Weld Results

Yan Zhan
SUNY Stony Brook

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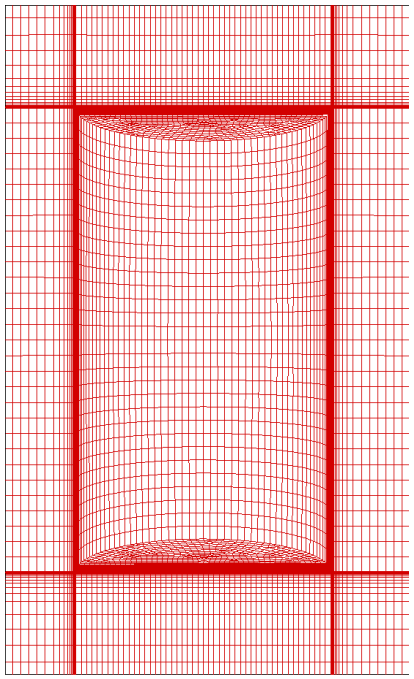
Outline

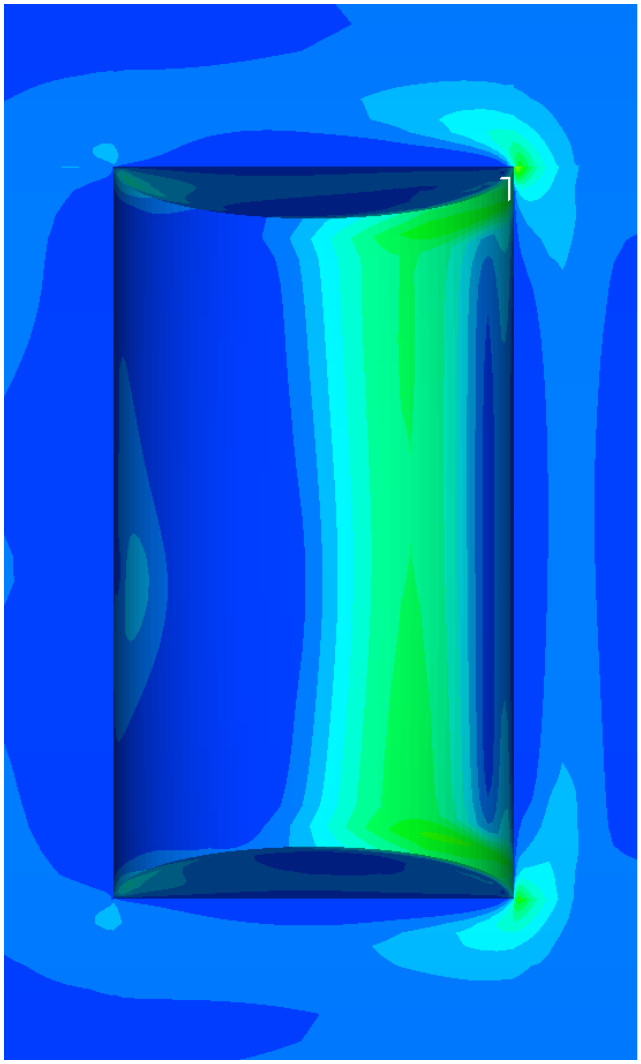
- Studied Parameters
- Results Analysis
  - Contours Plots For the Weld Region
  - Axial Velocity Profile at Different Locations Near the Weld
  - Plots of Turbulent Kinetic Energy and Momentum Thickness Near the Weld
  - Line Plot Goes From Inlet To Outlet

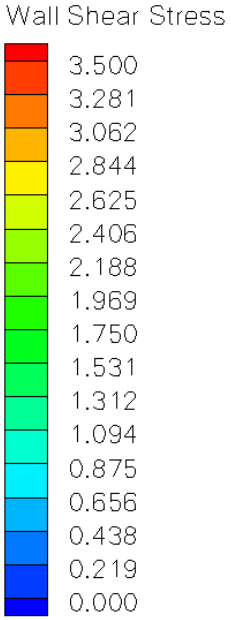
Studied Parameters

Name (Unit)	Equation
Wall Shear Stress $(kg/(m \cdot s^2))$	$\tau_w = \mu \left.\frac{\partial U}{\partial y}\right\|_{y=0}$
Friction Velocity (m/s)	$u_\tau = \sqrt{\tau/\rho}$
Turbulent Kinetic Energy (m^2/s^2)	$k = \frac{1}{2}(\overline{(u')^2} + \overline{(v')^2} + \overline{(w')^2})$
Turbulent Dissipation Rate (m^2/s^3)	$\epsilon \equiv \frac{\mu}{\rho}\overline{\frac{\partial u'_i}{\partial x_k}\frac{\partial u'_i}{\partial x_k}}$
Turbulence Intensity (%)	$I \equiv \frac{u'}{U_{mean}} = \frac{\sqrt{2k/3}}{\sqrt{U^2+V^2+W^2}}$
Momentum Thickness (m)	$\delta_\theta = \int_0^a \frac{U}{U_{max}}\left(1 - \frac{U}{U_{max}}\right) dr$

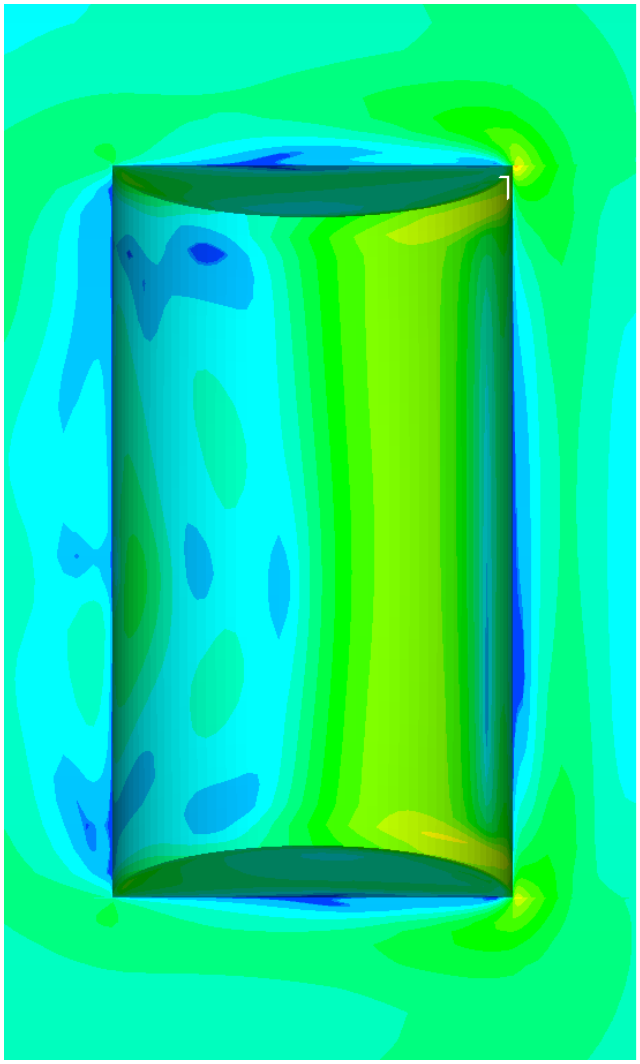
Weld Region

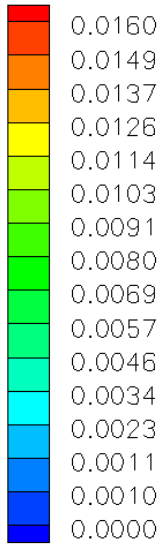


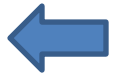



Wall Shear Stress
3.500
3.281
3.062
2.844
2.625
2.406
2.188
1.969
1.750
1.531
1.312
1.094
0.875
0.656
0.438
0.219
0.000

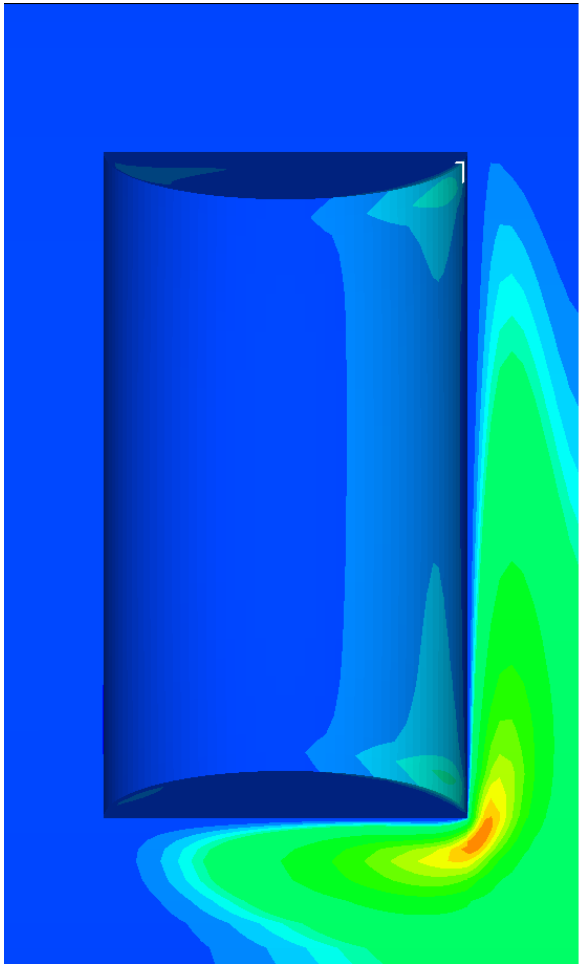
Flow

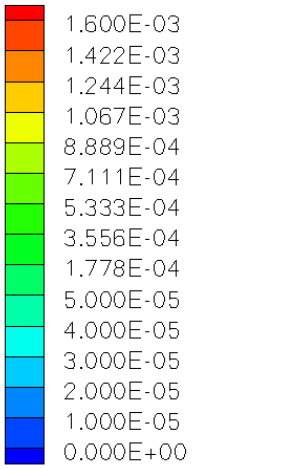



friction velocity
0.0160
0.0149
0.0137
0.0126
0.0114
0.0103
0.0091
0.0080
0.0069
0.0057
0.0046
0.0034
0.0023
0.0011
0.0010
0.0000

