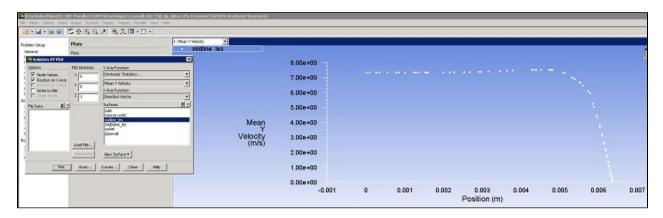
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In the Line/Rake Surface window, under End Points choose (x0 (m), y0 (m), z0 (m)) = (0,0.03175,0) and (x1 (m), y1 (m), z1 (m)) = (0,0.03175,0.00635). Name the surface as midline_les under New Surface Name. Click Create. The line can be viewed using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



Click Here for Higher Resolution

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

Go to all FLUENT Learning Modules