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Computational and Experimental Studies of Pressure Relief Doors in Ventilated Nacelle Compartments

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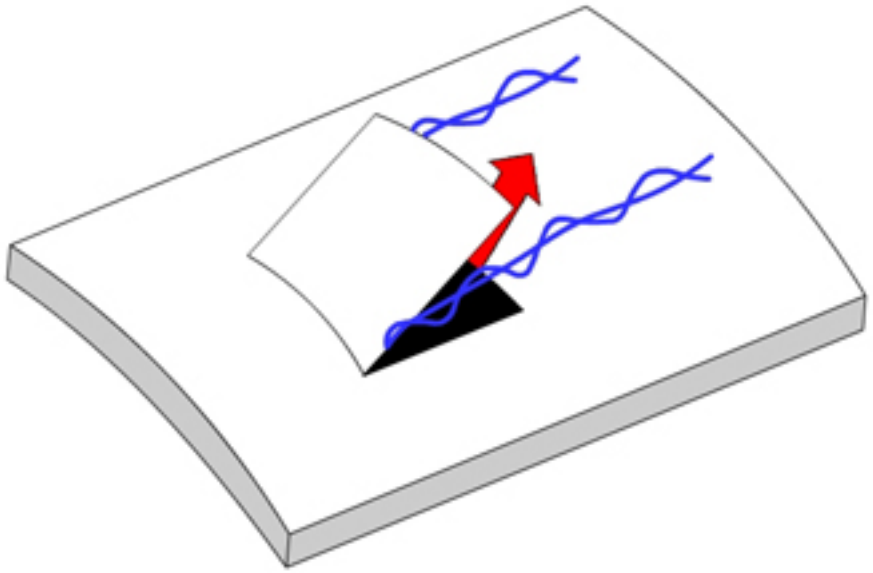
Background

- Requirement for Nacelle Ventilation
  - Pressure Relief Door
- Complex 3D combination of flow phenomena



- *Slender body*
- *Oblique Jet*
- *Shear layers*
- *Compressible Flow*

Assume Static Behaviour

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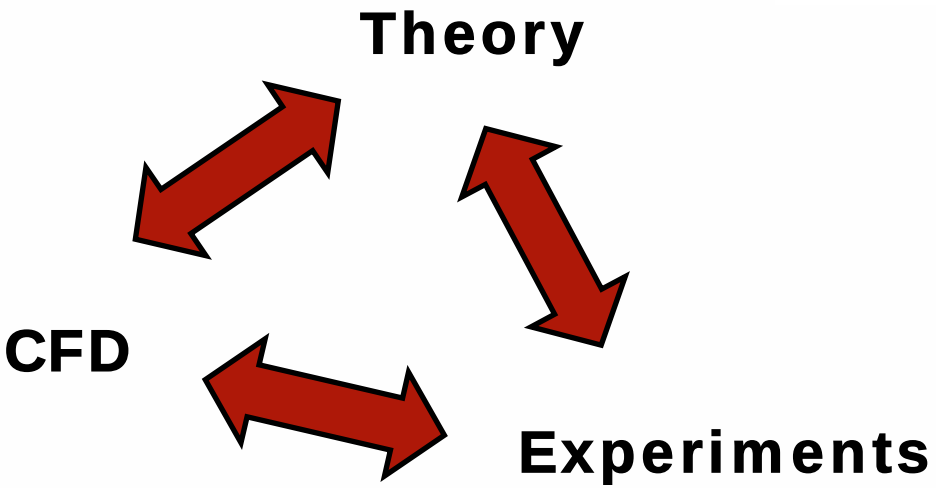
Methodology



- Use CFD to help with design of experiment ✓
- Gather experimental performance data
- Validate CFD model to use for design
- Gain theoretical understanding of flow physics

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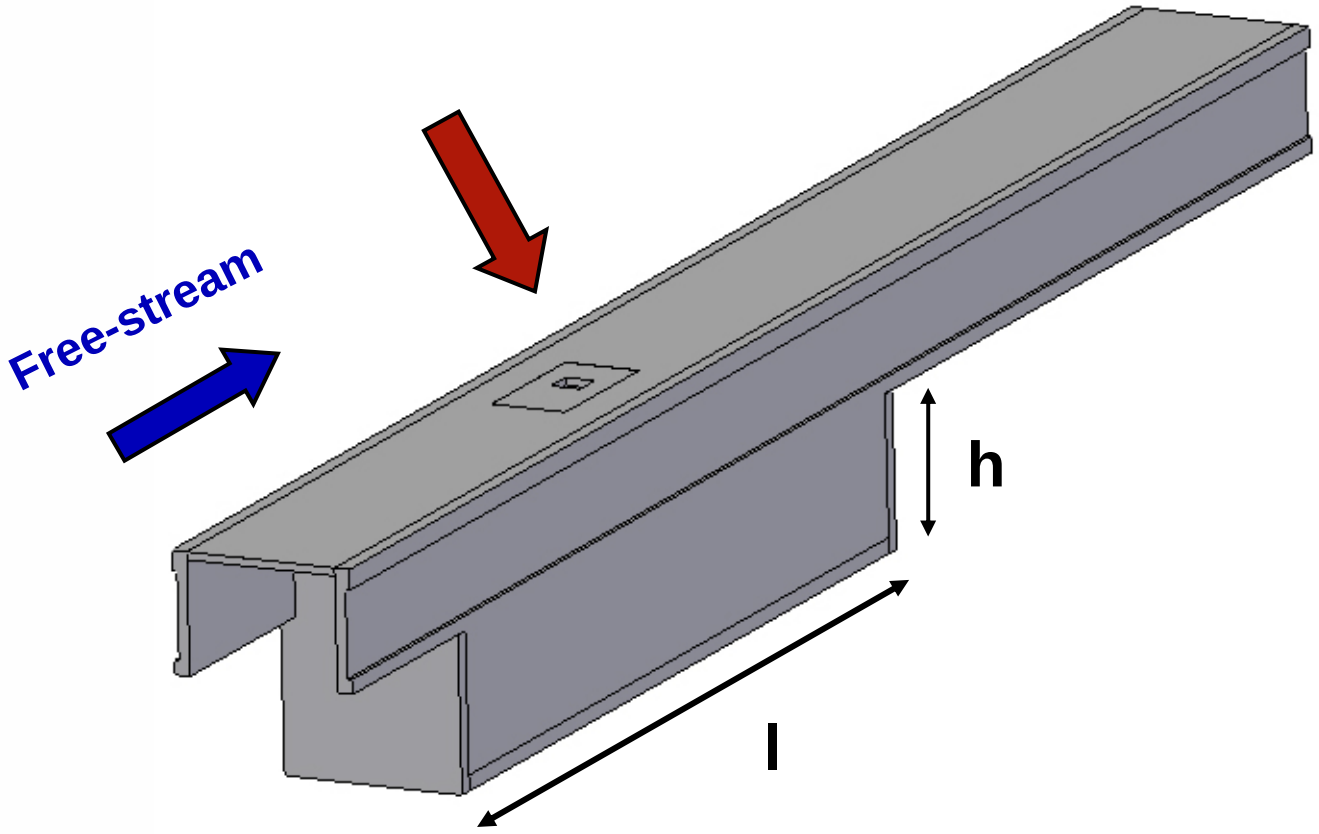
Experimental Setup