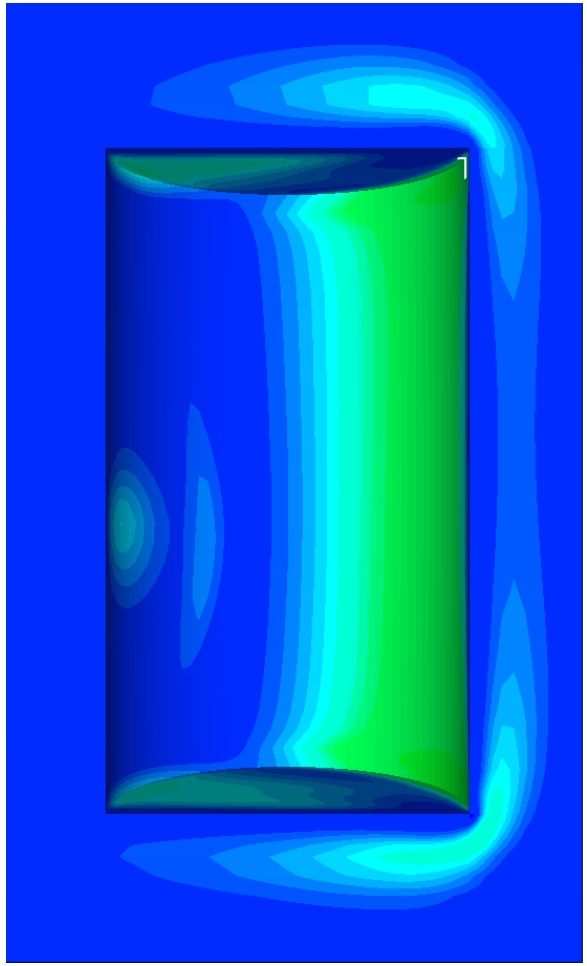


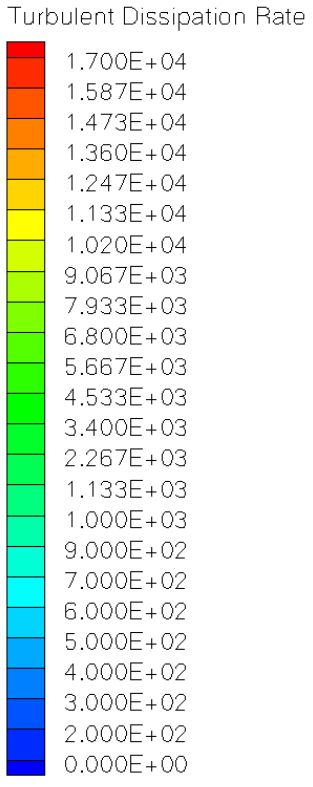
Flow

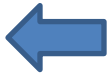



Turbulent Kinetic Energy
1.600E-03
1.422E-03
1.244E-03
1.067E-03
8.889E-04
7.111E-04
5.333E-04
3.556E-04
1.778E-04
5.000E-05
4.000E-05
3.000E-05
2.000E-05
1.000E-05
0.000E+00

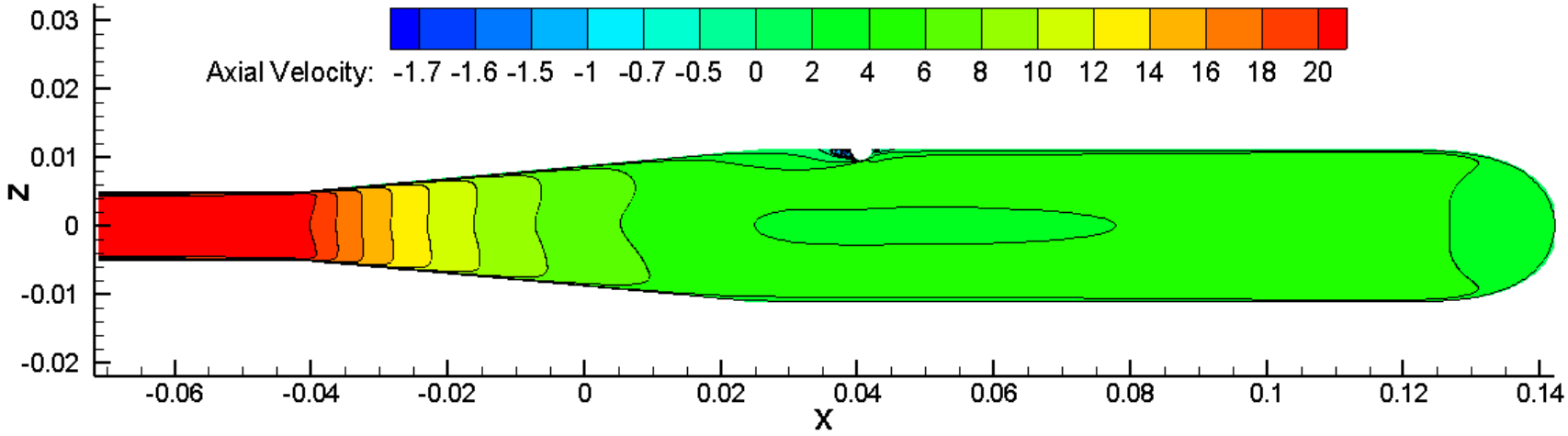
Flow

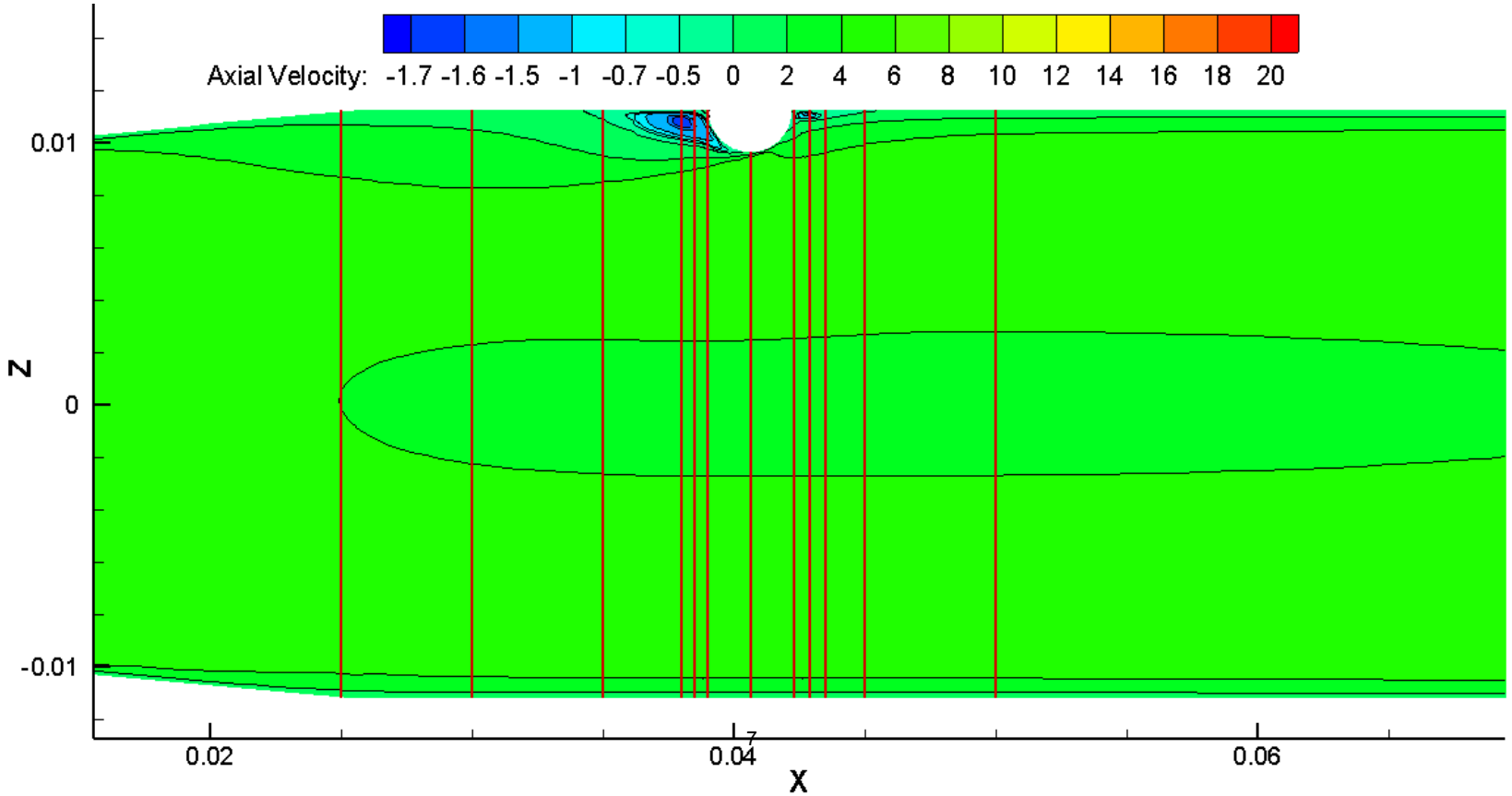


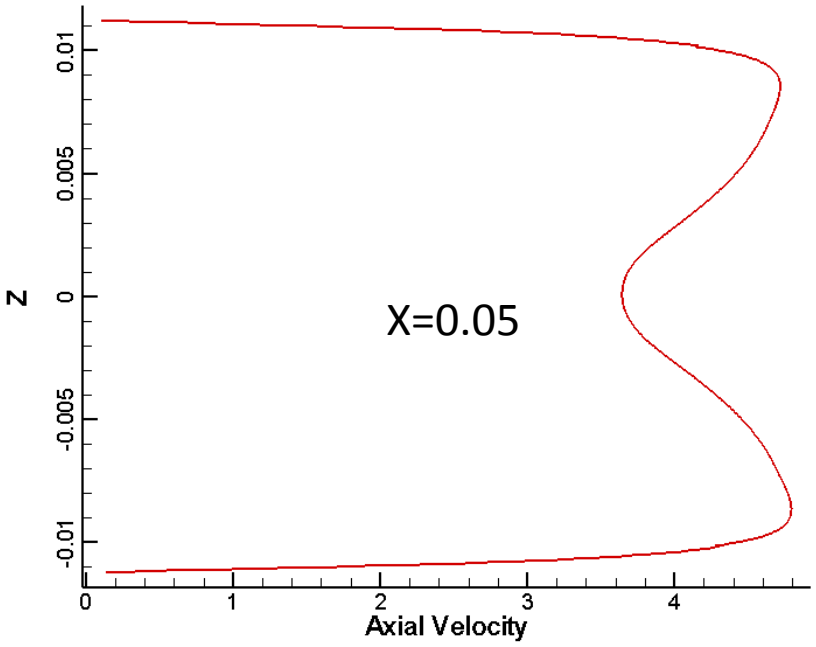

Turbulent Dissipation Rate
1.700E+04
1.587E+04
1.473E+04
1.360E+04
1.247E+04
1.133E+04
1.020E+04
9.067E+03
7.933E+03
6.800E+03
5.667E+03
4.533E+03
3.400E+03
2.267E+03
1.133E+03
1.000E+03
9.000E+02
7.000E+02
6.000E+02
5.000E+02
4.000E+02
3.000E+02
2.000E+02
0.000E+00

