Summary and Comparison of NASA's Supersonic Boom Prediction Methods

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Boom Workshop

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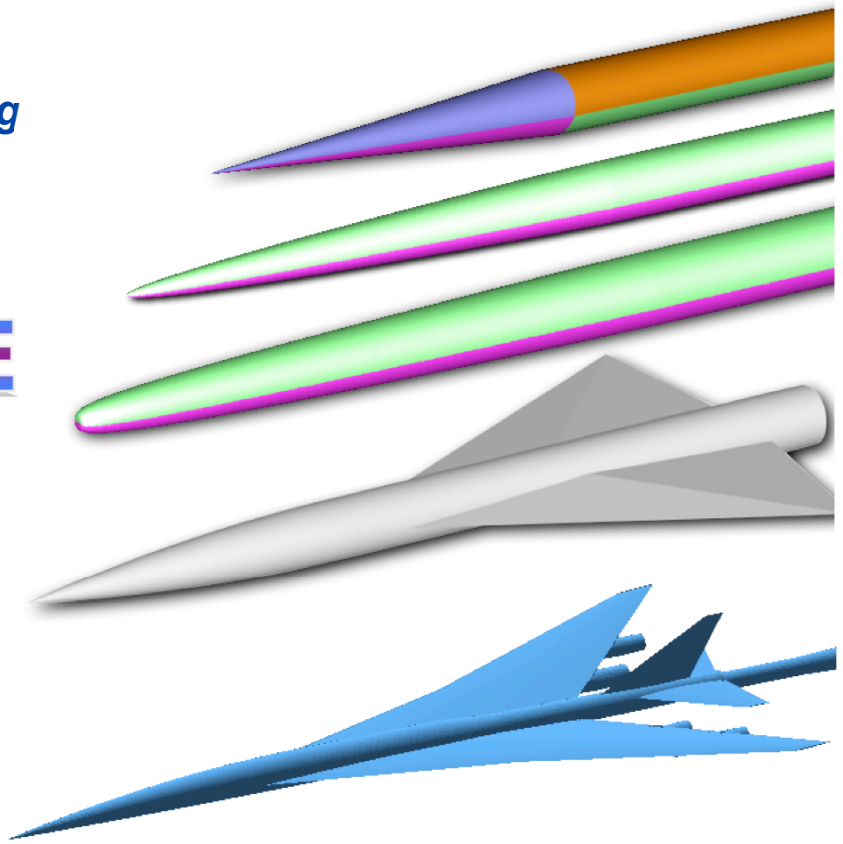
AIRPLANE

Cart3D

FUN3D

Fully Unstructured Navier-Stokes

USM3D

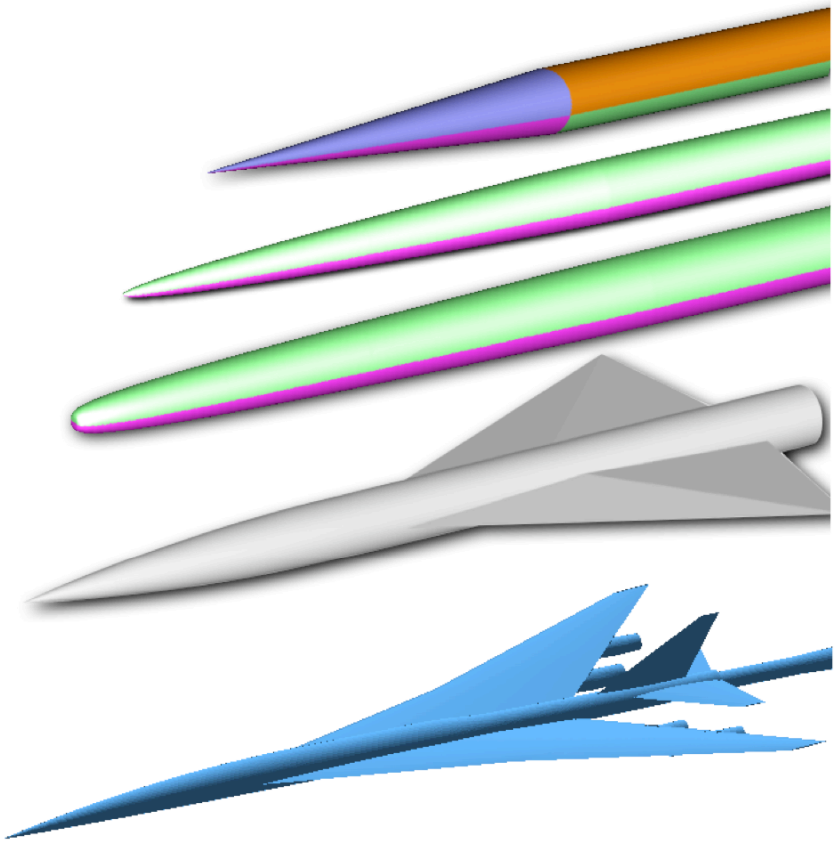


Presentation Outline

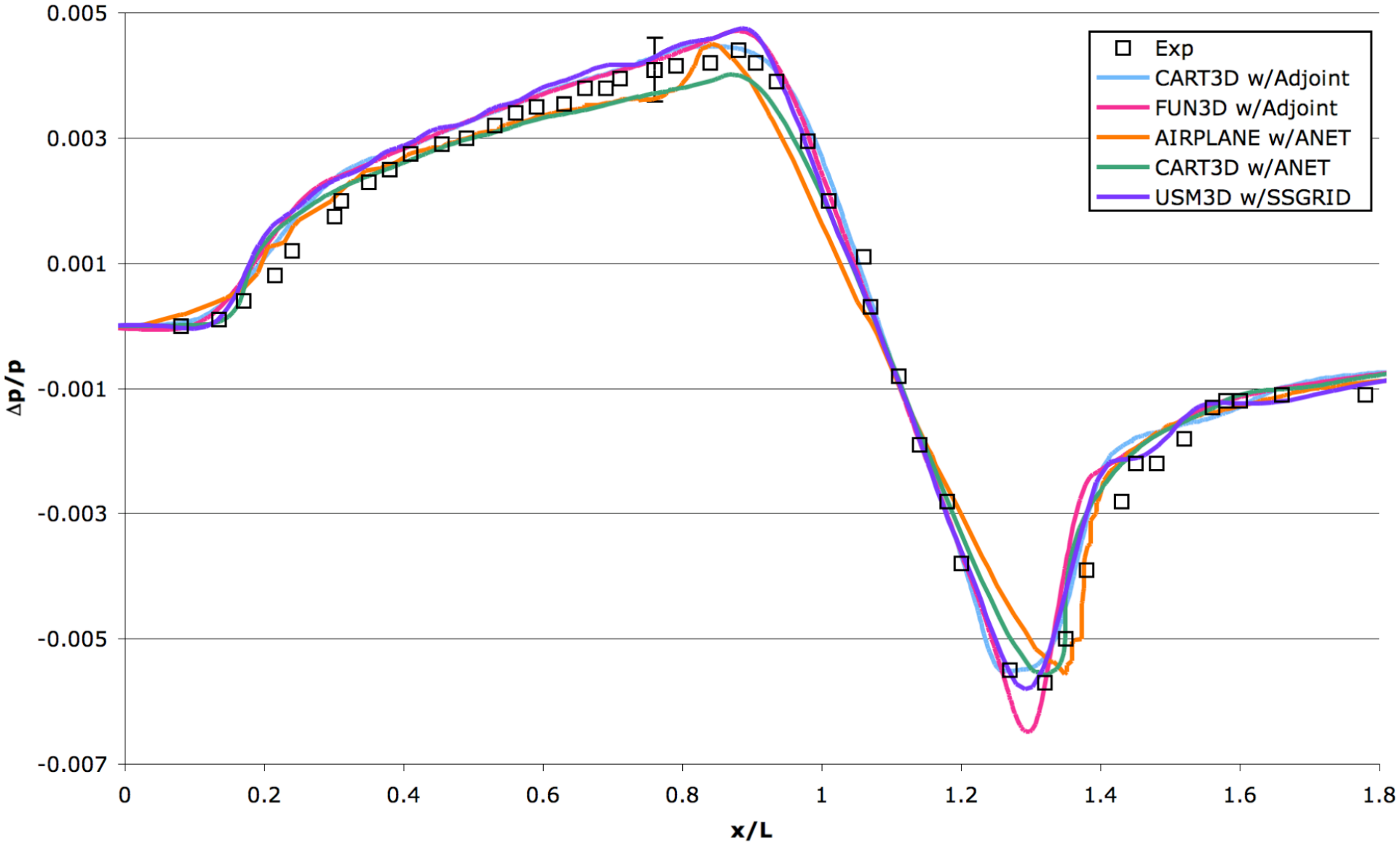
- Comparison of Computational Results with Experimental Data
- Comparison of Computational Results from Delta Wing Body Distance Study
- Time to Obtain CFD Results Comparison