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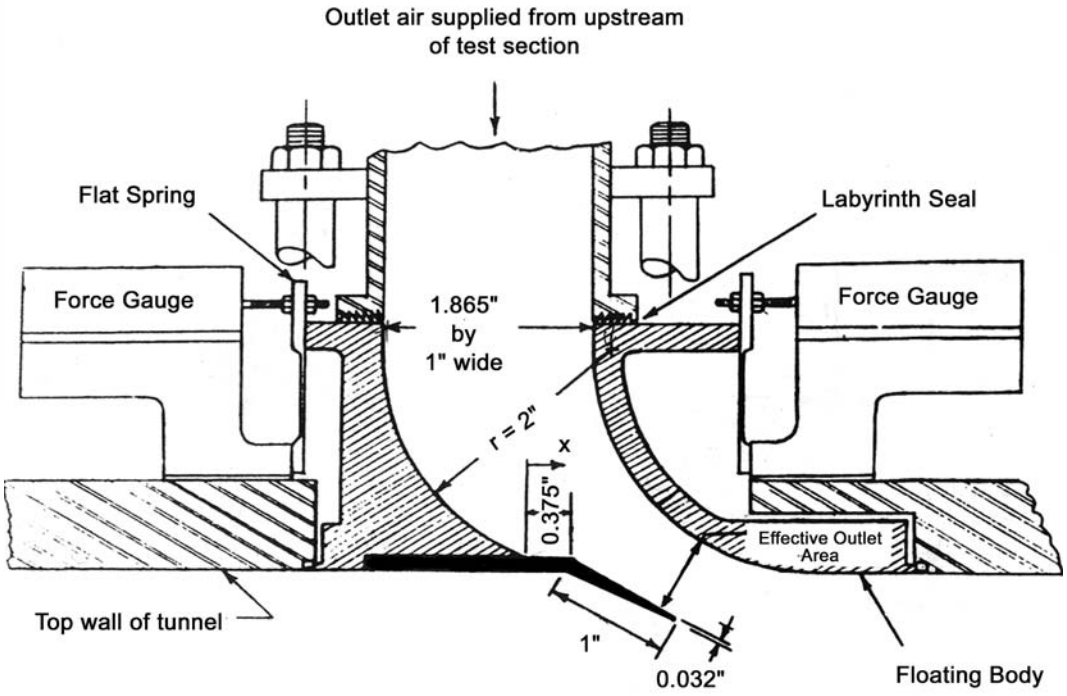
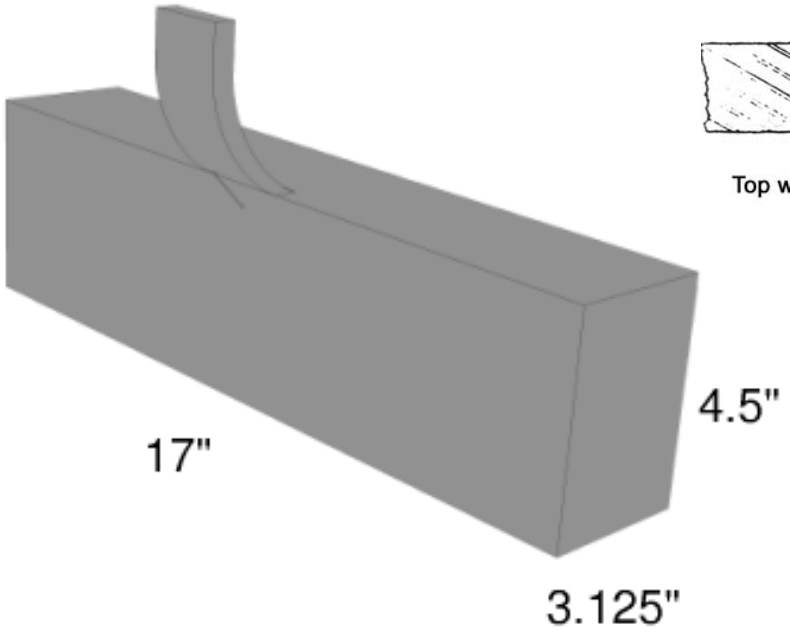
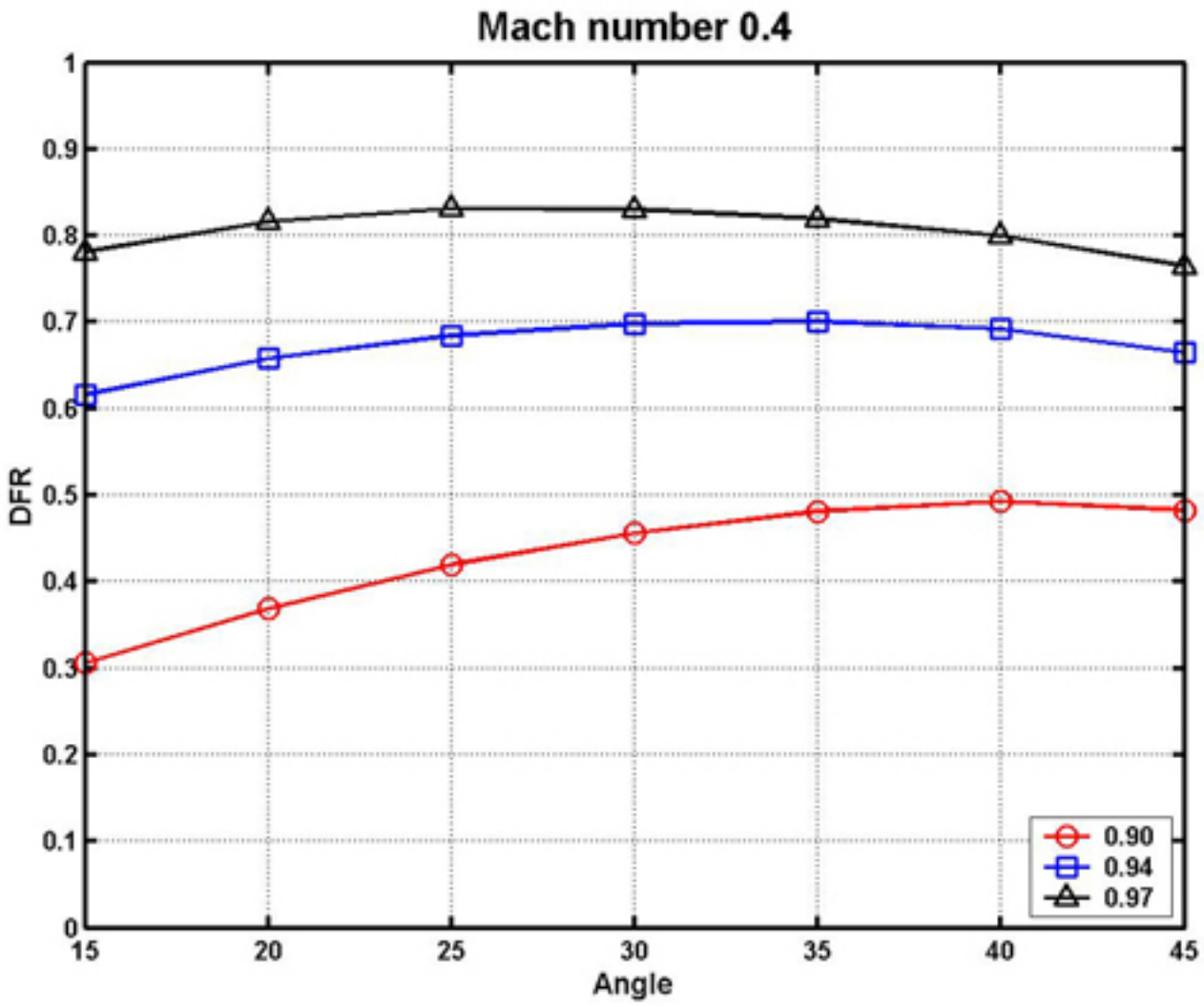
NACA TN4007 Vick, 1957