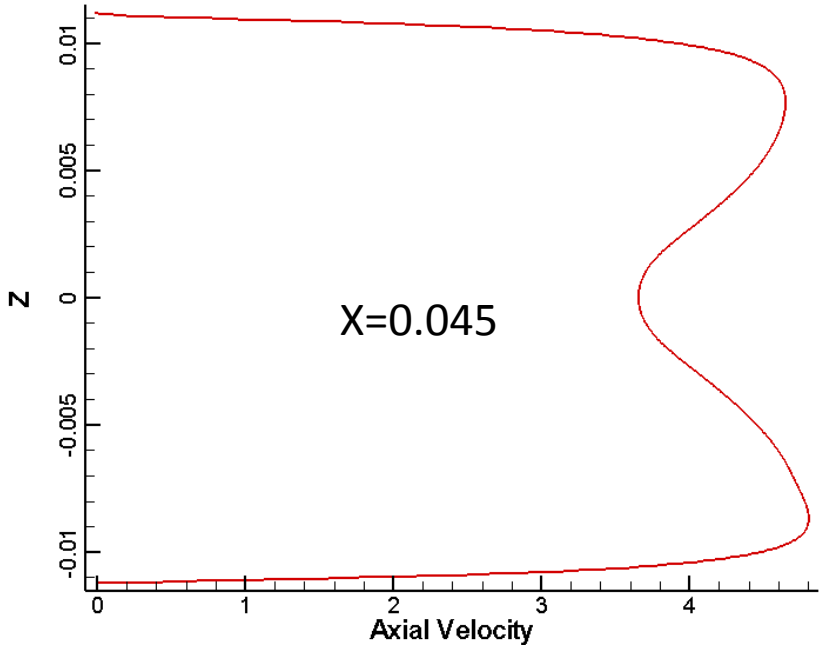


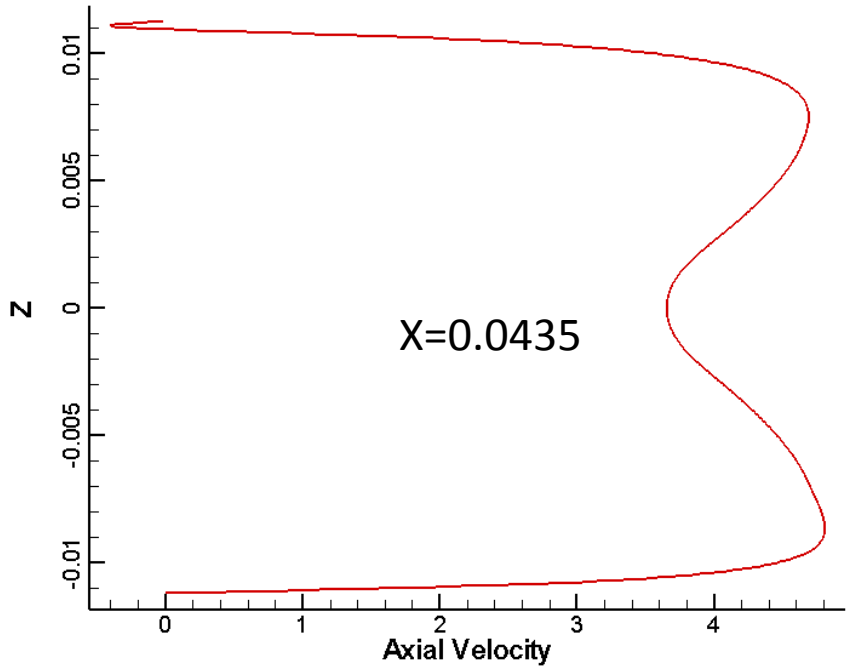
Flow

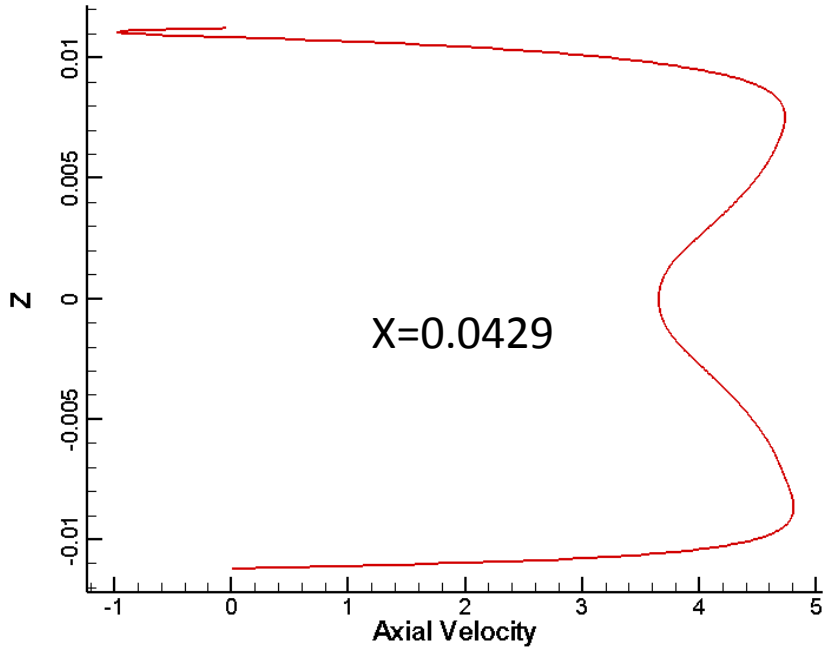

Axial Velocity: -1.7 -1.6 -1.5 -1 -0.7 -0.5 0 2 4 6 8 10 12 14 16 18 20
0.03
0.02
0.01
0
-0.01
-0.02
Z
-0.06 -0.04 -0.02 0 0.02 0.04 0.06 0.08 0.1 0.12 0.14
X

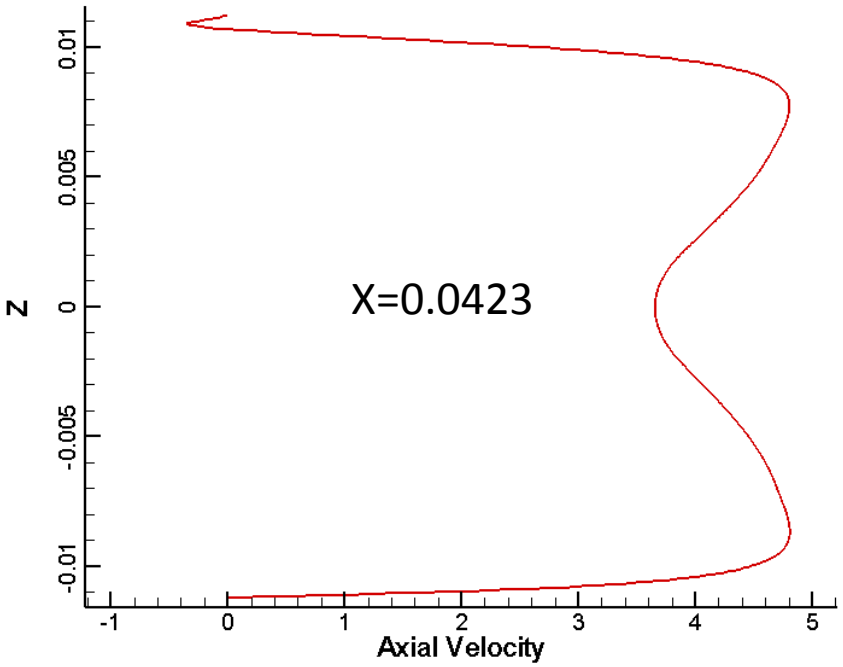

Axial Velocity: -1.7 -1.6 -1.5 -1 -0.7 -0.5 0 2 4 6 8 10 12 14 16 18 20
0.01
0
-0.01
Z
0.02 0.04 0.06
X