Configurations Studied

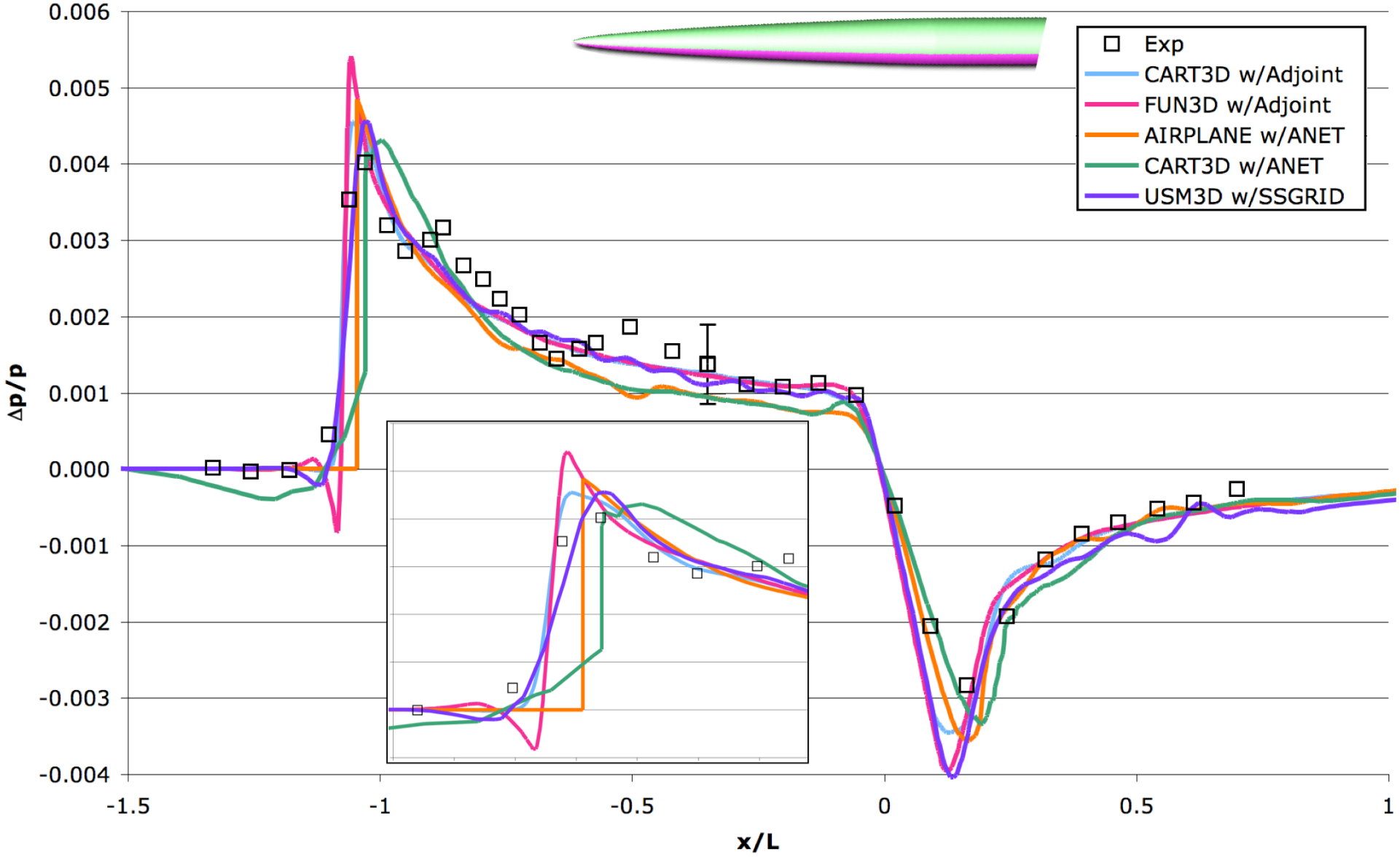
- Bodies of Revolution
  - Cone-Cylinder
  - Parabolic
  - Quartic
- 69-degree Swept Delta-Wing-Body
- Ames Low Boom Wing Tail (LBWT) with 4 Nacelles