Results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DFR
Angle
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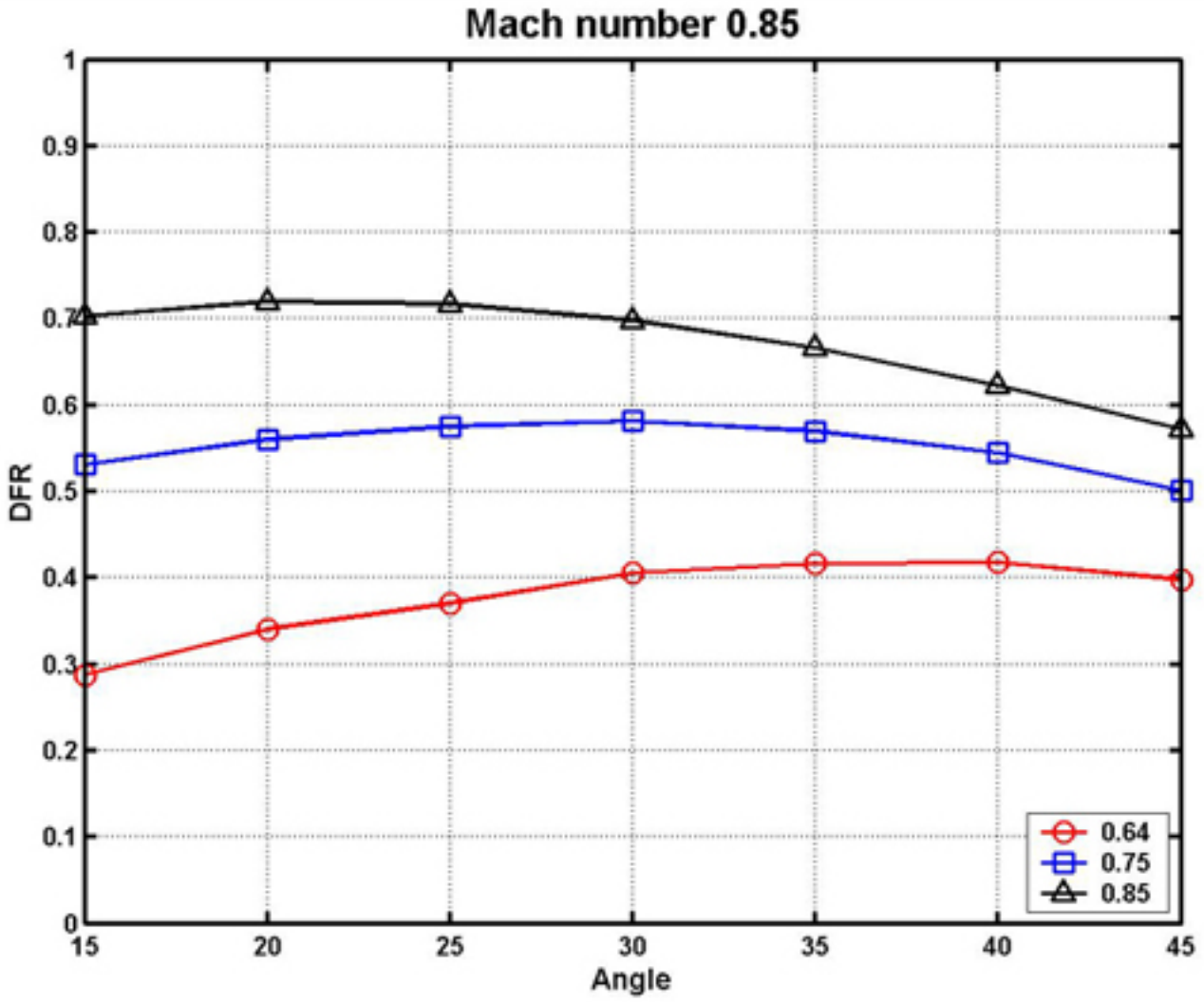
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
15
20
25
30
35
40
45
0.90
0.94
0.97

Results


Mach number 0.85
DFR
Angle
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
15
20
25
30
35
40
45
0.64
0.75
0.85

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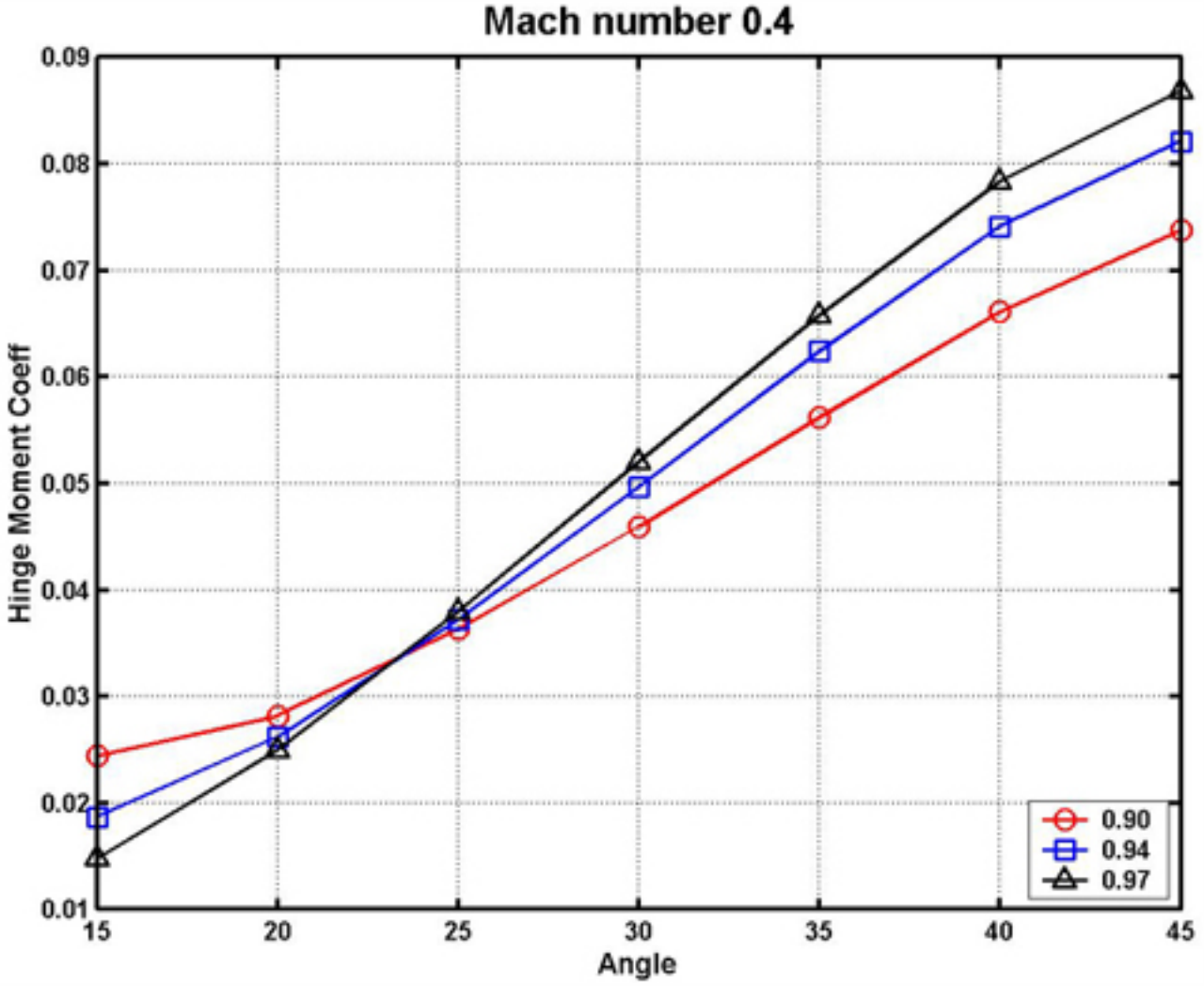
Results