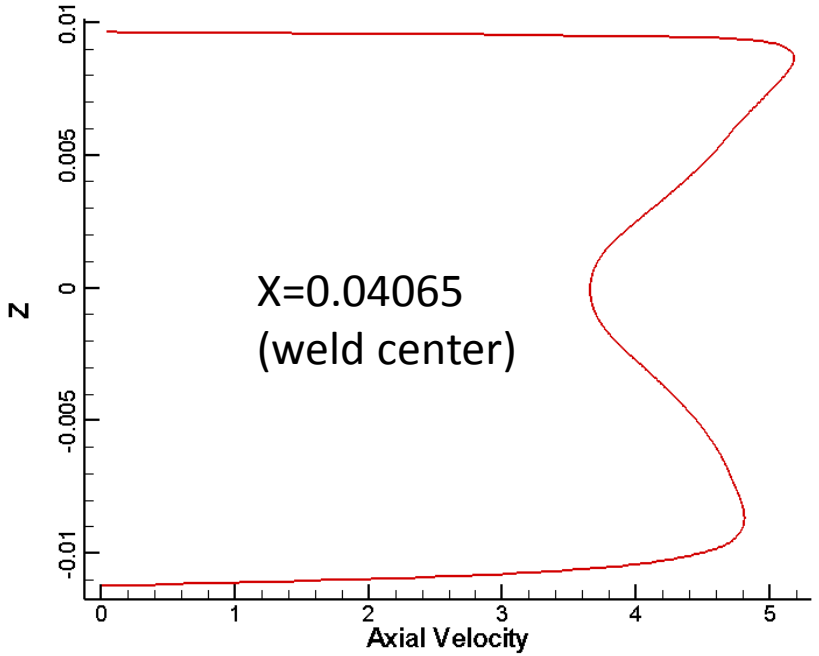

X=0.05
Z
0.01
0.005
0
-0.005
-0.01
0
1
2
3
4
Axial Velocity

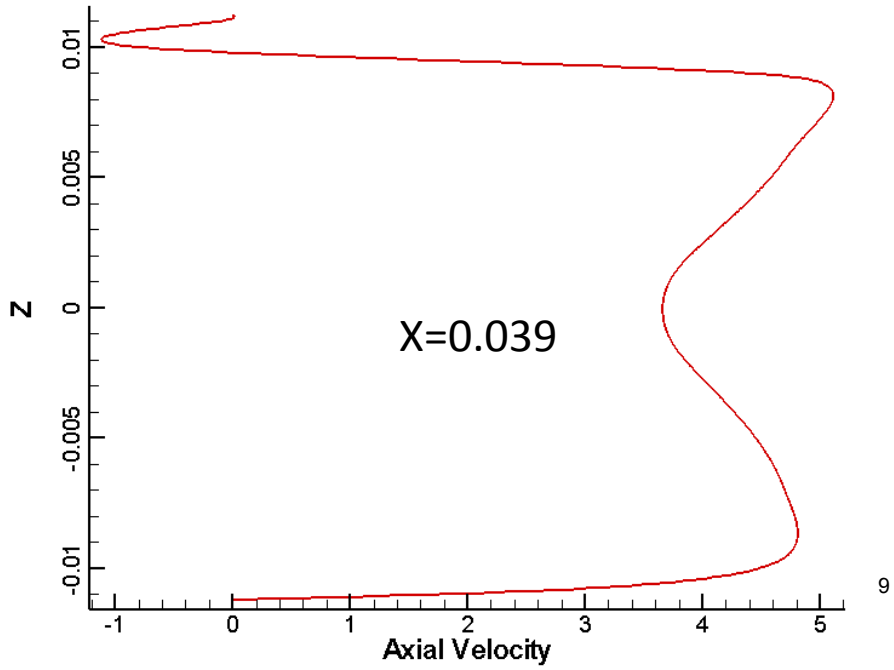

X=0.045
Z
0.01
0.005
0
-0.005
-0.01
0
1
2
3
4
Axial Velocity

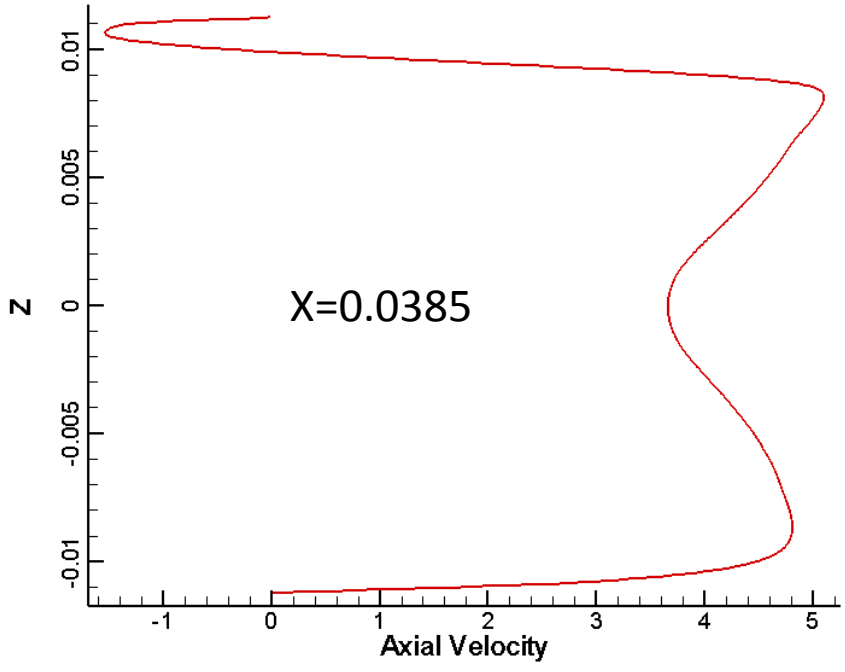

X=0.0435
Z
0.01
0.005
0
-0.005
-0.01
0
1
2
3
4
Axial Velocity

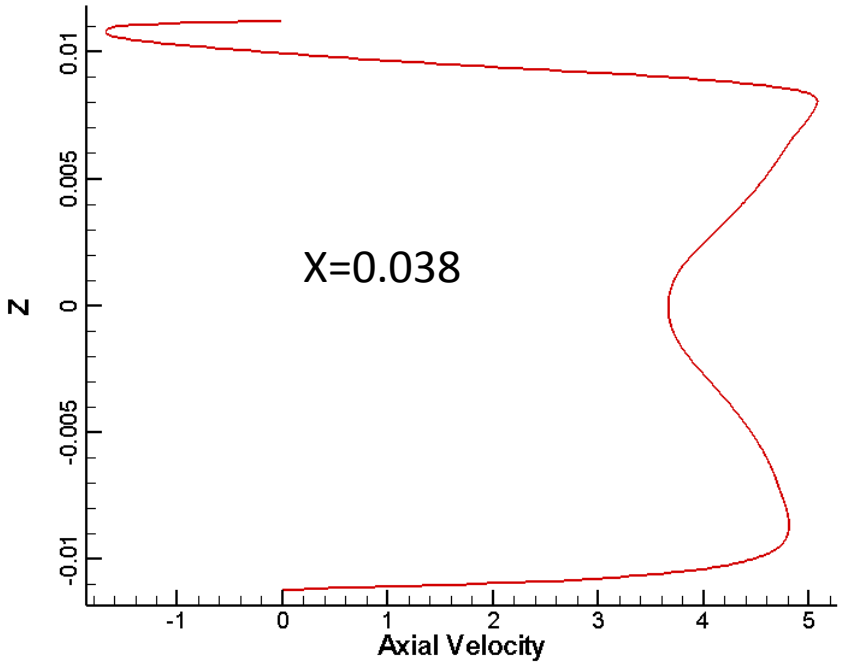

X=0.0429
Z
0.01
0.005
0
-0.005
-0.01
-1
0
1
2
3
4
5
Axial Velocity

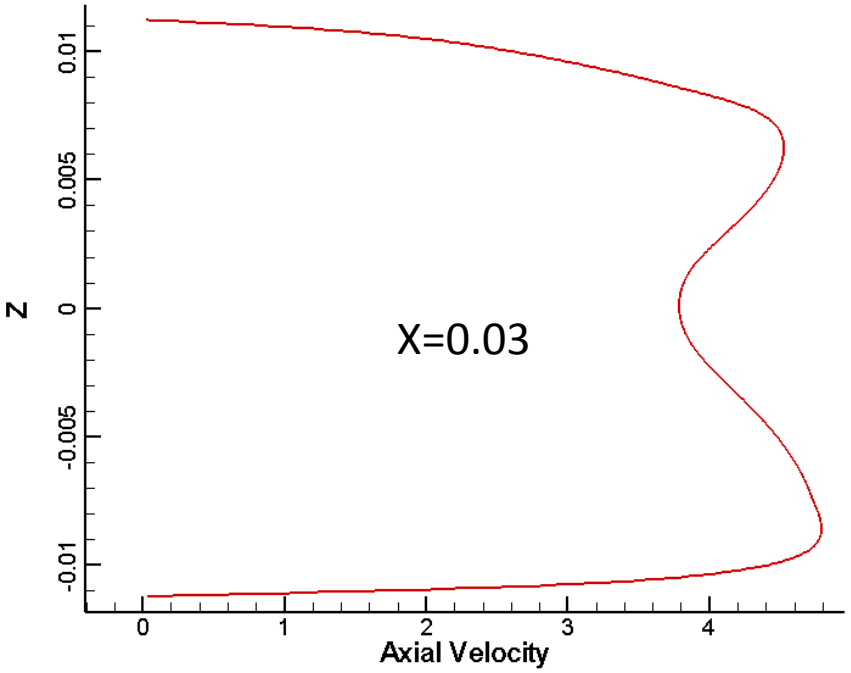

X=0.0423
Z
0.01
0.005
0
-0.005
-0.01
-1
0
1
2
3
4
5
Axial Velocity