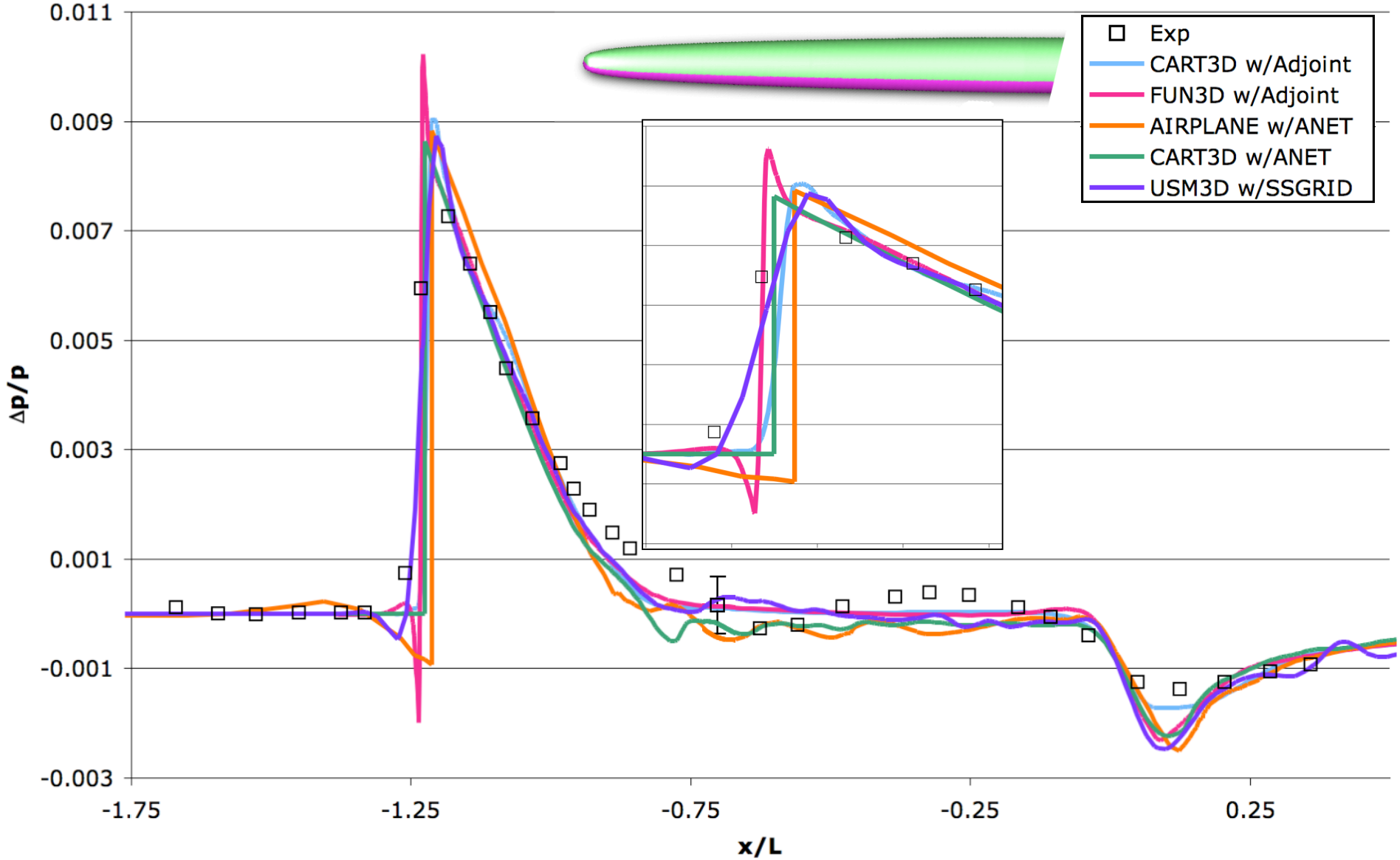
Cone-Cylinder - 10 Body Lengths Below



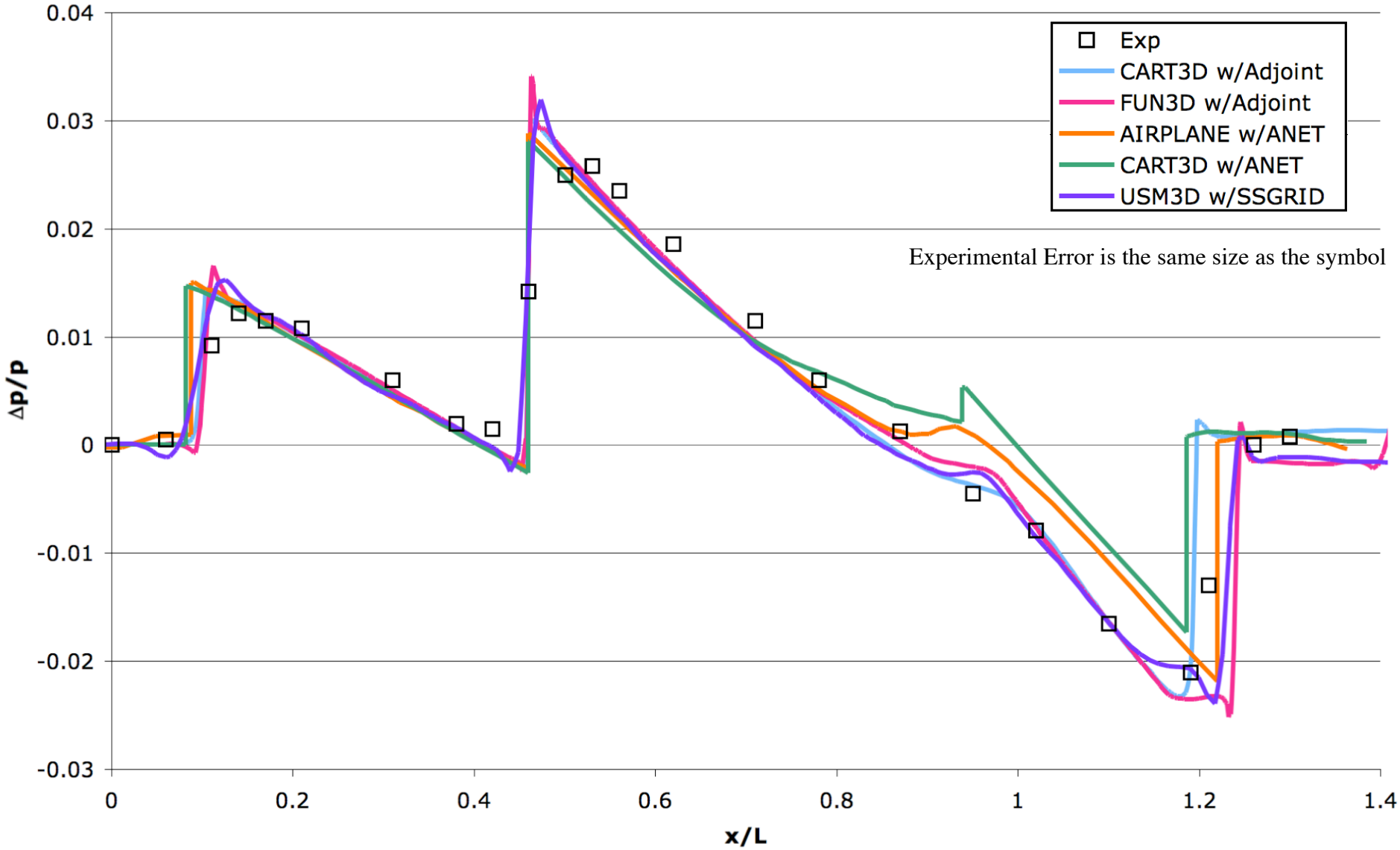
Parabolic Body of Revolution - 10 BL



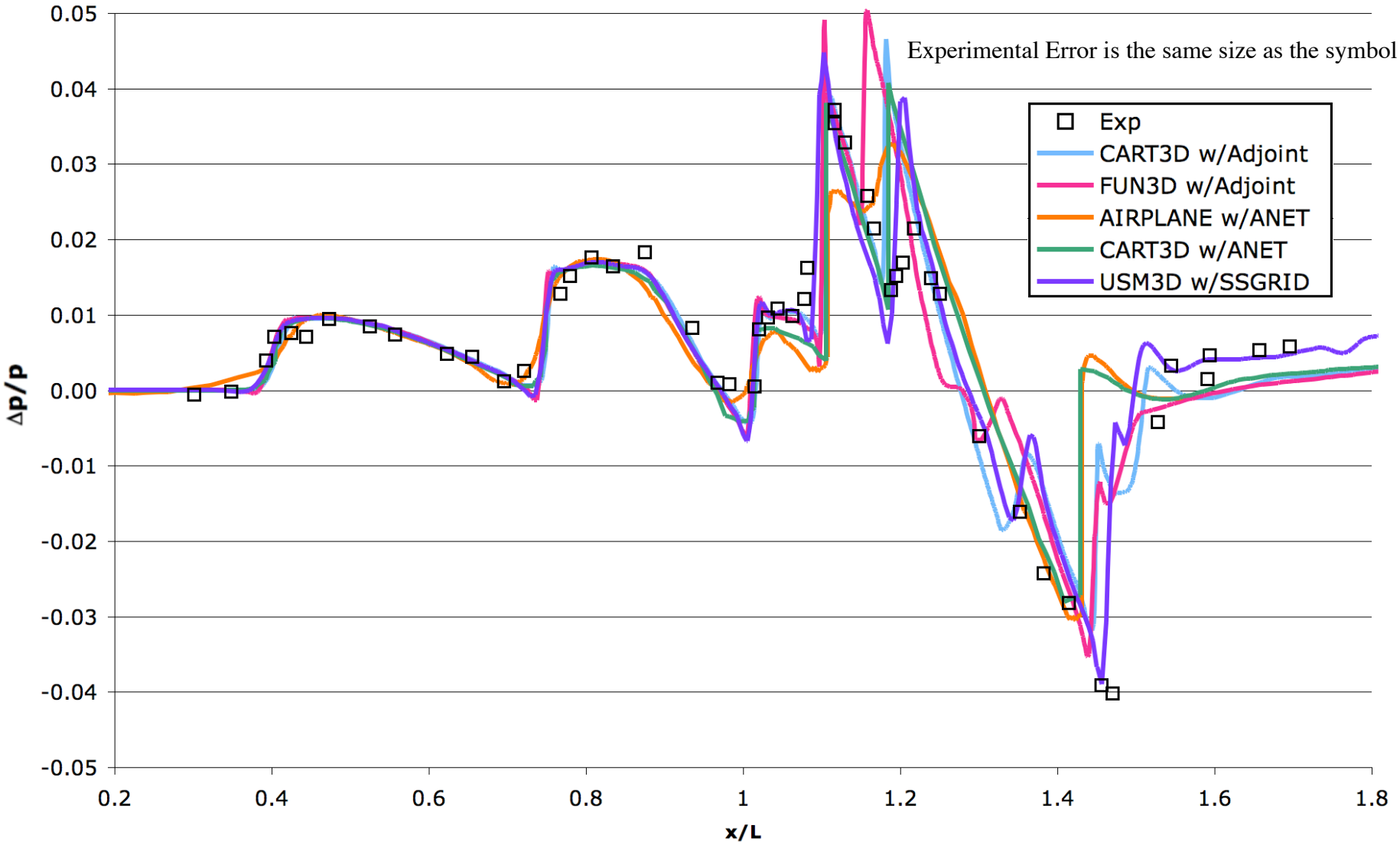
Quartic Body of Revolution - 10 BL



69-degree Swept Delta-Wing-Body - 3.6 BL



Ames Low Boom Wing Tail (LBWT) with 4 Nacelles - 1.167 BL



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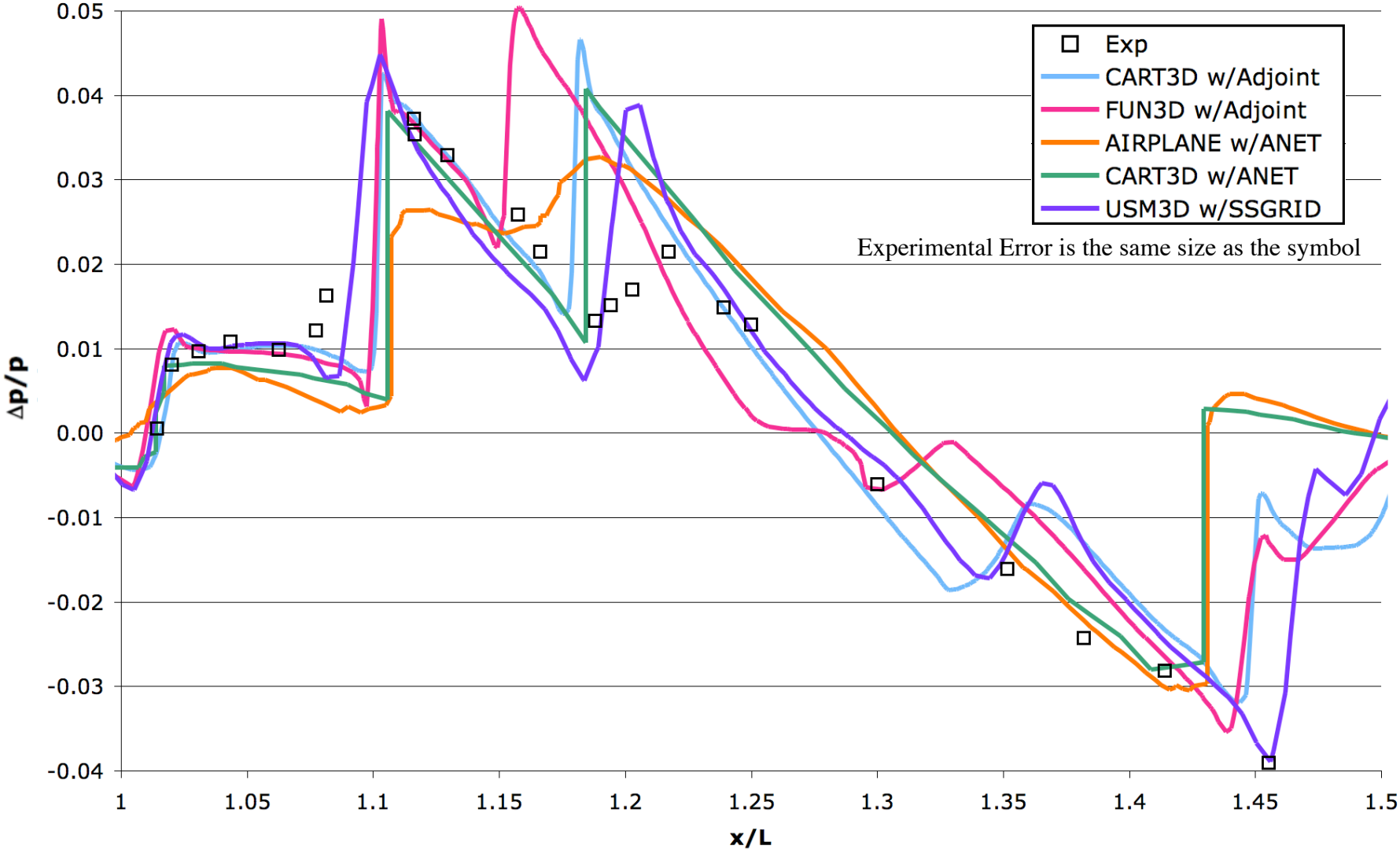