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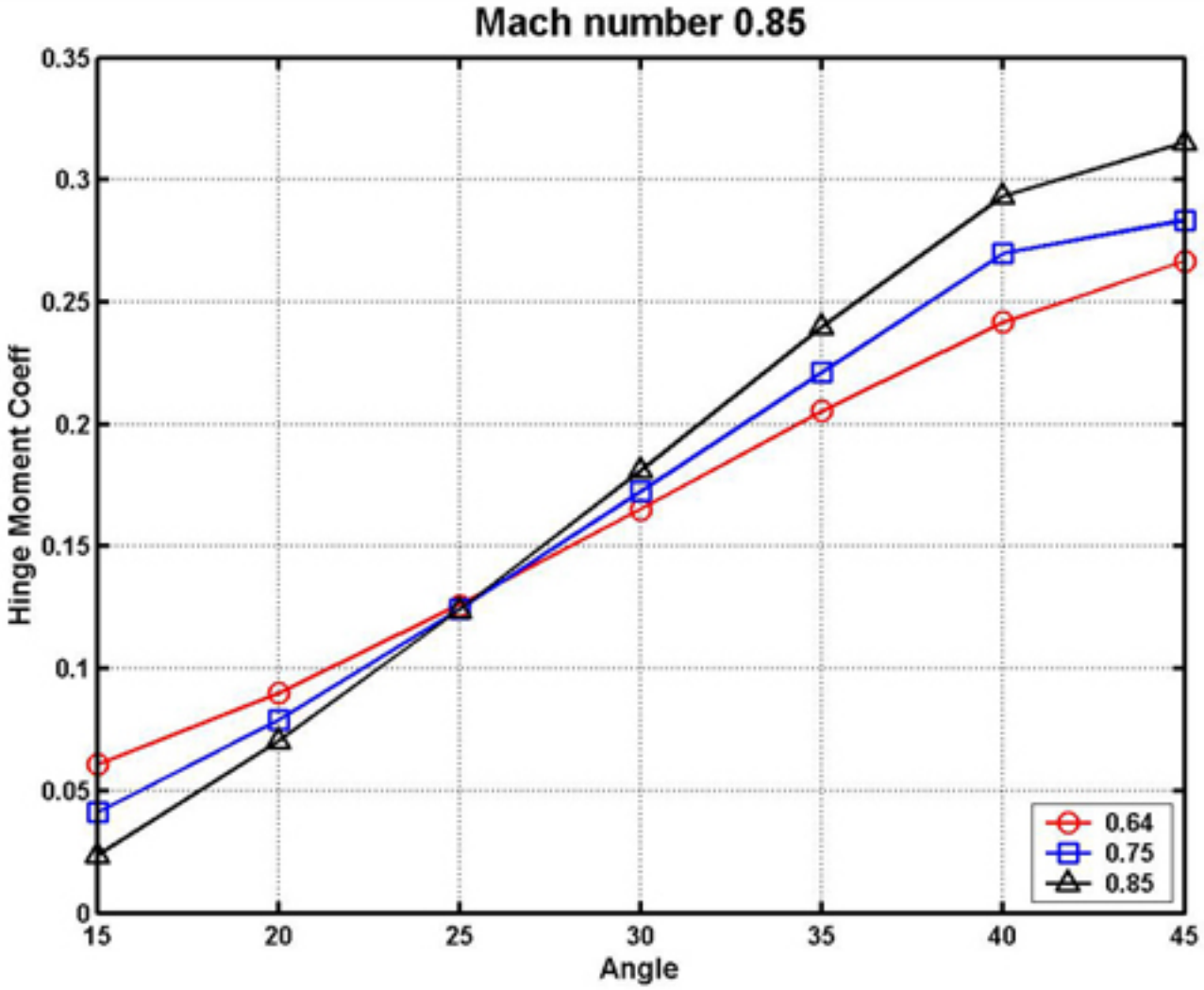
Mach number 0.85
Hinge Moment Coeff
Angle
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0.3
0.25
0.2
0.15
0.1
0.05
0
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25
30
35
40
45
0.64
0.75
0.85