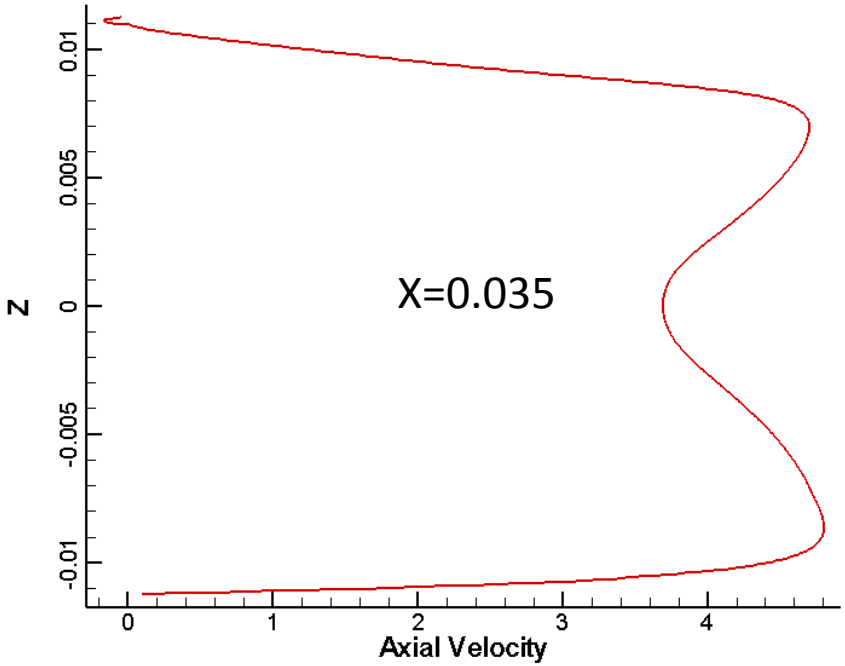

X=0.04065
(weld center)
Z
0.01
0.005
0
-0.005
-0.01
0
1
2
3
4
5
Axial Velocity

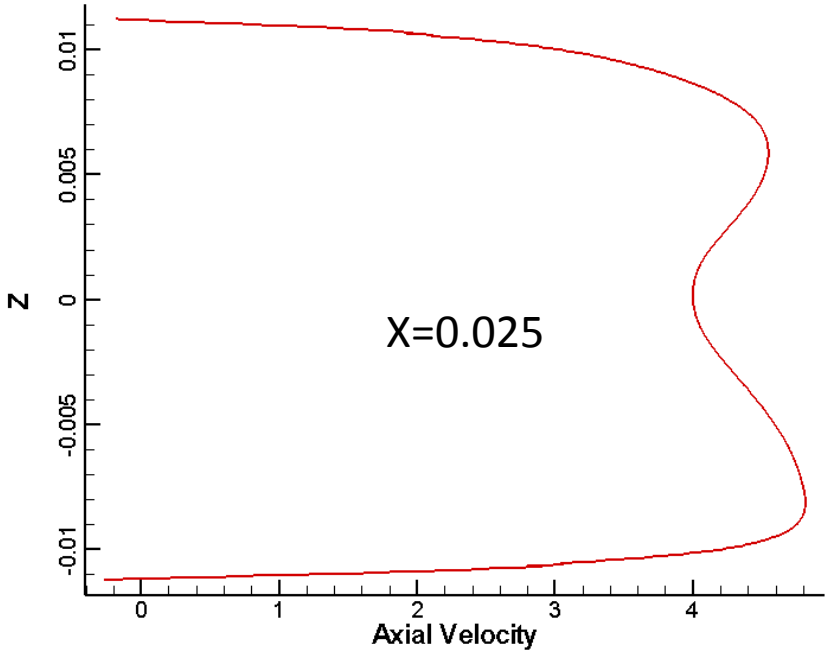

X=0.039
Z
0.01
0.005
0
-0.005
-0.01
-1
0
1
2
3
4
5
Axial Velocity


X=0.0385
Z
0.01
0.005
0
-0.005
-0.01
-1
0
1
2
3
4
5
Axial Velocity

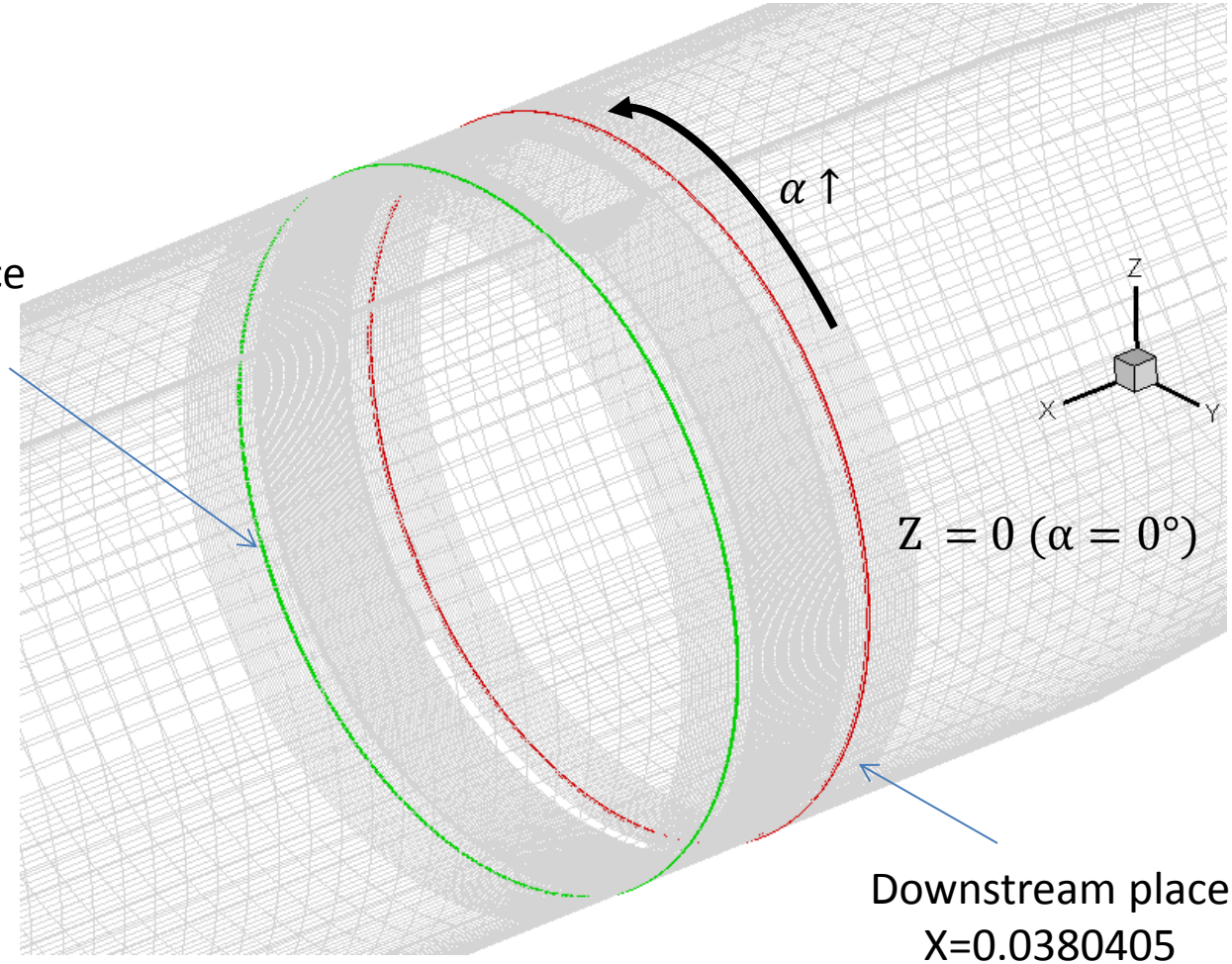

X=0.038
Z
0.01
0.005
0
-0.005
-0.01
-1
0
1
2
3
4
5
Axial Velocity


X=0.03
Z
0.01
0.005
0
-0.005
-0.01
0
1
2
3
4
Axial Velocity

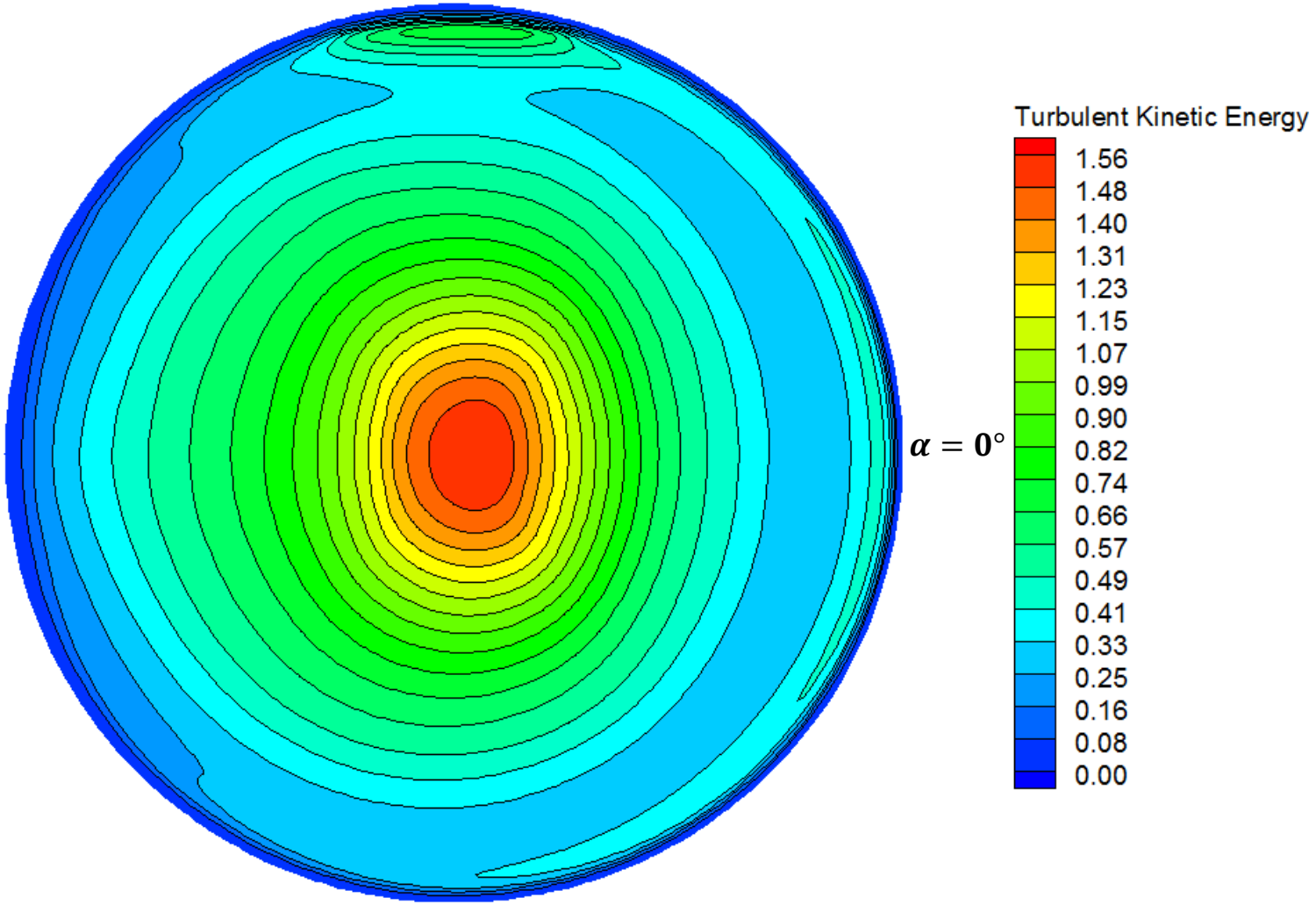

X=0.035
Z