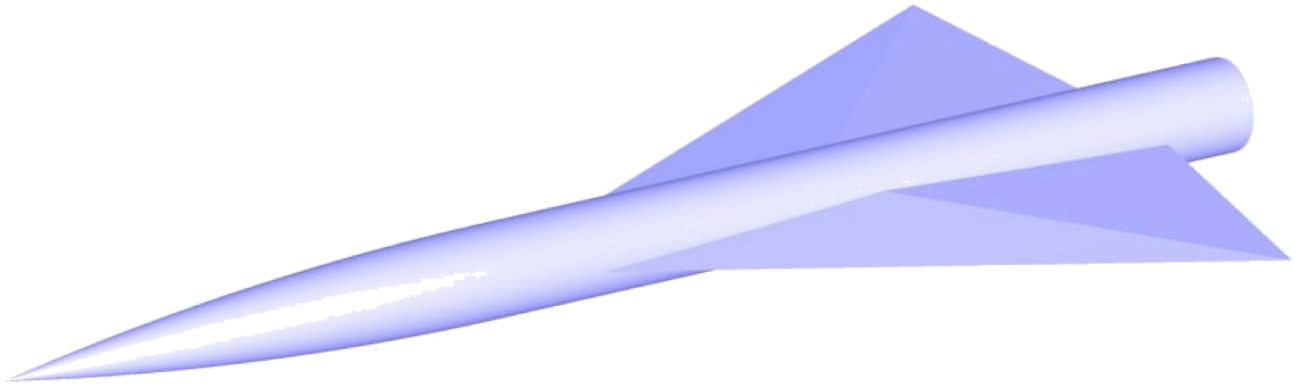
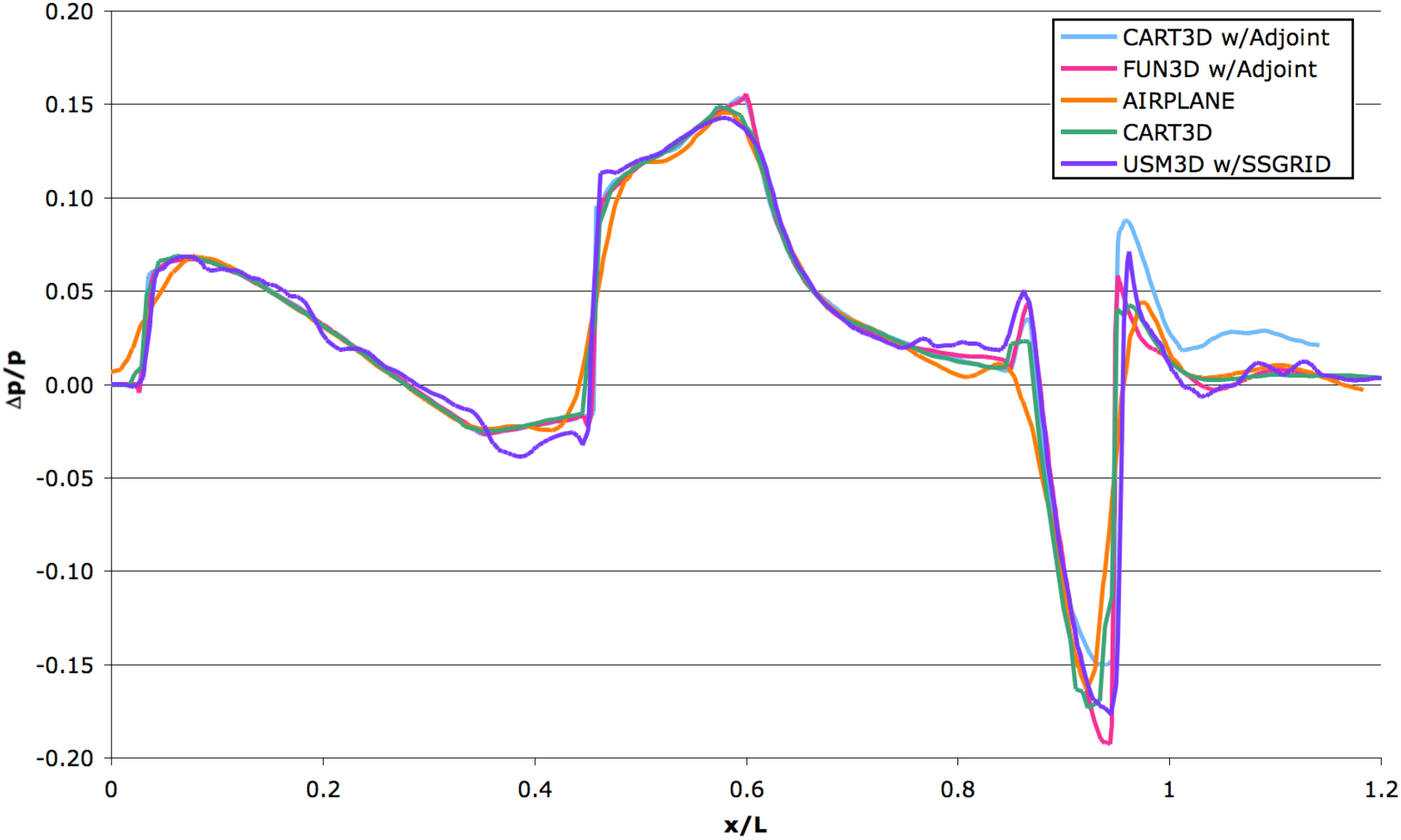


Near Field Study

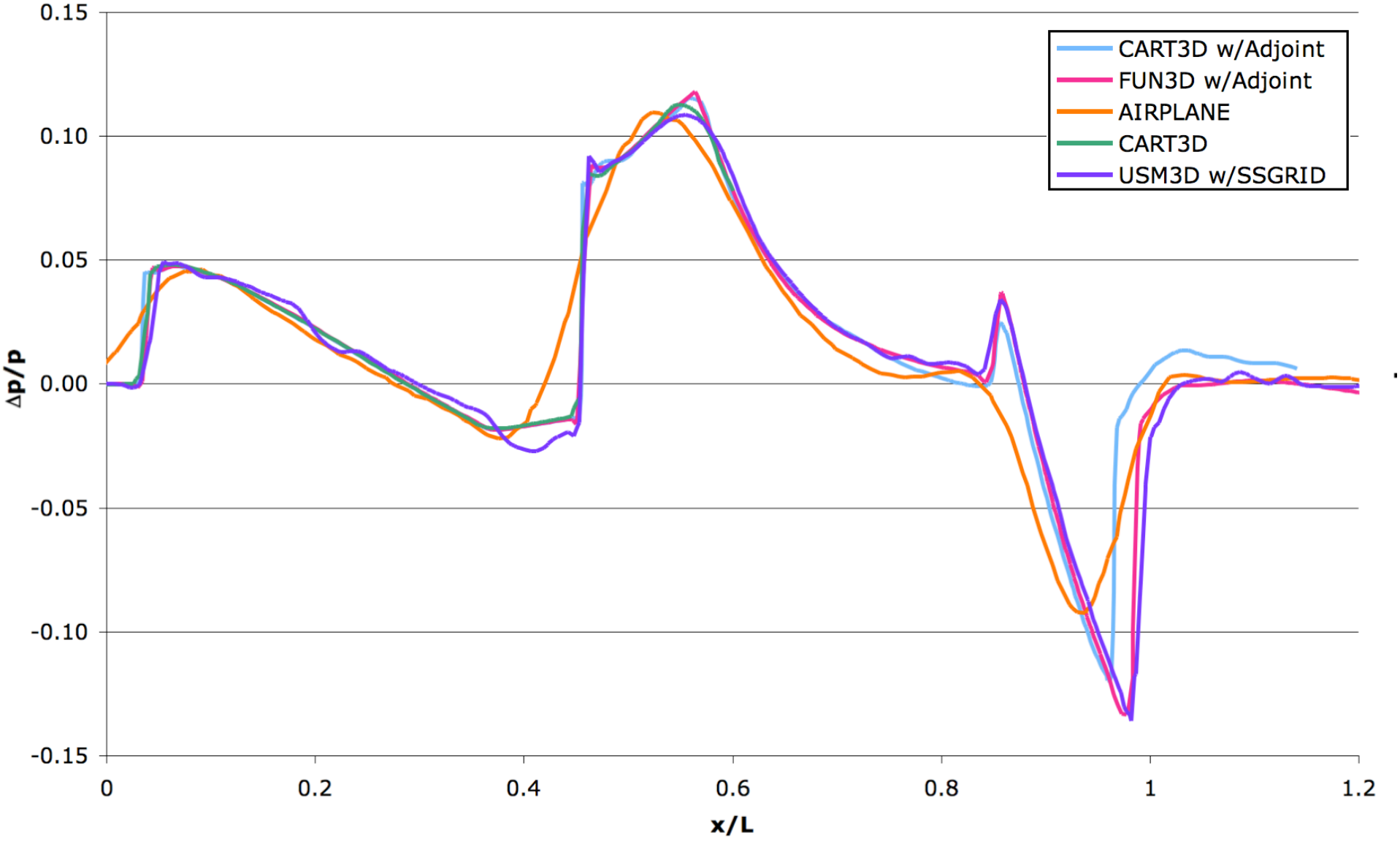
- Study conducted using Delta Wing Body
- Study included cuts at 0.2, 0.4, 0.8, 1.2, 2.0 and 2.8 body lengths below the model
- No experimental data available for comparison
- No extrapolation (AIRPLANE & CART3D)