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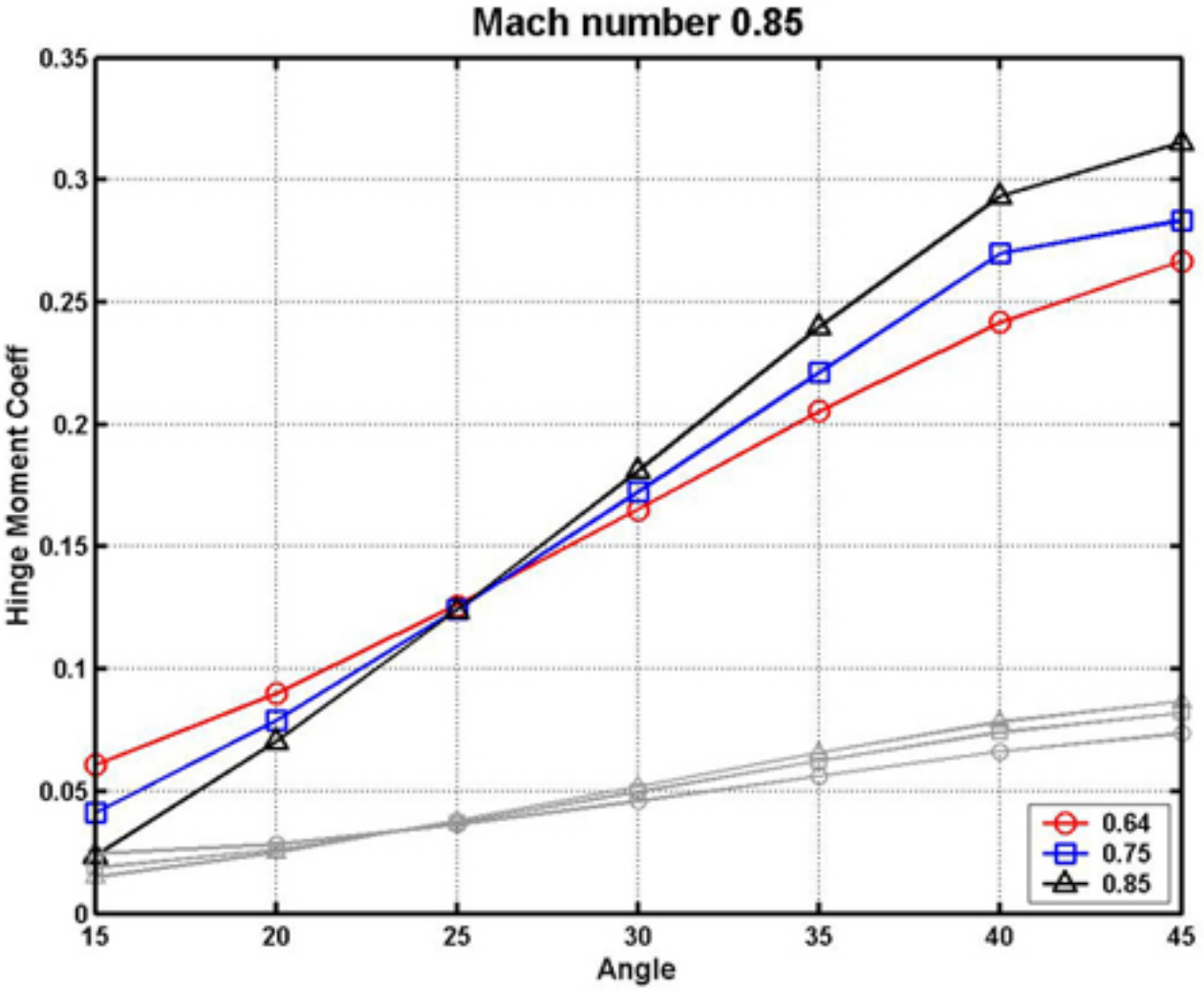
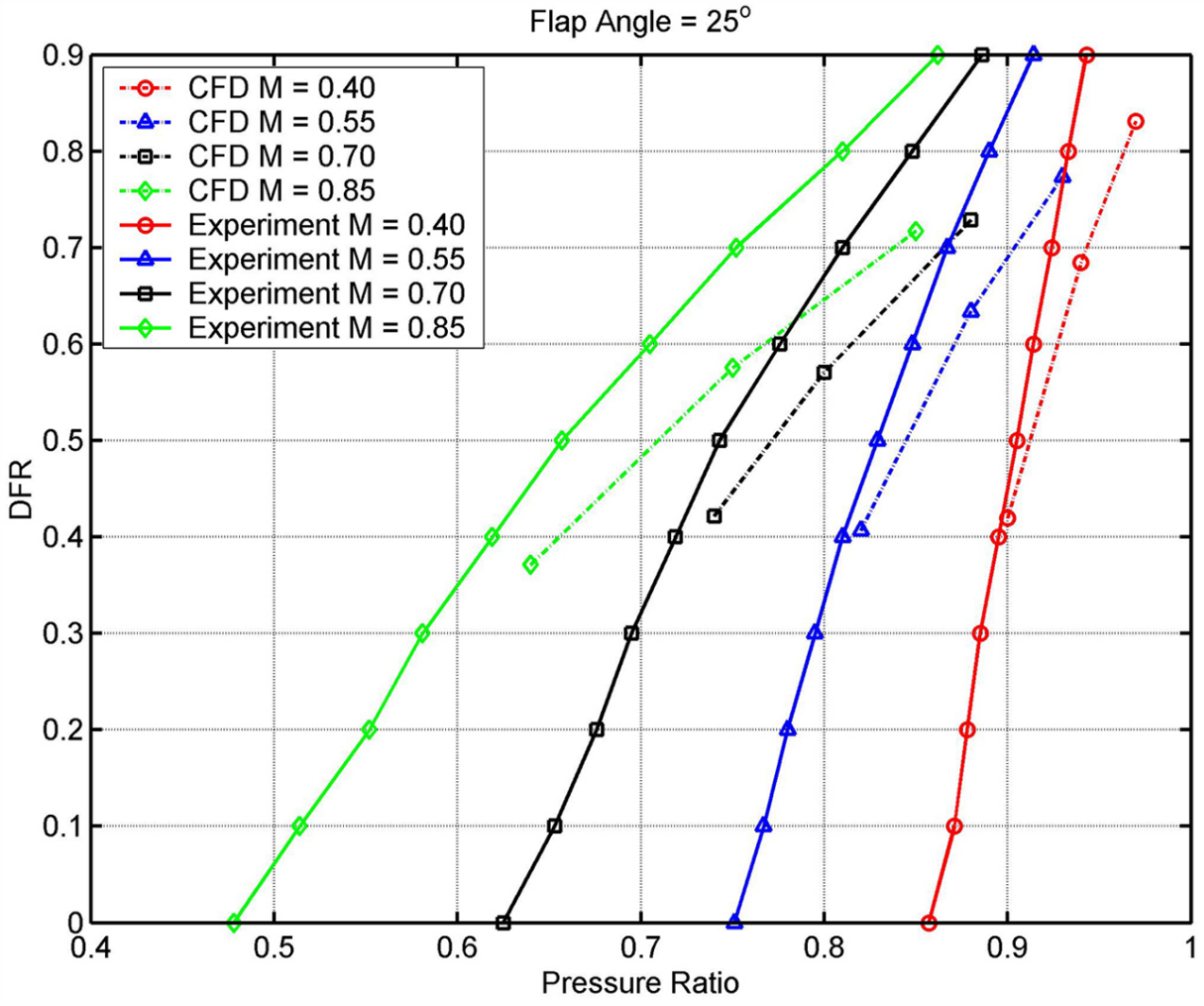
Results



Results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CFD M = 0.55
CFD M = 0.70
CFD M = 0.85
Experiment M = 0.40
Experiment M = 0.55
Experiment M = 0.70
Experiment M = 0.85
DFR
Pressure Ratio
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.4
0.5
0.6
0.7
0.8
0.9
1