0.01
0.005
0
-0.005
-0.01
0
1
2
3
4
Axial Velocity


X=0.025
Z
0.01
0.005
0
-0.005
-0.01
0
1
2
3
4
Axial Velocity

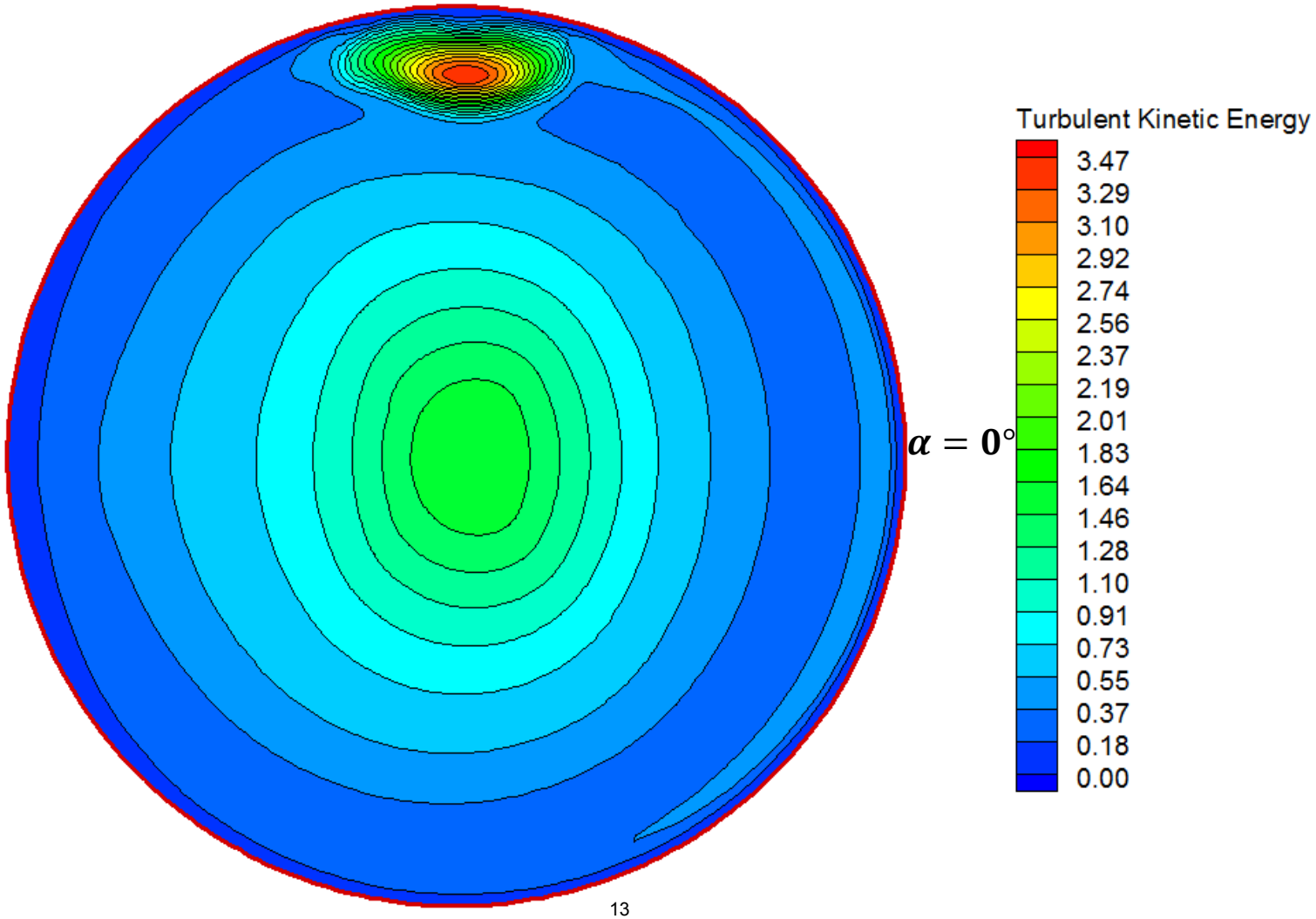
Planes in the Vicinity of the Weld



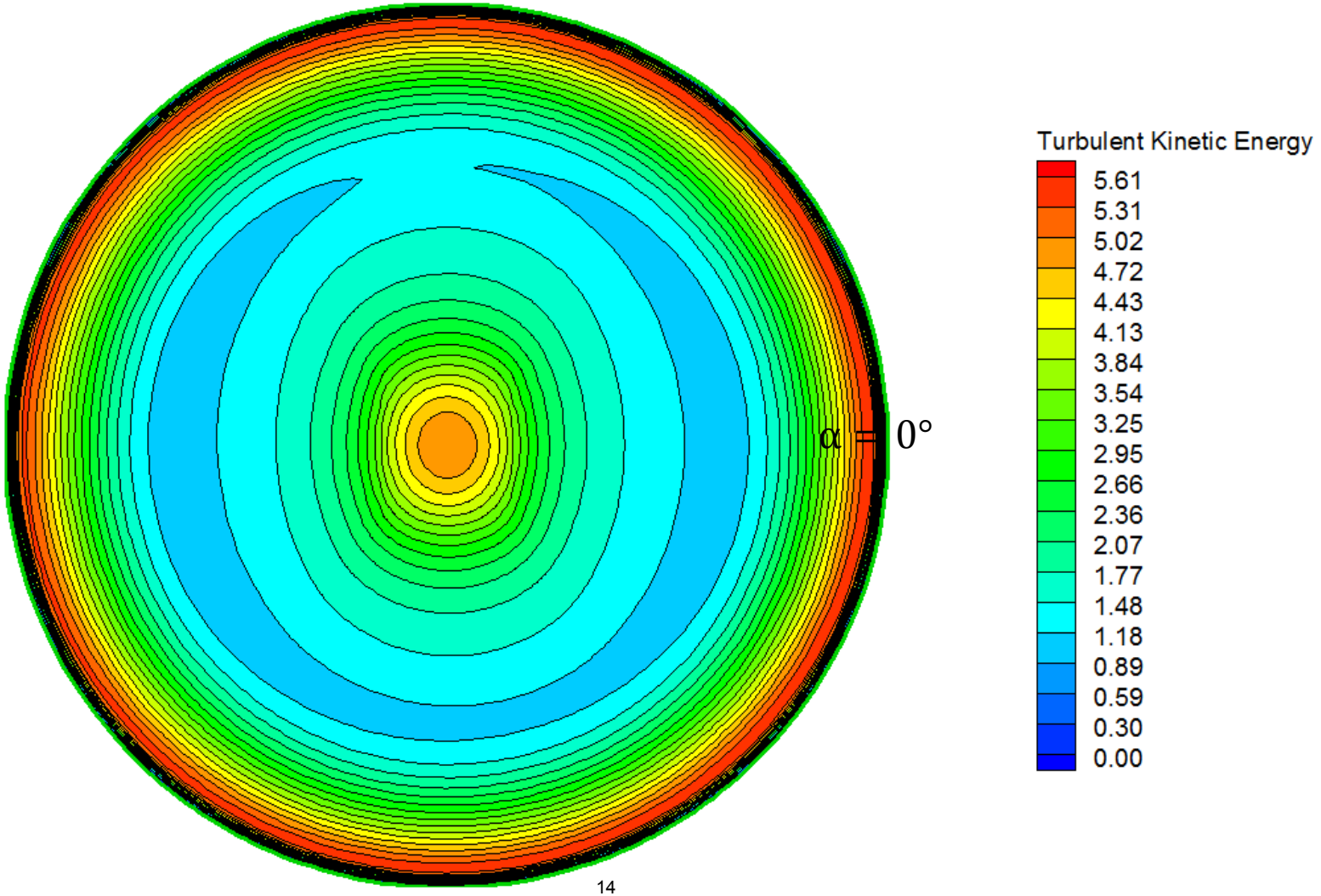
Upstream place X=0.0430405



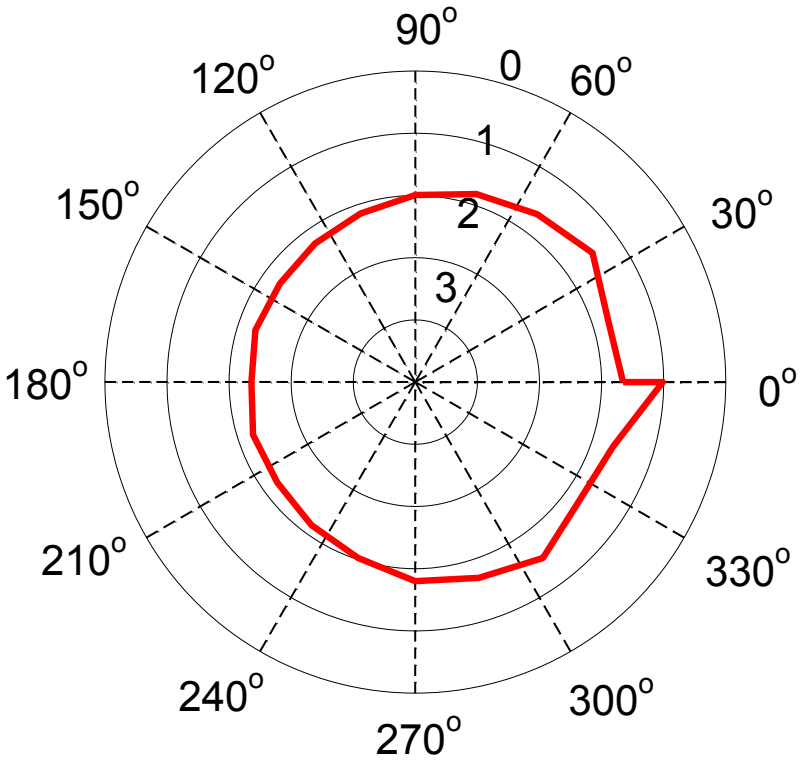
Downstream place X= 0.0380405



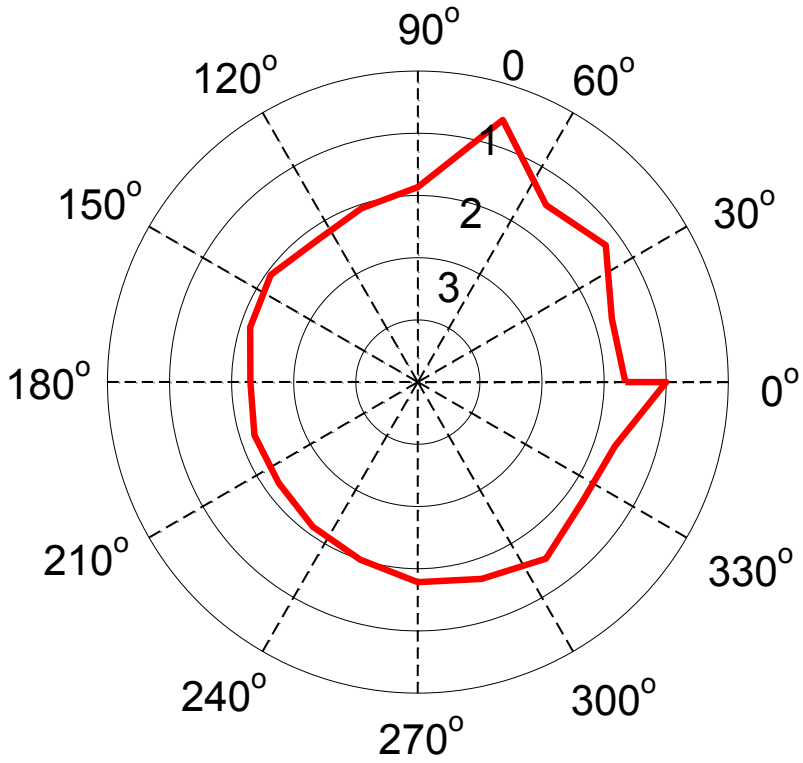
At the Exit


α = 0°
Turbulent Kinetic Energy
5.61
5.31
5.02
4.72
4.43
4.13
3.84
3.54
3.25
2.95
2.66
2.36
2.07
1.77
1.48
1.18
0.89
0.59
0.30
0.00