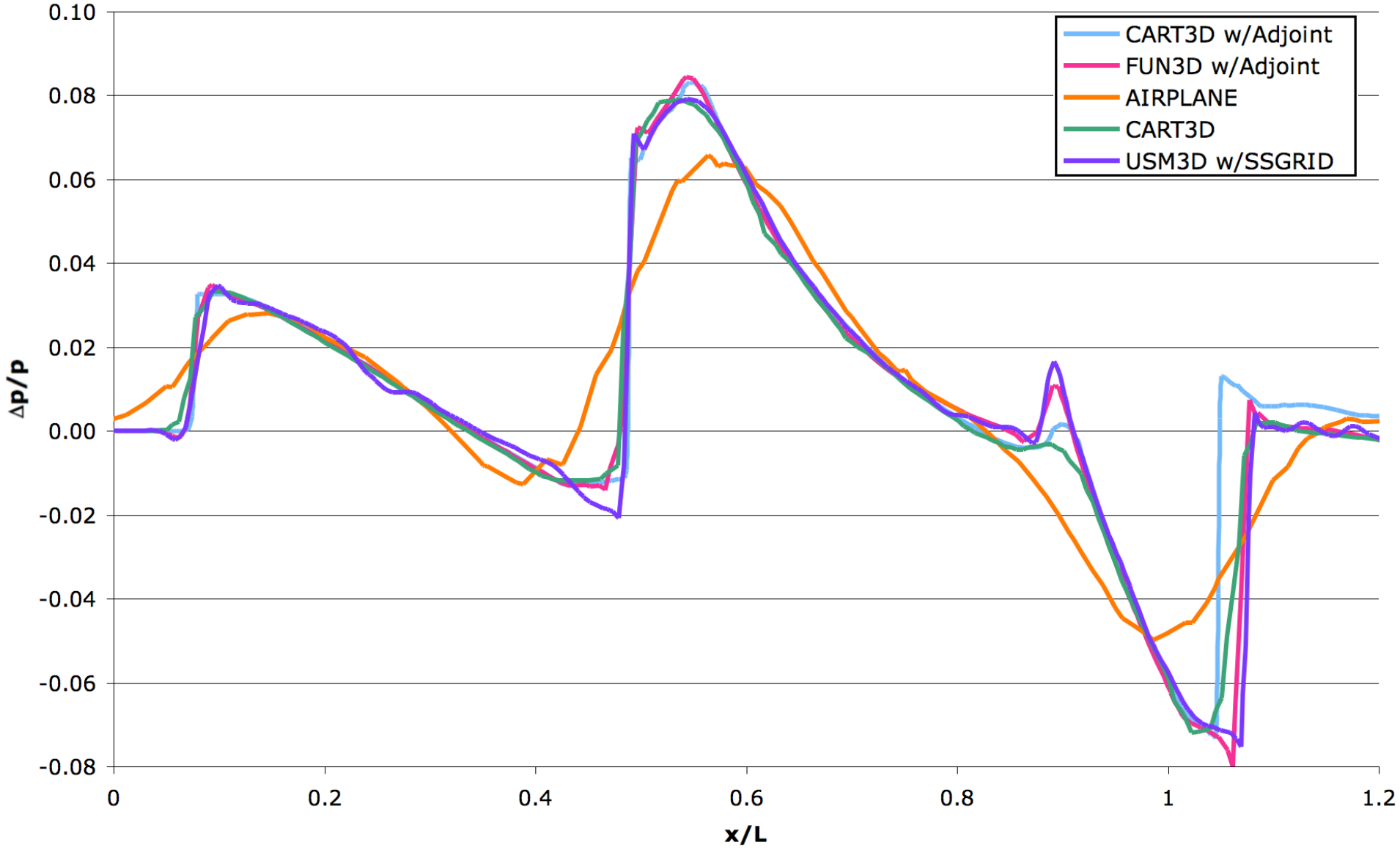
69-degree Swept Delta-Wing-Body - 0.2 BL



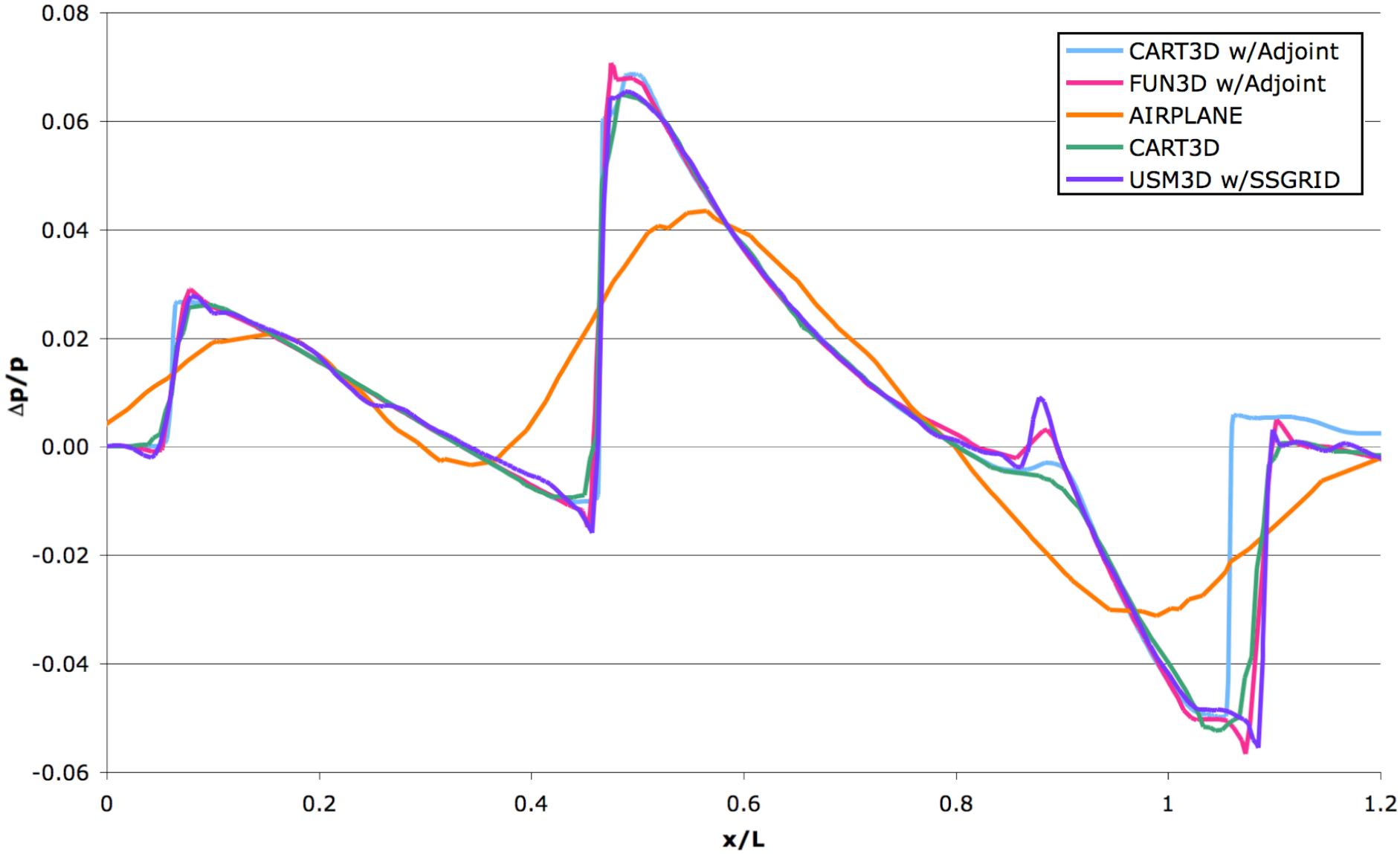
69-degree Swept Delta-Wing-Body - 0.4 BL



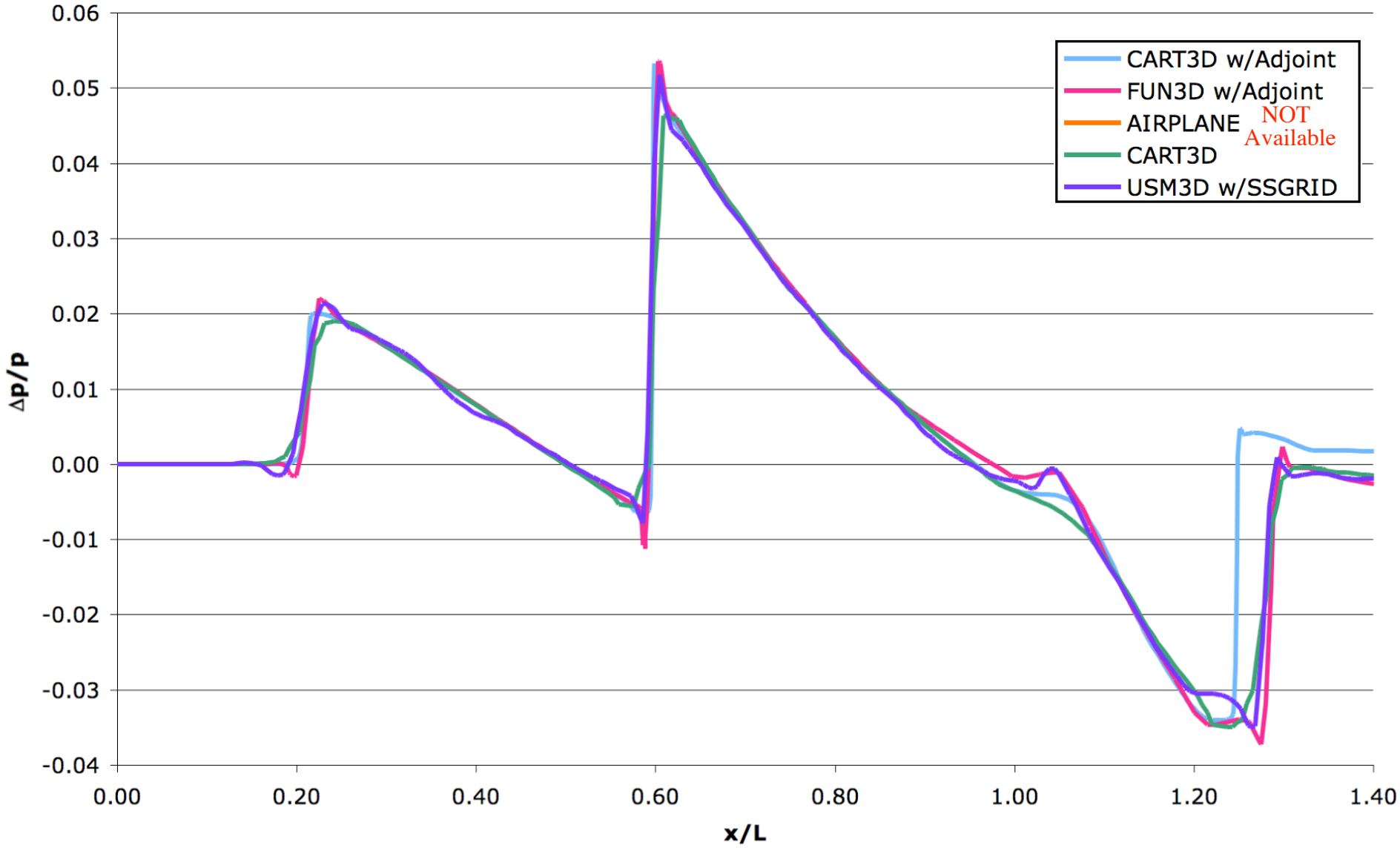
69-degree Swept Delta-Wing-Body - 0.8 BL