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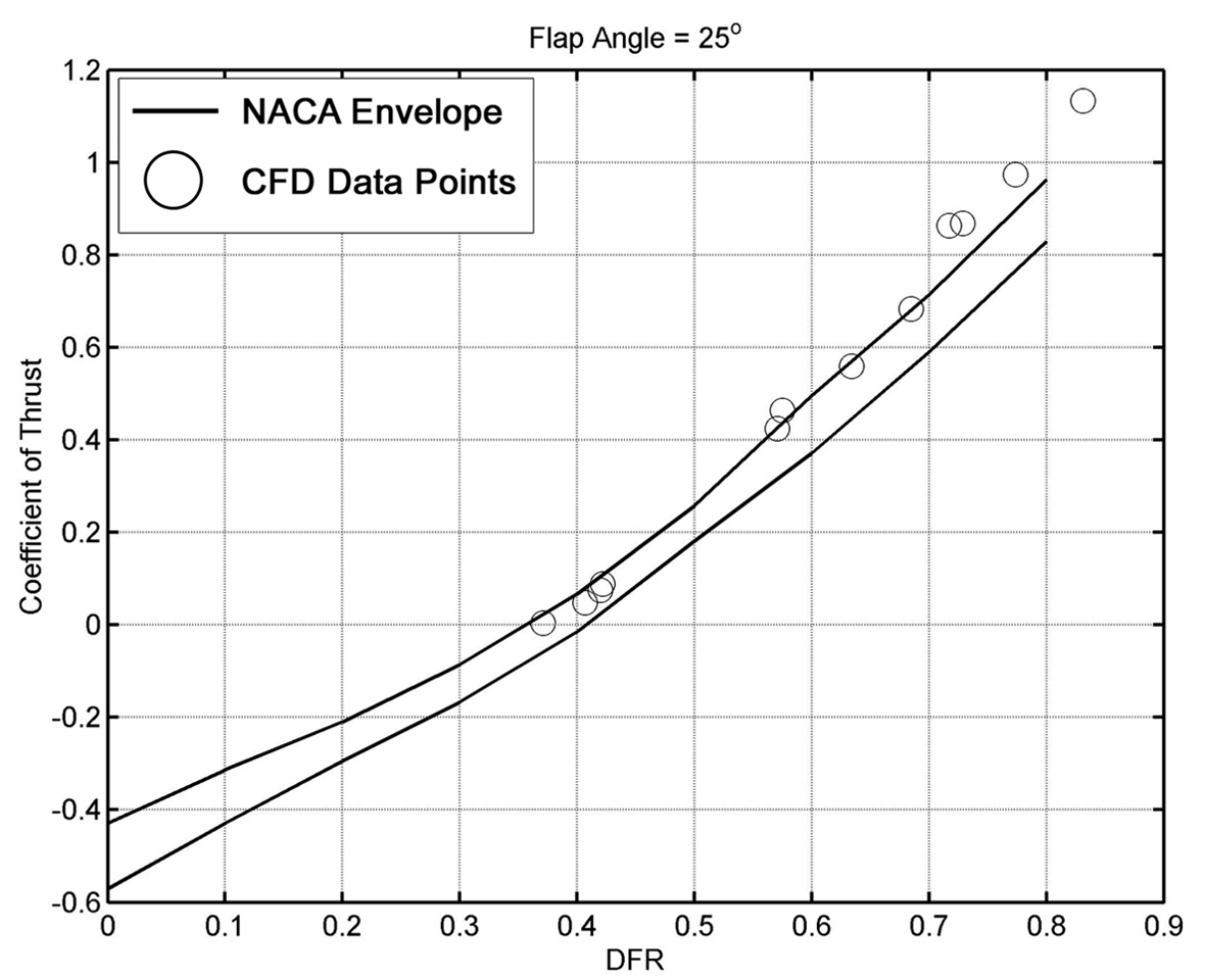
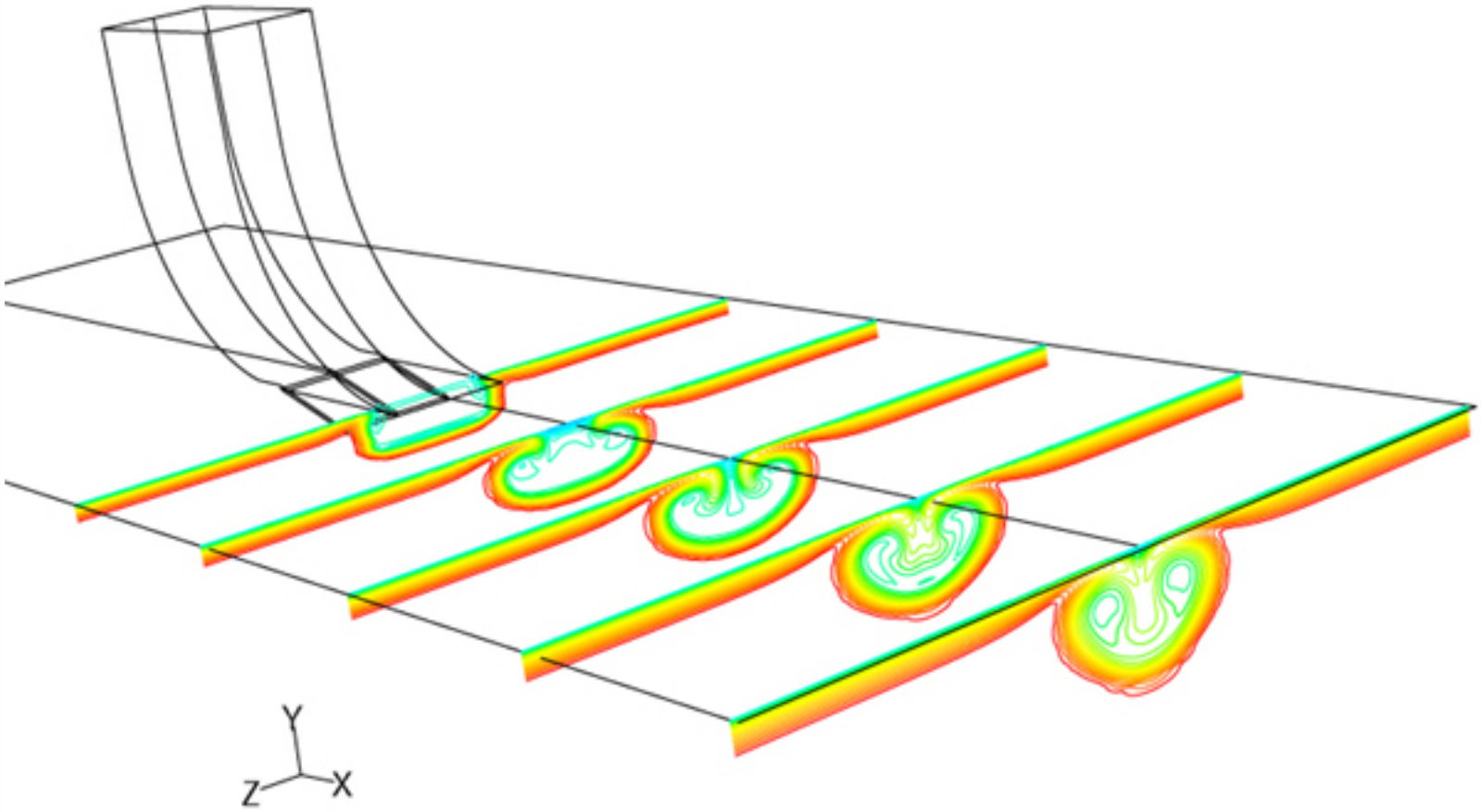
Results



Results



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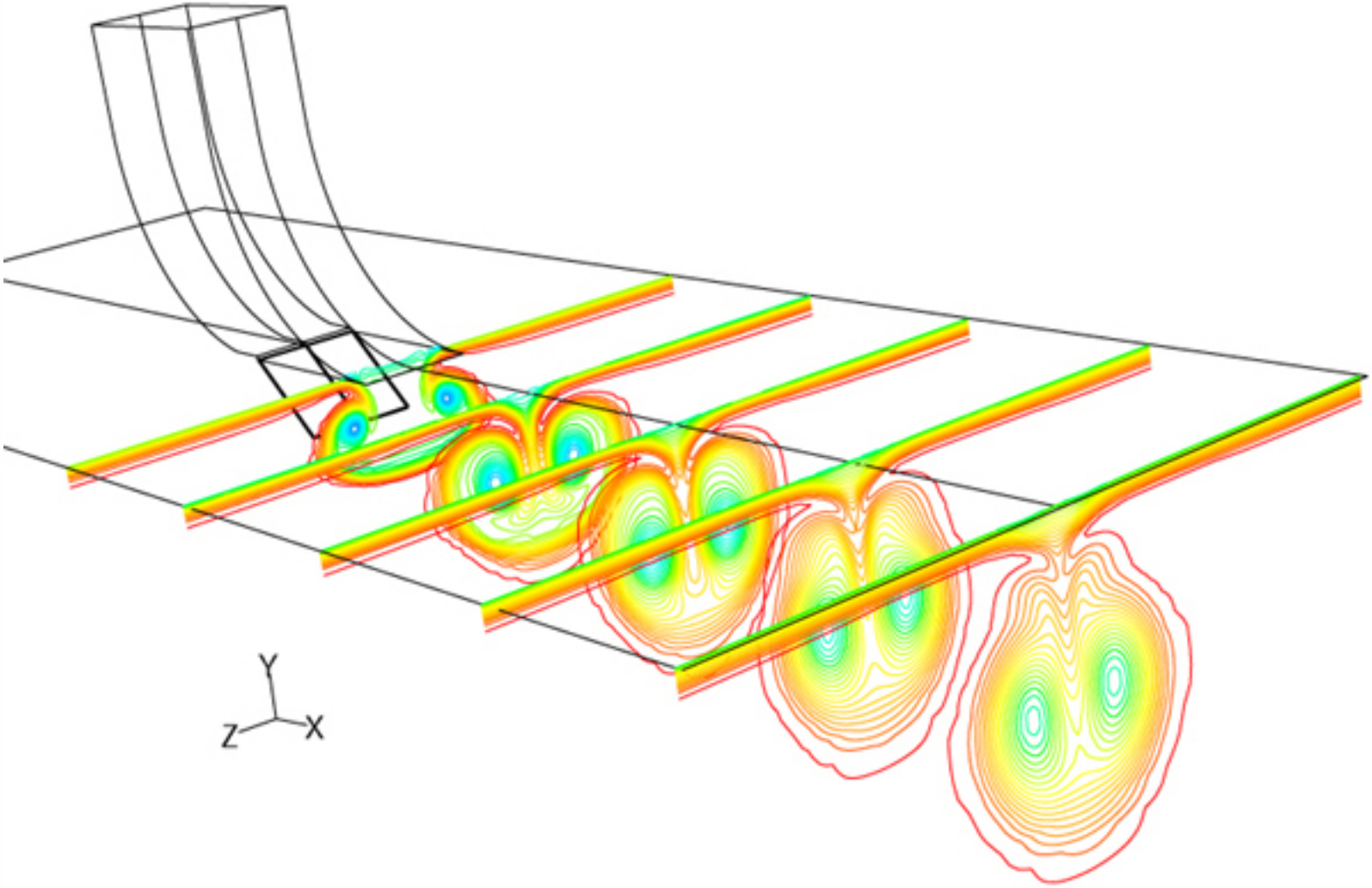
Results