Momentum Thickness At the Vicinity of the Weld

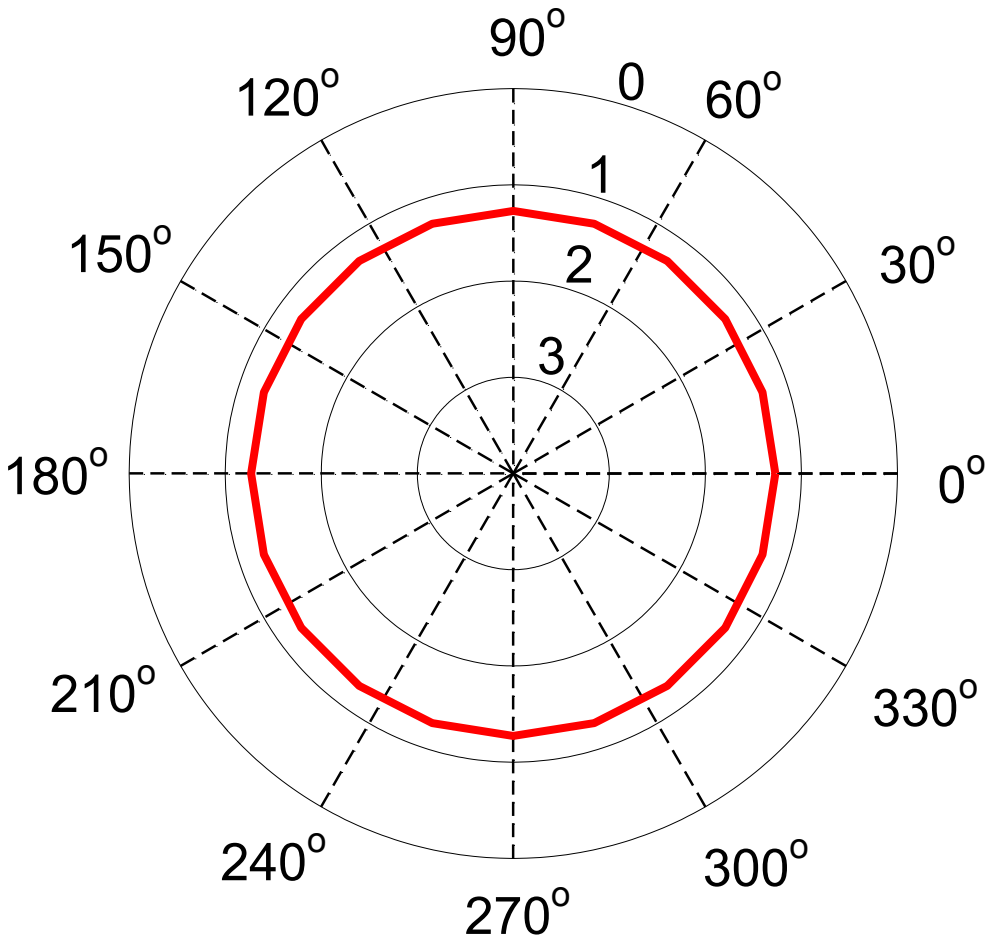


Upstream Plot

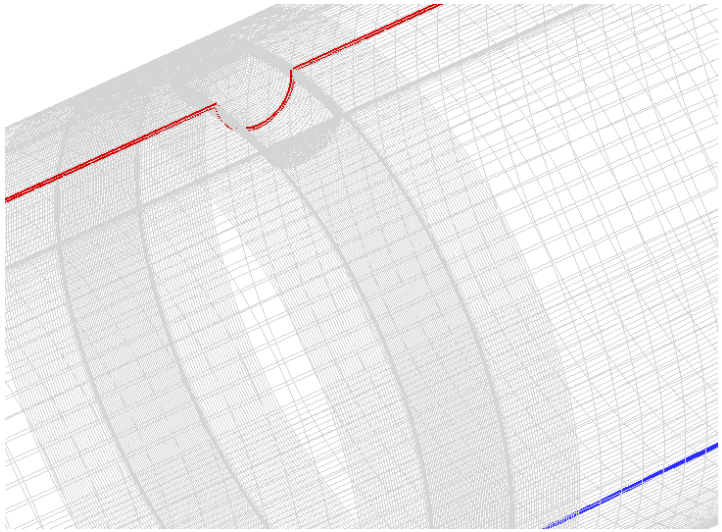


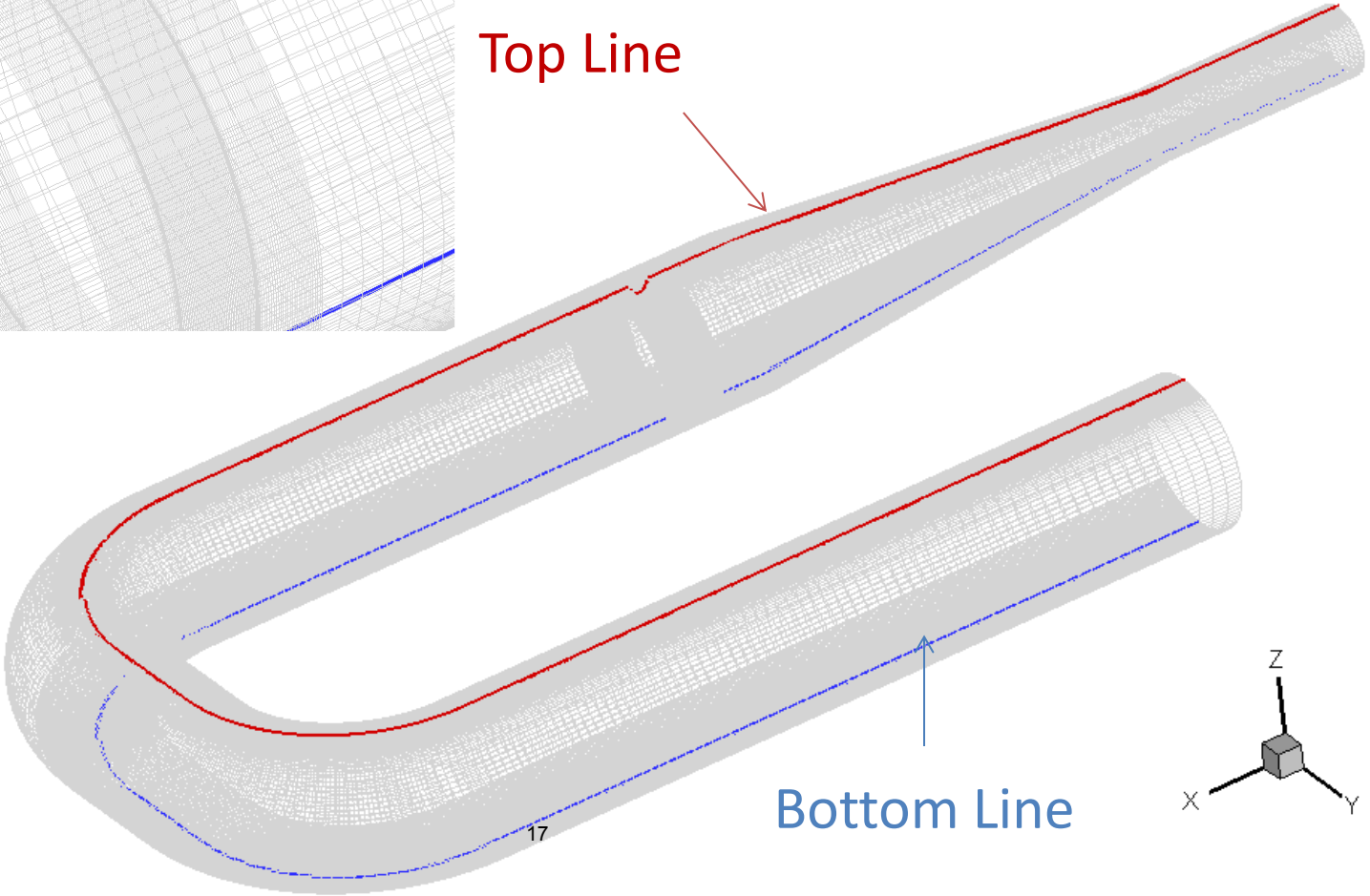
Downstream Plot

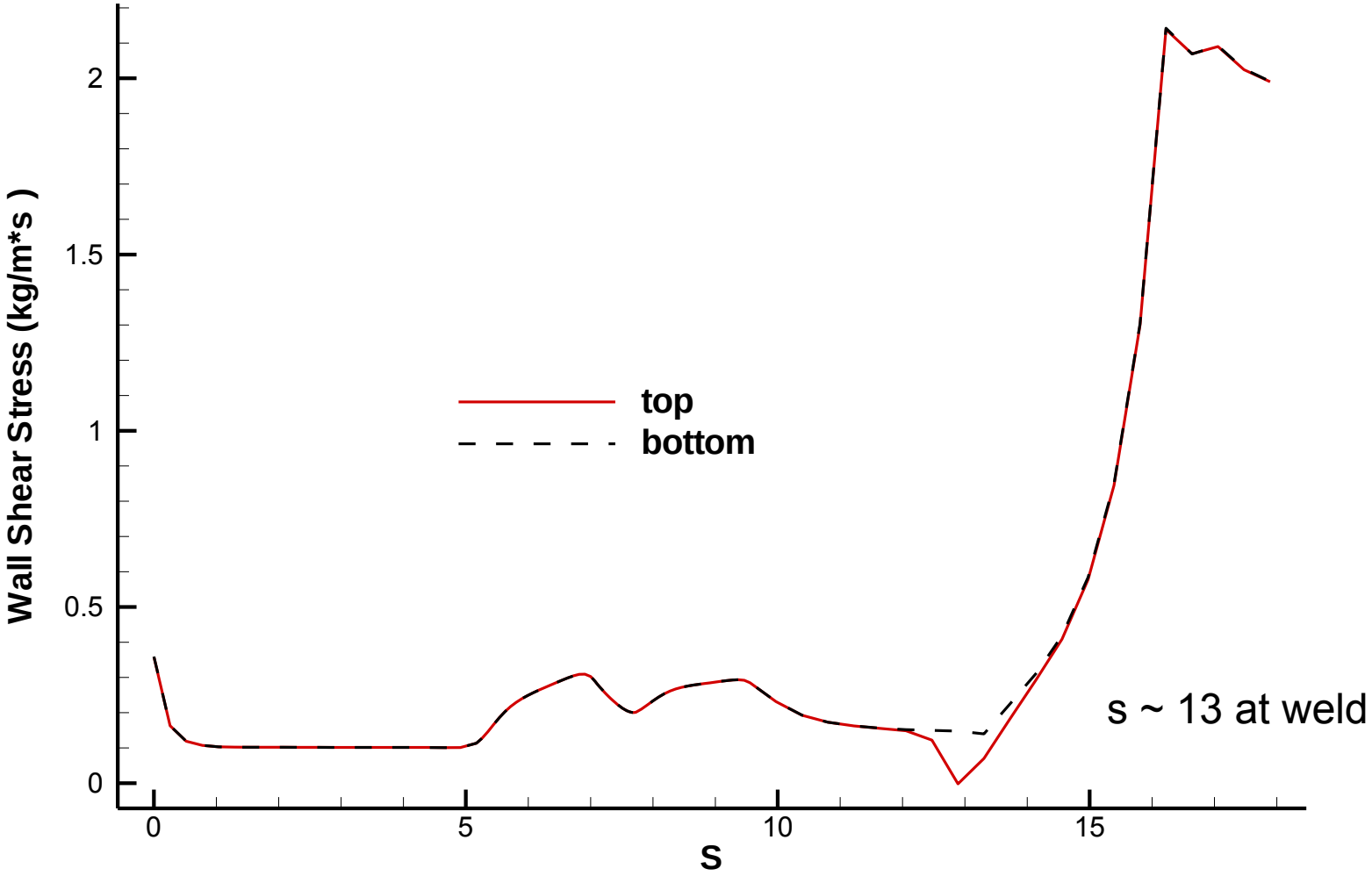
Exit Plot



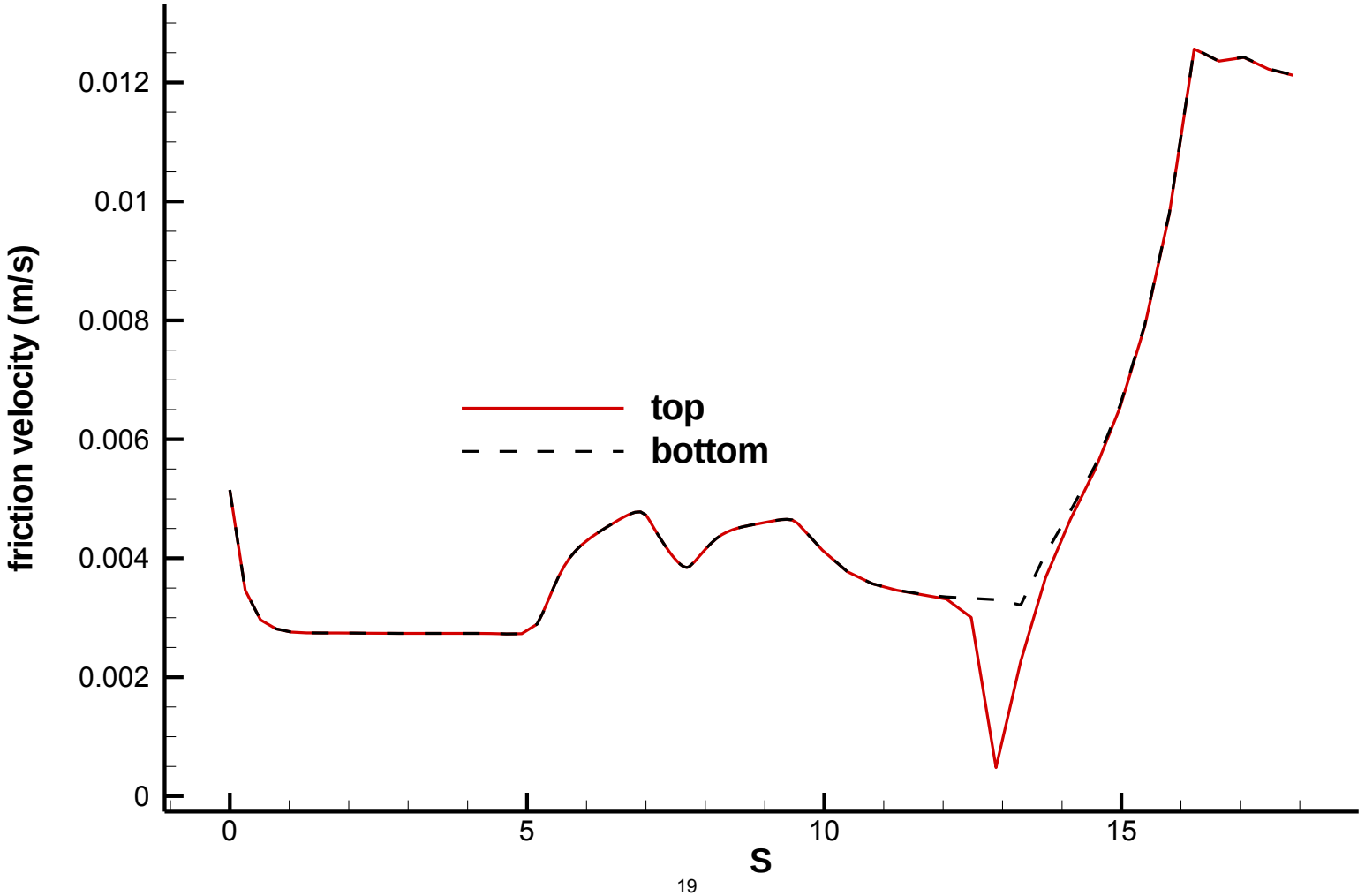
Lines Go From Inlet to Outlet

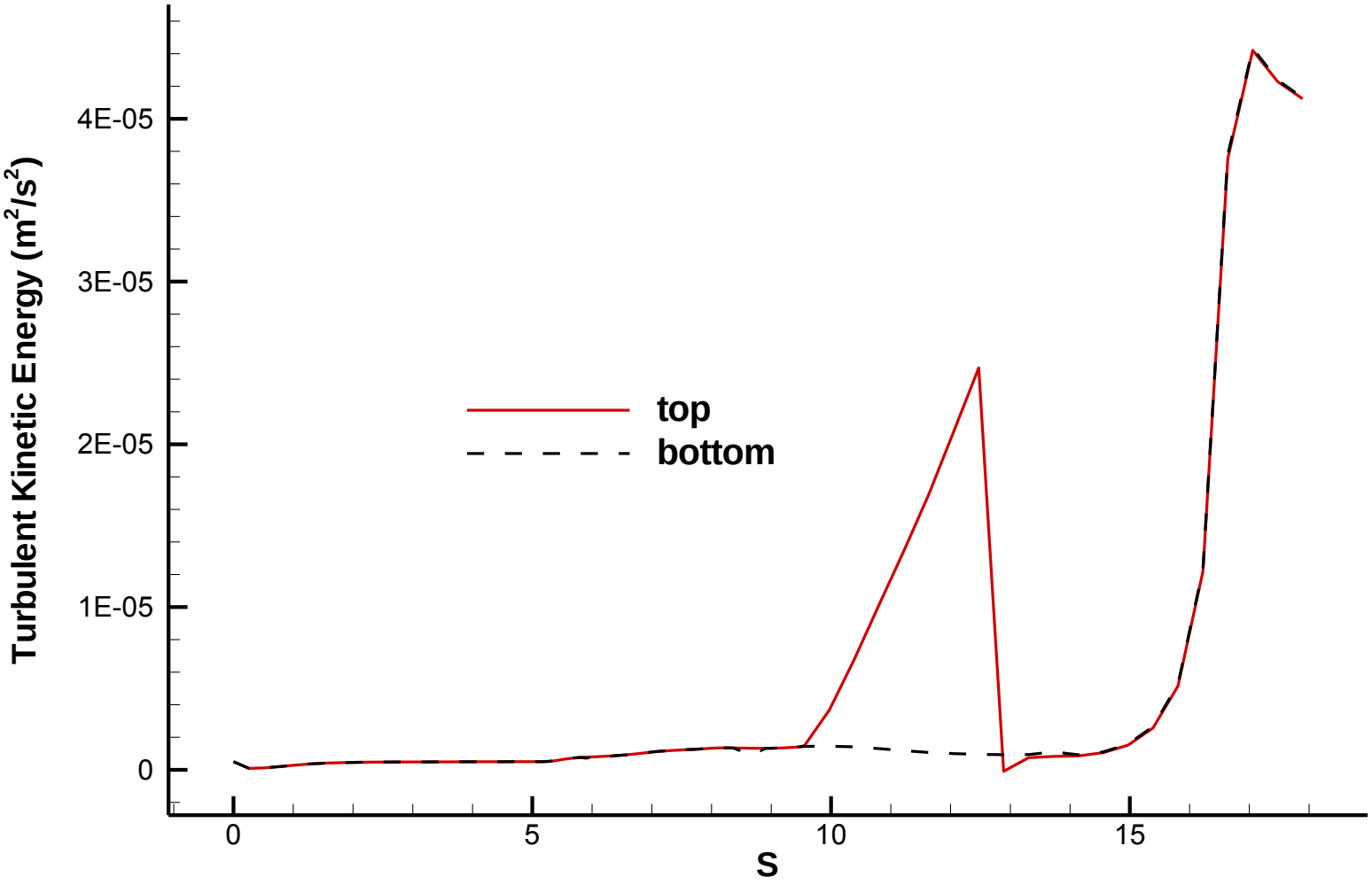


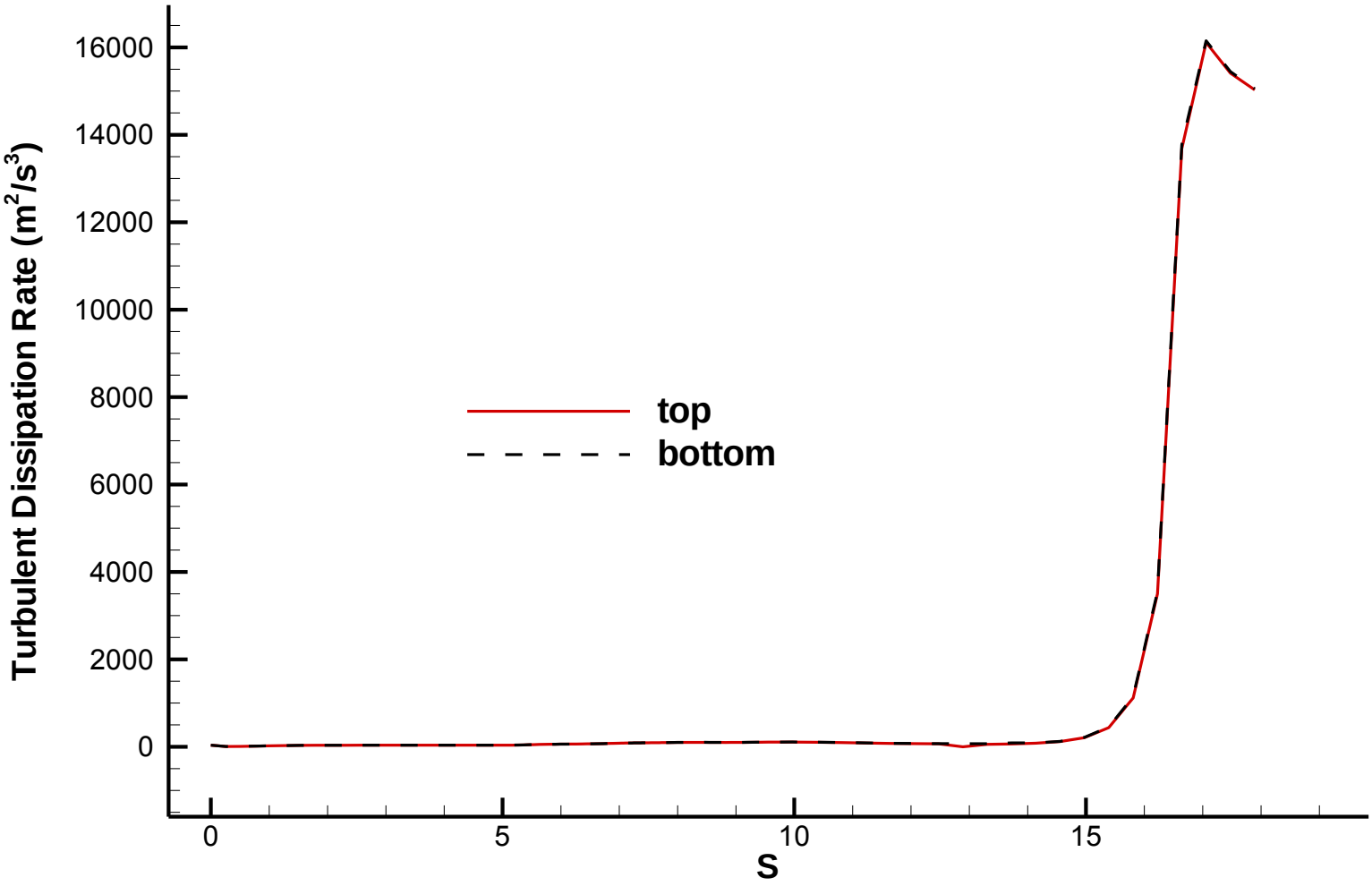