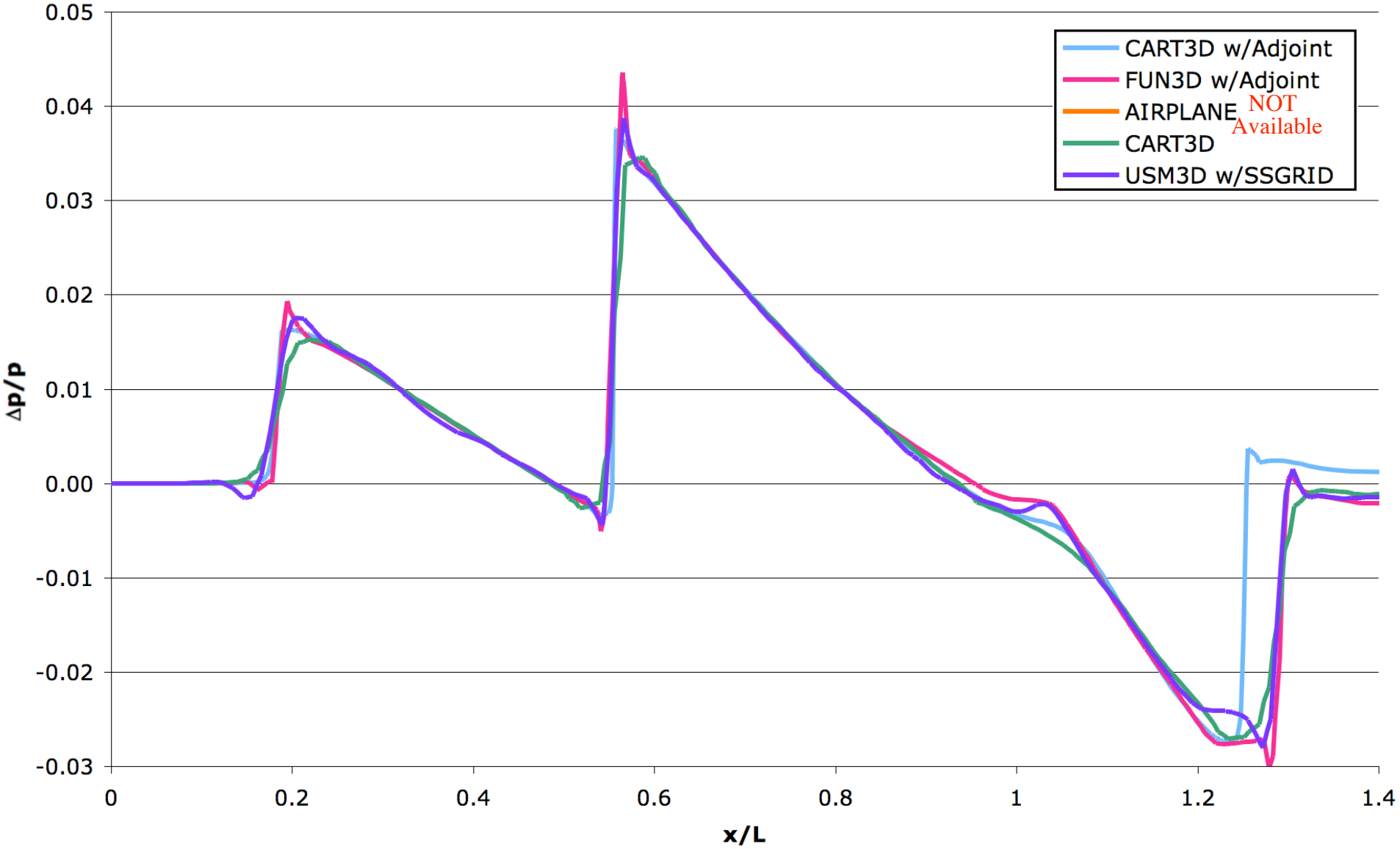
69-degree Swept Delta-Wing-Body - 1.2 BL



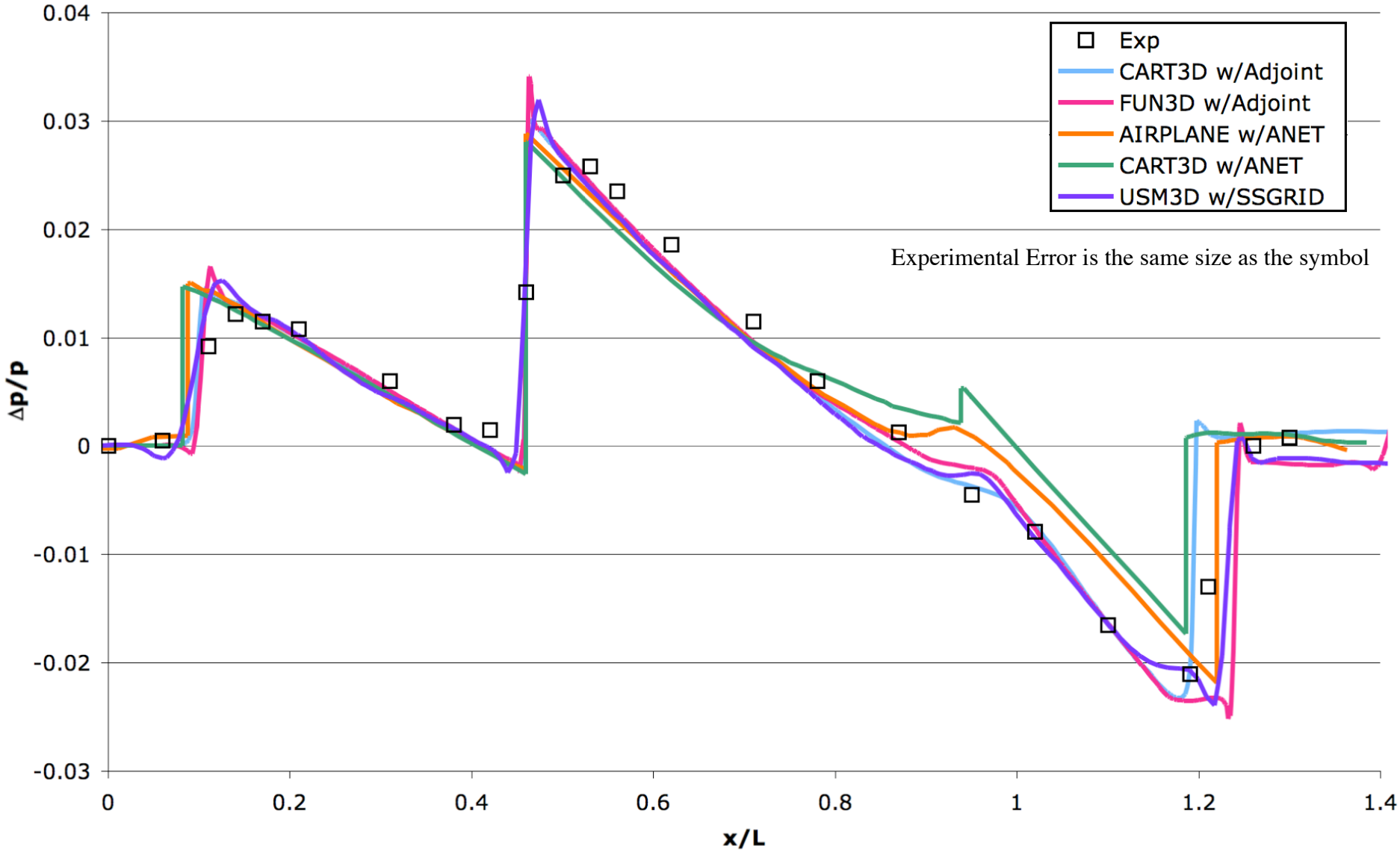
69-degree Swept Delta-Wing-Body - 2.0 BL