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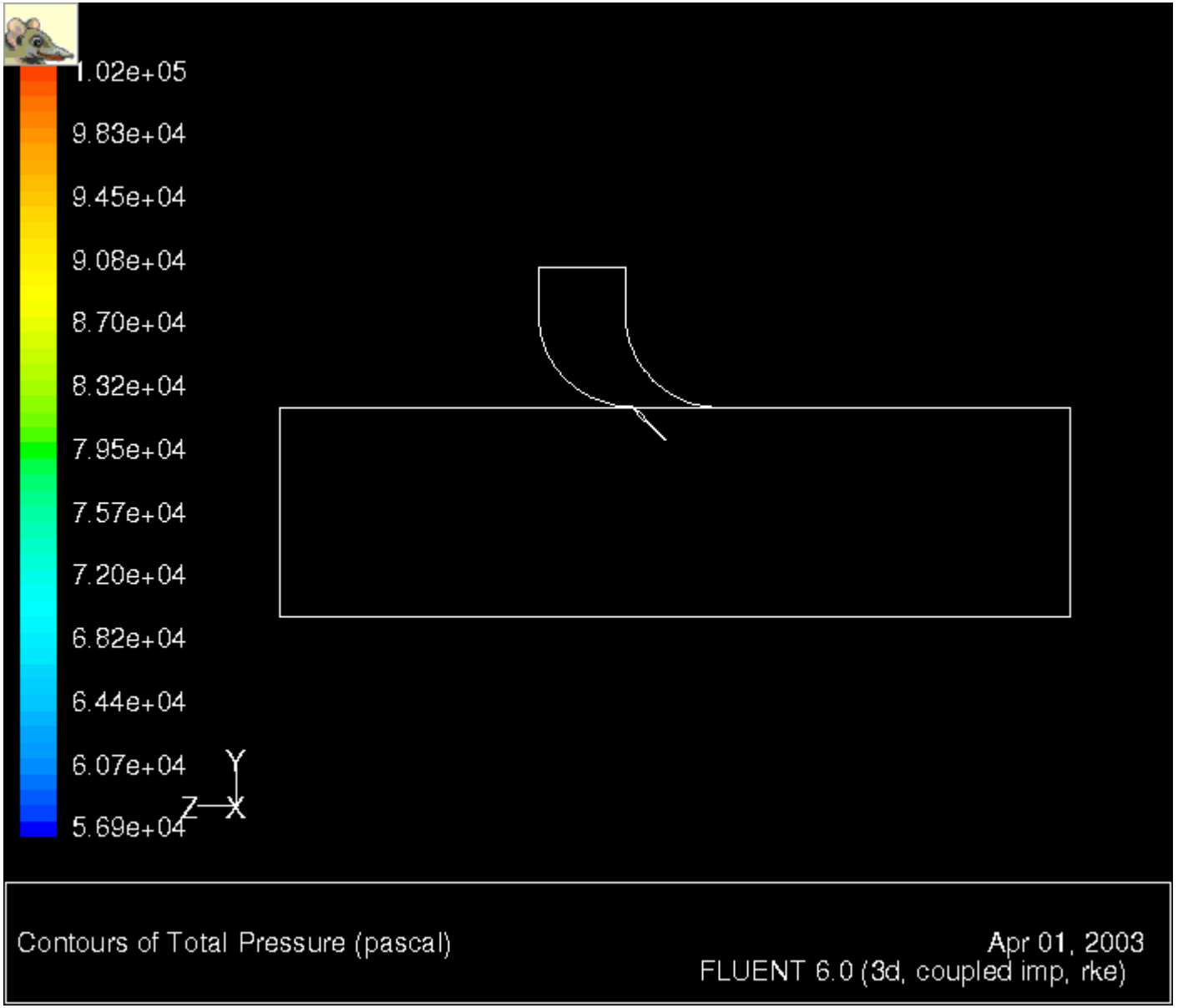

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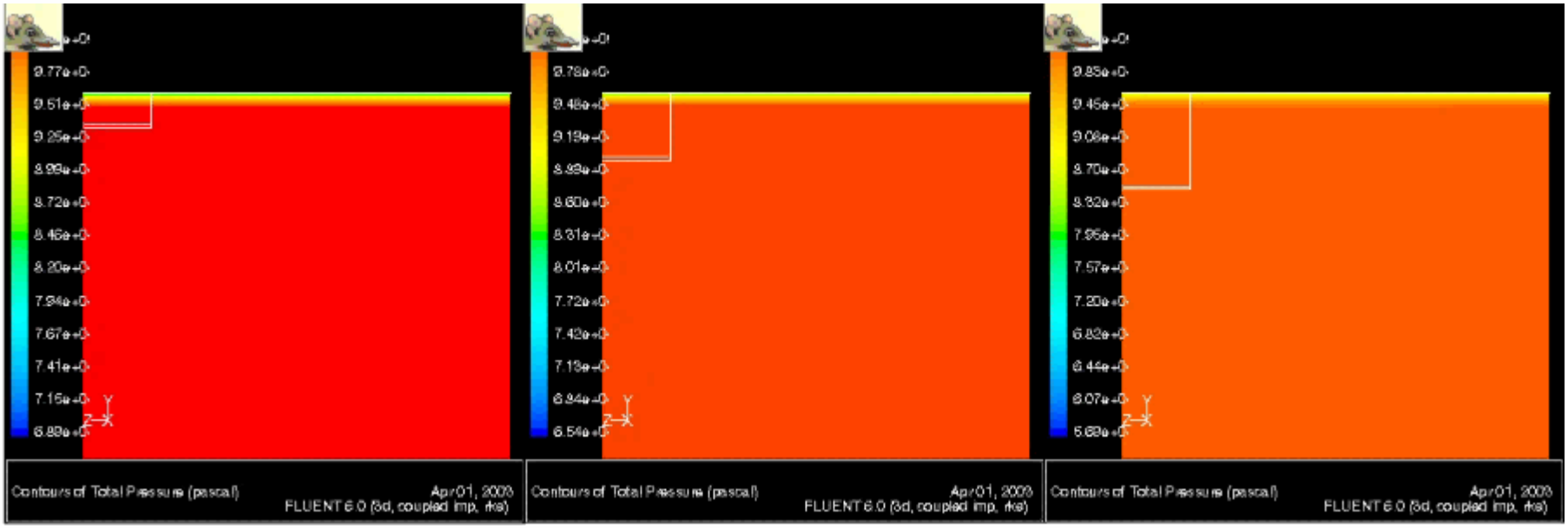
Results