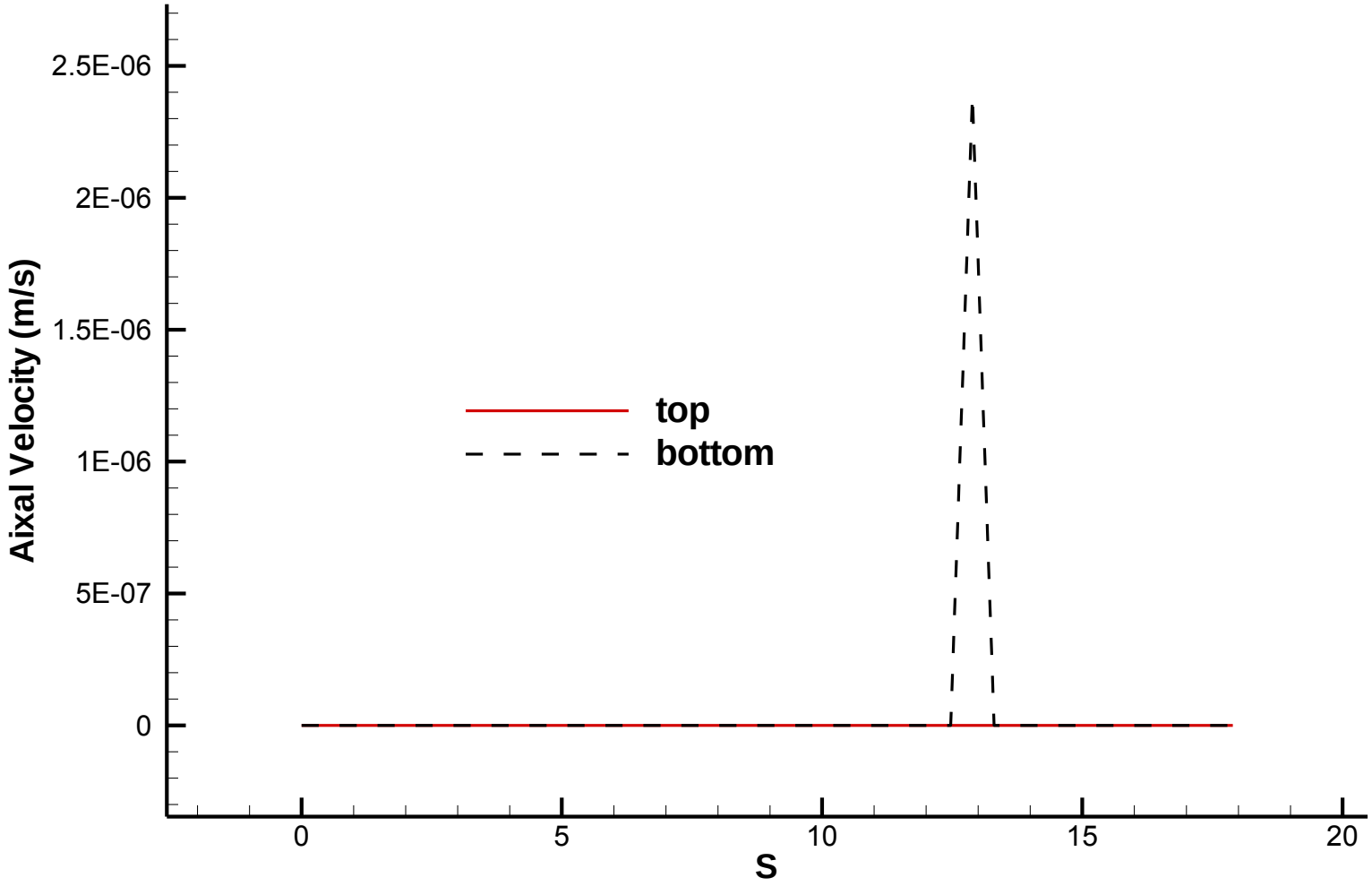


S: distance to the pipe inlet along the center line


friction velocity (m/s)
0.012
0.01
0.008
0.006
0.004
0.002
0
top
bottom
0
5
10
15
S


Turbulent Kinetic Energy (m²/s²)
4E-05
3E-05
2E-05
1E-05
0
top
bottom
0
5
10
15
S


Turbulent Dissipation Rate (m²/s³)
16000
14000
12000
10000
8000
6000
4000
2000
0
0
5
10
15
S
top
bottom


2.5E-06
2E-06
1.5E-06
1E-06
5E-07
0
Aixal Velocity (m/s)
top
bottom
0
5
10
15
20
S