69-degree Swept Delta-Wing-Body - 2.8 BL



69-degree Swept Delta-Wing-Body - 3.6 BL

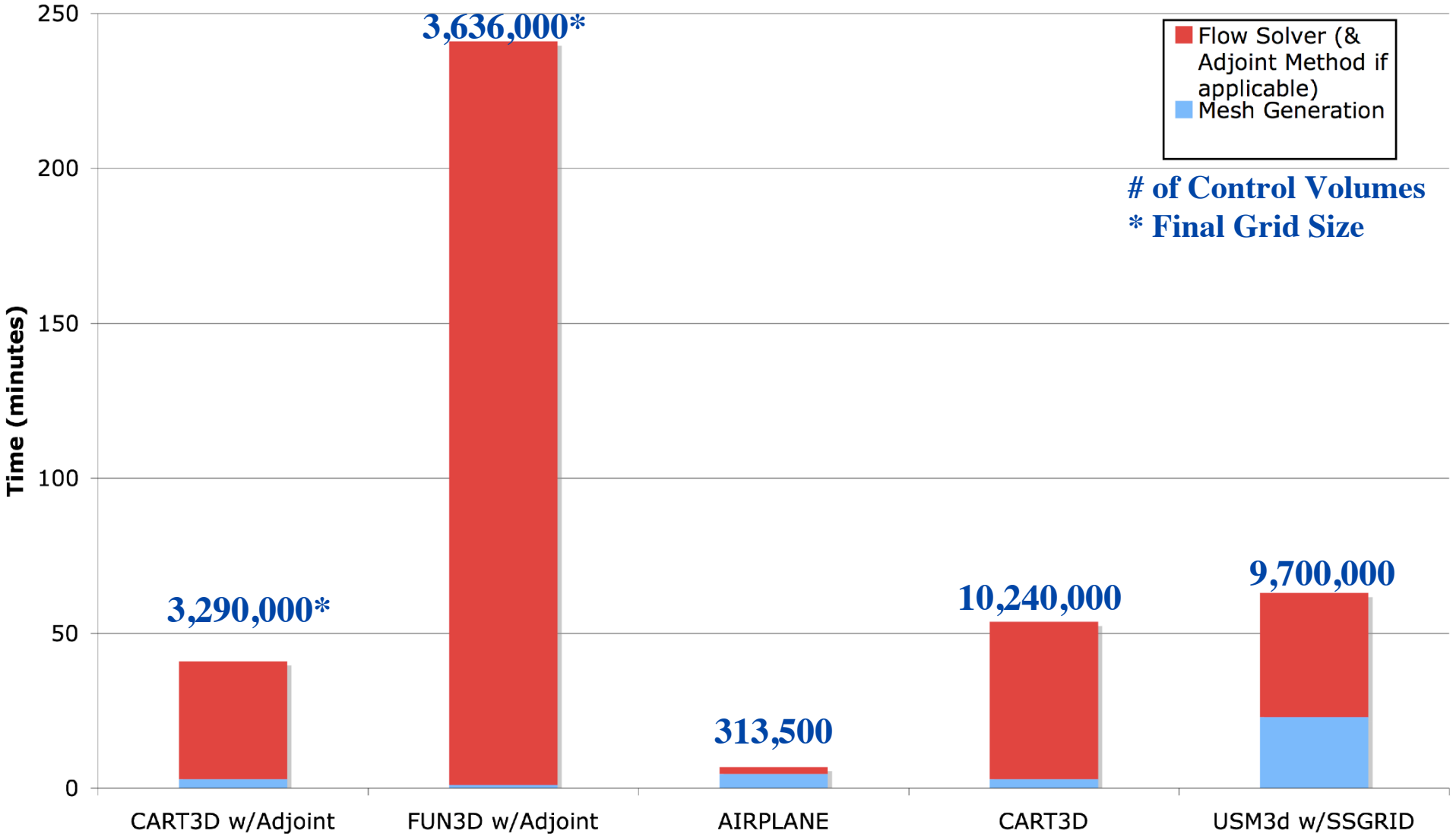


Time to Obtain Data

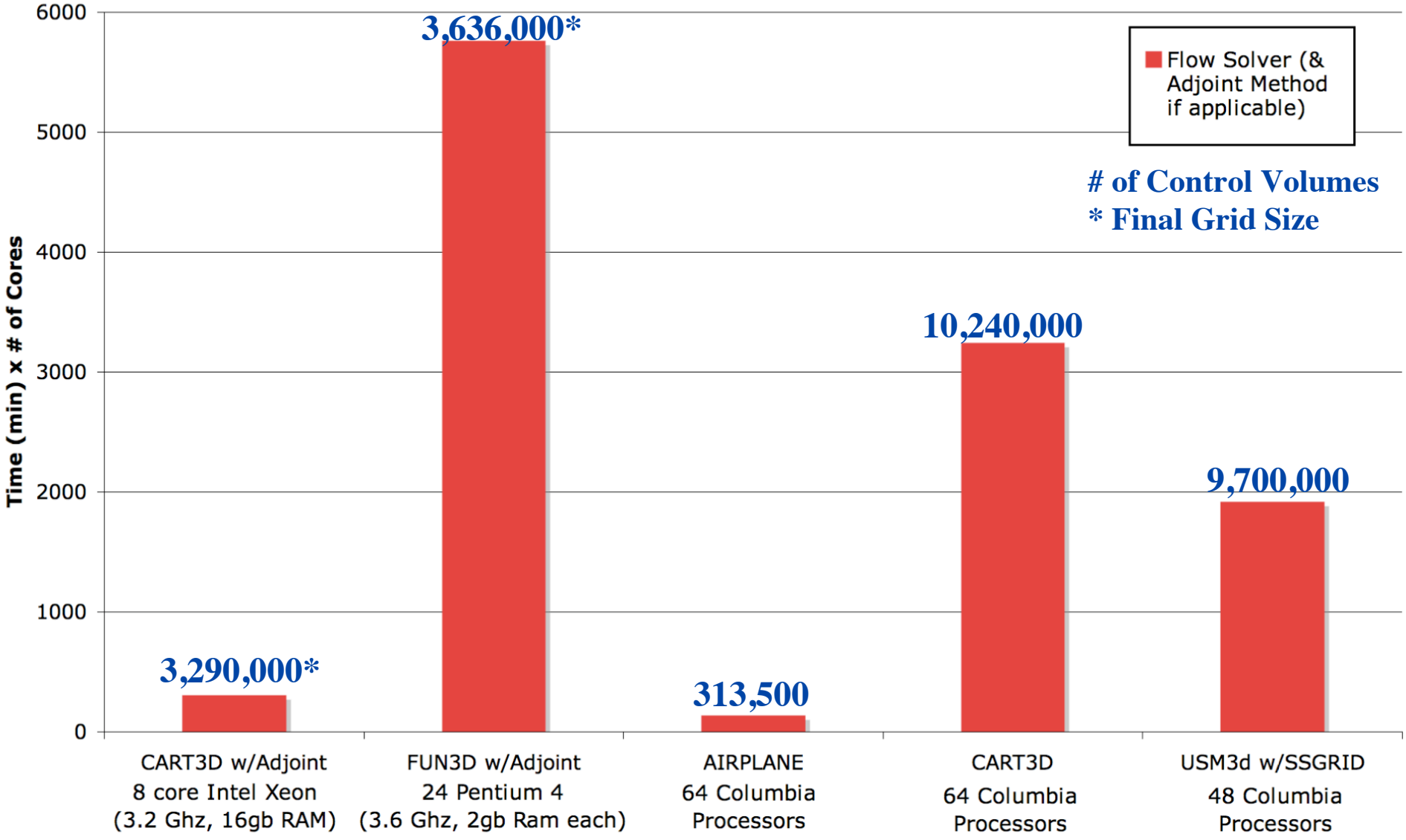
- Data Includes Only Computer Time
  - Time to Create Grid
  - Time to Get Computational Solution
- All of the methods used different computers!!!

	CART3D w/Adjoint	FUN3D w/Adjoint	AIRPLANE	CART3D	USM3D w/SSGRID
Grid Gen	8 core Intel Xeon (3.2 Ghz, 16gb of memory)	1 3.6 Ghz Pentium 4 2gb memory	1 processor on Columbia (1.5 Ghz Sgi Altix)	1 processor on Columbia (1.5 Ghz Sgi Altix)	1 core Intel Xeon Mac Pro (3 Ghz w/16gb of memory)
Solution	8 core Intel Xeon (3.2 Ghz, 16gb of memory)	24 3.6 Ghz Pentium 4 2gb of memory each	64 processors on Columbia (1.5 Ghz Sgi Altix)	64 processors on Columbia (1.5 Ghz Sgi Altix)	48 processors on Columiba (1.5 Ghz Sgi Altix)