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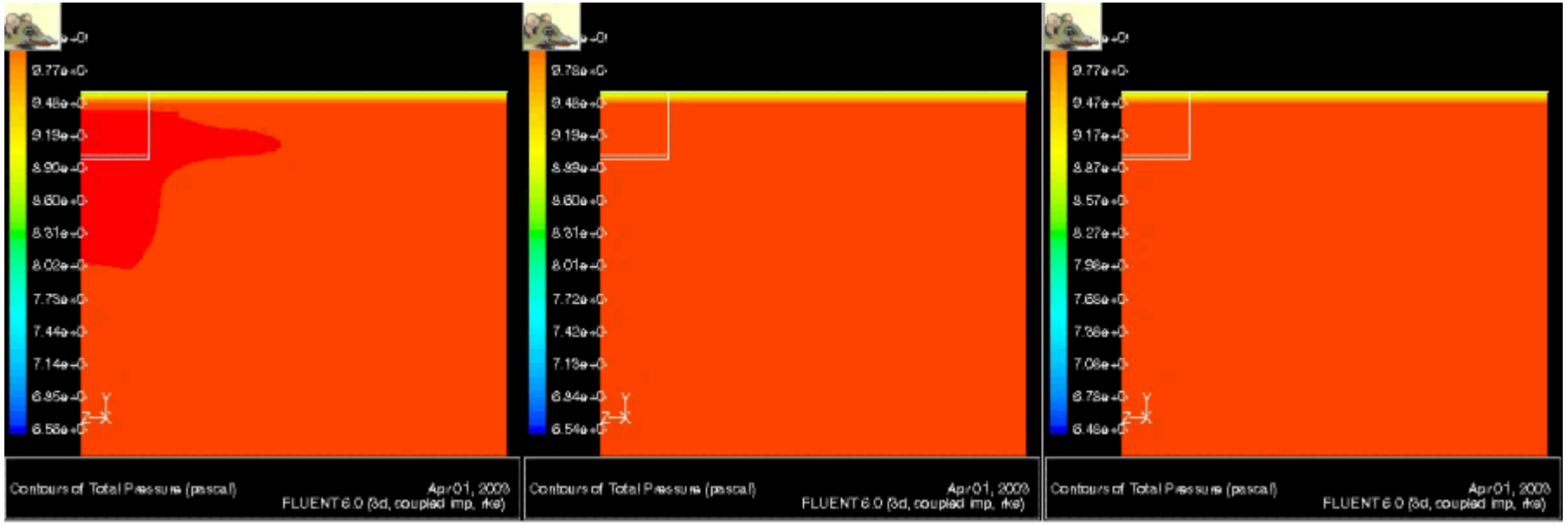
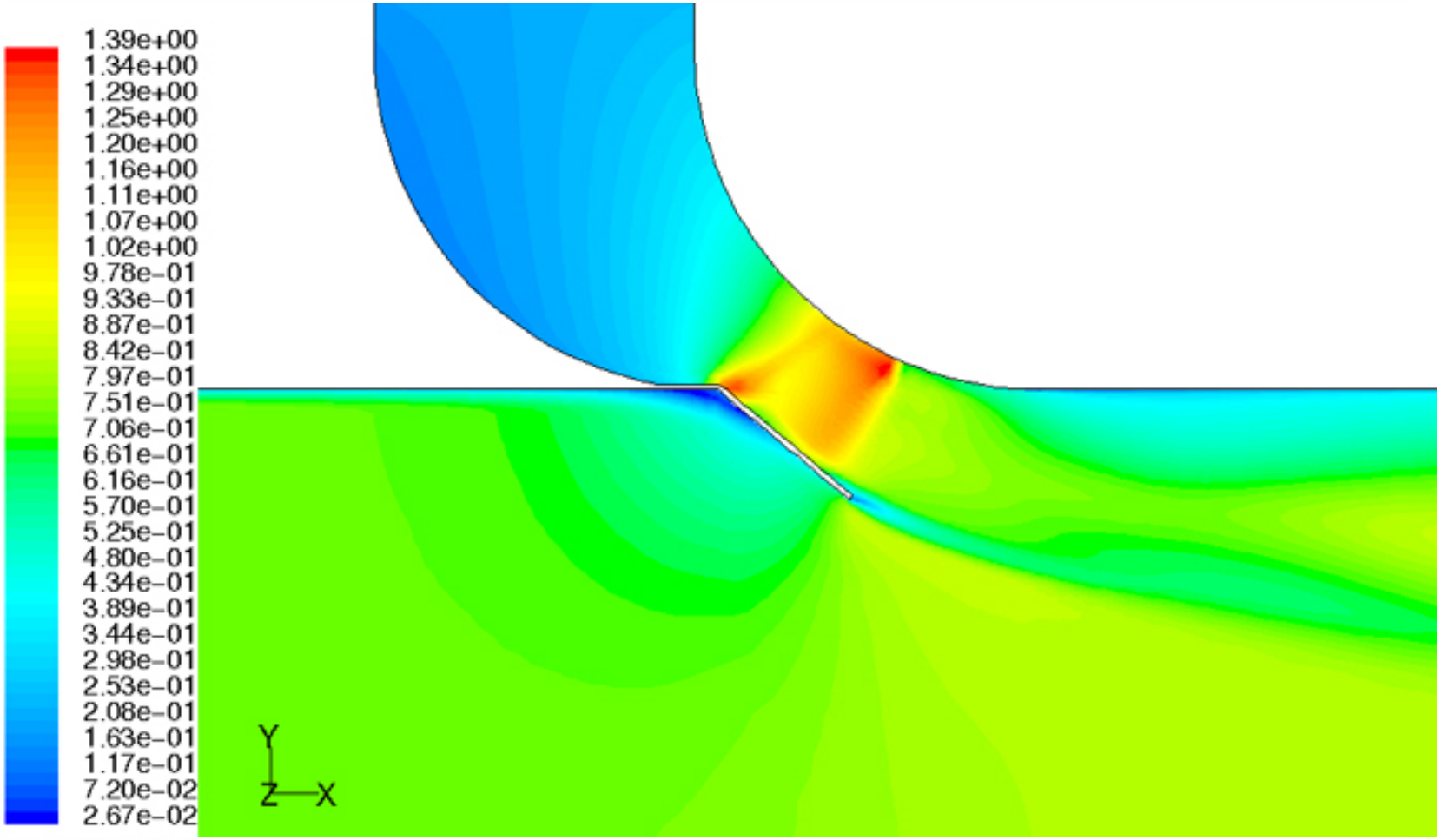
Results



Results


1.39e+00
1.34e+00
1.29e+00
1.25e+00
1.20e+00
1.16e+00
1.11e+00
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1.02e+00
9.78e-01
9.33e-01
8.87e-01
8.42e-01
7.97e-01
7.51e-01
7.06e-01
6.61e-01
6.16e-01
5.70e-01
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4.34e-01
3.89e-01
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2.98e-01
2.53e-01
2.08e-01
1.63e-01
1.17e-01
7.20e-02
2.67e-02
Y
Z
X

Conclusions

- Good agreement between CFD and NACA TN4007
- Confidence in modelling assumptions
- Large amount of data available to focus experiment
- Potential applications in other fields
  - Boundary layer control
  - Prevention of shock induced separation
  - Cooling and mixing