Weld Results
Yan Zhan
*SUNY Stony Brook*

June 13\textsuperscript{rd}, 2013
Outline

• Studied Parameters
• Results Analysis
  – Contours Plots For the Weld Region
  – Axial Velocity Profile at Different Locations Near the Weld
  – Plots of Turbulent Kinetic Energy and Momentum Thickness Near the Weld
  – Line Plot Goes From Inlet To Outlet
# Studied Parameters

<table>
<thead>
<tr>
<th>Name (Unit)</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wall Shear Stress</strong> <em>(kg/(m \cdot s^2))</em></td>
<td>( \tau_w = \mu \frac{\partial U}{\partial y} \bigg</td>
</tr>
<tr>
<td><strong>Friction Velocity</strong> <em>(m/s)</em></td>
<td>( u_\tau = \sqrt{\tau/\rho} )</td>
</tr>
<tr>
<td><strong>Turbulent Kinetic Energy</strong> <em>(m^2/s^2)</em></td>
<td>( k = \frac{1}{2}(\overline{(u')^2} + \overline{(v')^2} + \overline{(w')^2}) )</td>
</tr>
<tr>
<td><strong>Turbulent Dissipation Rate</strong> <em>(m^2/s^3)</em></td>
<td>( \epsilon \equiv \frac{\mu}{\rho} \frac{\partial u'_i}{\partial x_k} \frac{\partial u'_i}{\partial x_k} )</td>
</tr>
<tr>
<td><strong>Turbulence Intensity</strong> <em>(%)</em></td>
<td>( I \equiv \frac{u'}{U_{\text{mean}}} = \frac{\sqrt{2k/3}}{\sqrt{U^2 + V^2 + W^2}} )</td>
</tr>
<tr>
<td><strong>Momentum Thickness</strong> <em>(m)</em></td>
<td>( \delta_\theta = \int_0^a \frac{U}{U_{\text{max}}} \left(1 - \frac{U}{U_{\text{max}}} \right) dr )</td>
</tr>
</tbody>
</table>
Weld Region
X=0.0423

X=0.04065  
(weld center)

X=0.039

X=0.0385
Planes in the Vicinity of the Weld

Upstream place
X=0.0430405

Downstream place
X=0.0380405

Z = 0 (α = 0°)
Upstream place $X=0.0430405$
Downstream place X= 0.0380405
At the Exit

$\alpha = 0^\circ$
Momentum Thickness At the Vicinity of the Weld

Upstream Plot

Downstream Plot
Lines Go From Inlet to Outlet
Wall Shear Stress (kg/m*s)

S: distance to the pipe inlet along the center line

s ~ 13 at weld

S: distance to the pipe inlet along the center line
Turbulent Kinetic Energy ($m^2/s^2$)

- $S$
- $0$  $5$  $10$  $15$
- $1E^{-05}$  $2E^{-05}$  $3E^{-05}$  $4E^{-05}$
- Top
- Bottom

Graph showing the comparison of turbulent kinetic energy at different positions (top and bottom) with respect to a parameter $S$. The lines indicate a sharp increase at certain values of $S$. 
Turbulent Dissipation Rate ($m^2/s^3$)

- Top
- Bottom