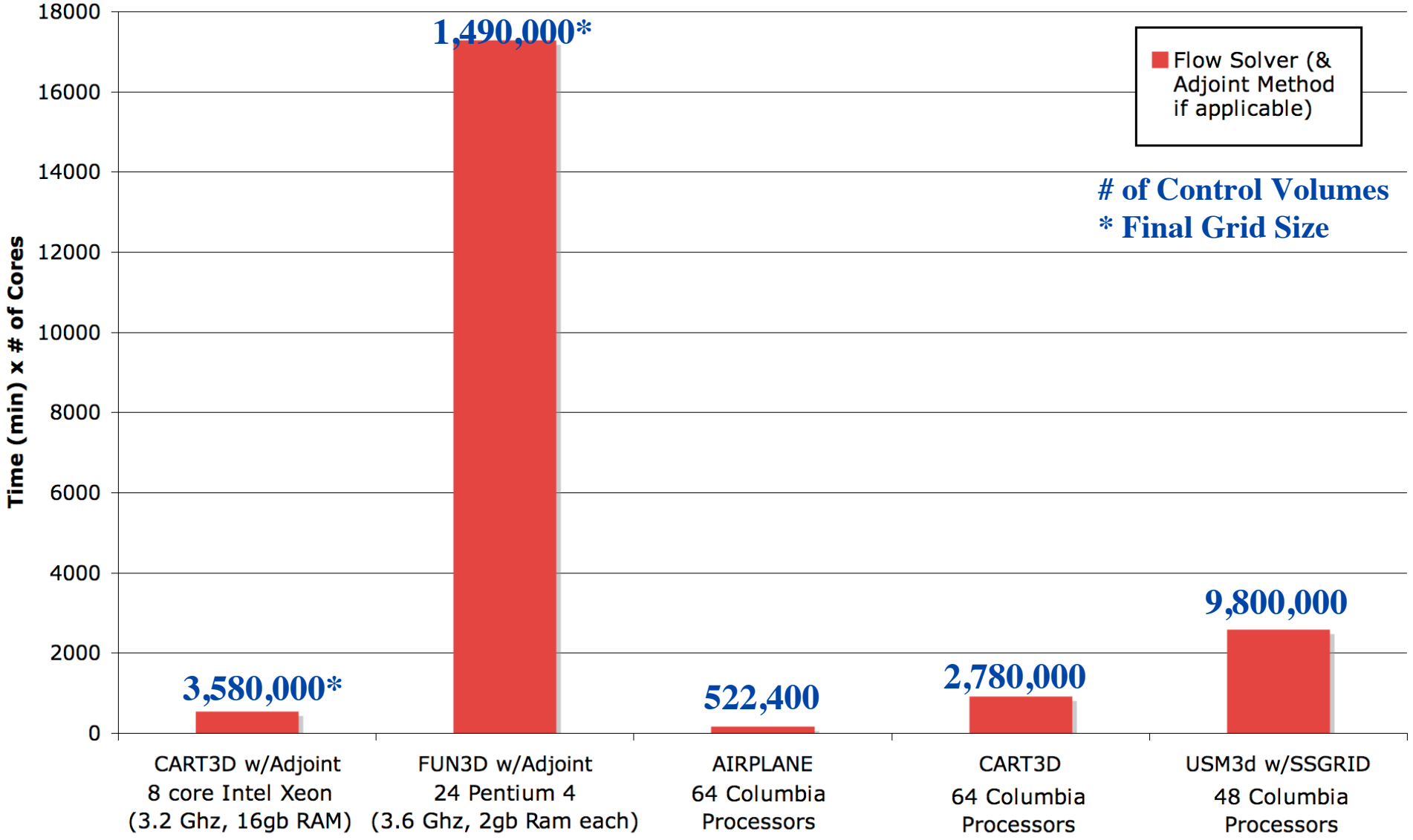
Cone-Cylinder Timings



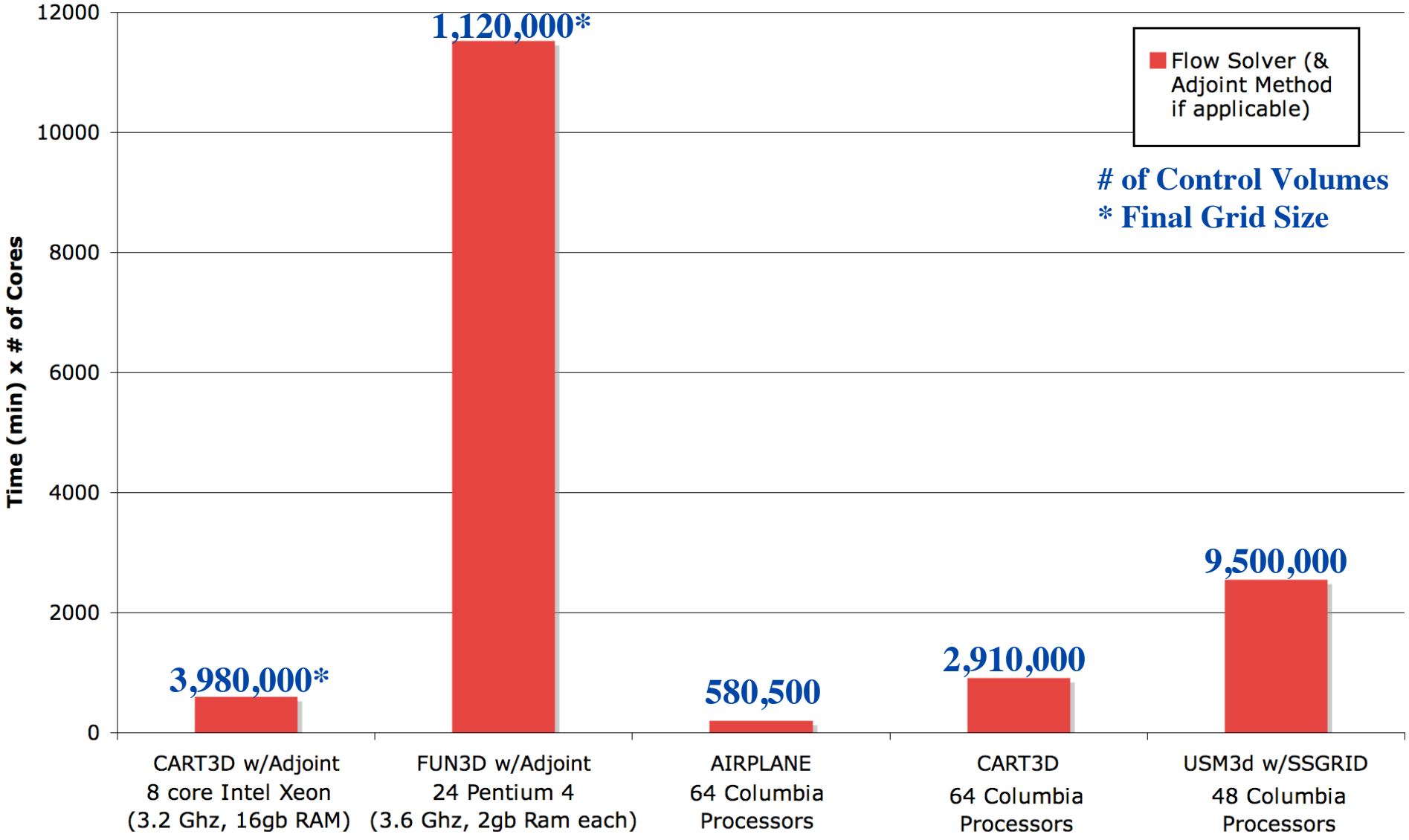
Cone-Cylinder Timings



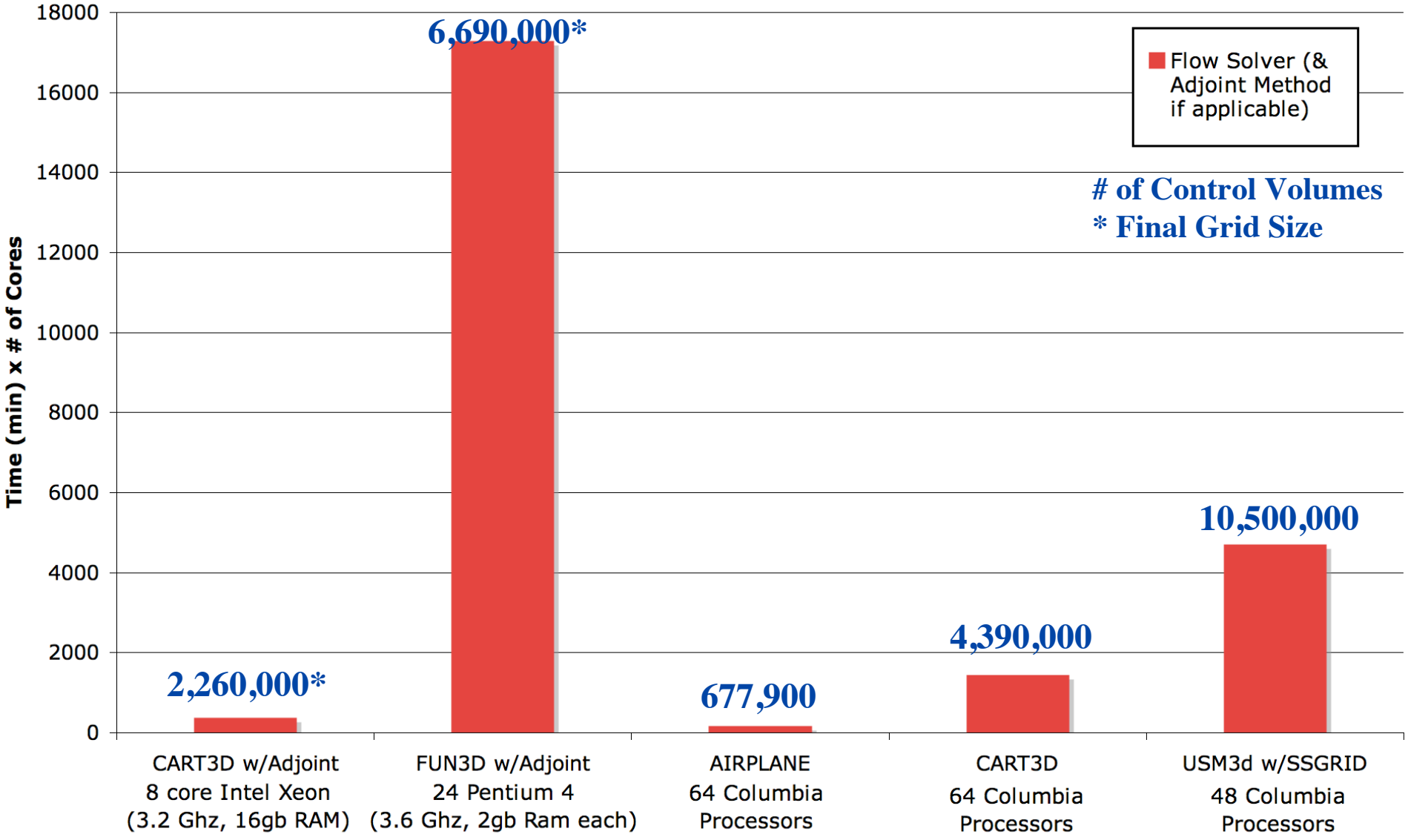
Parabolic Body of Revolution



Quartic Body of Revolution



69-degree Swept Delta-Wing-Body



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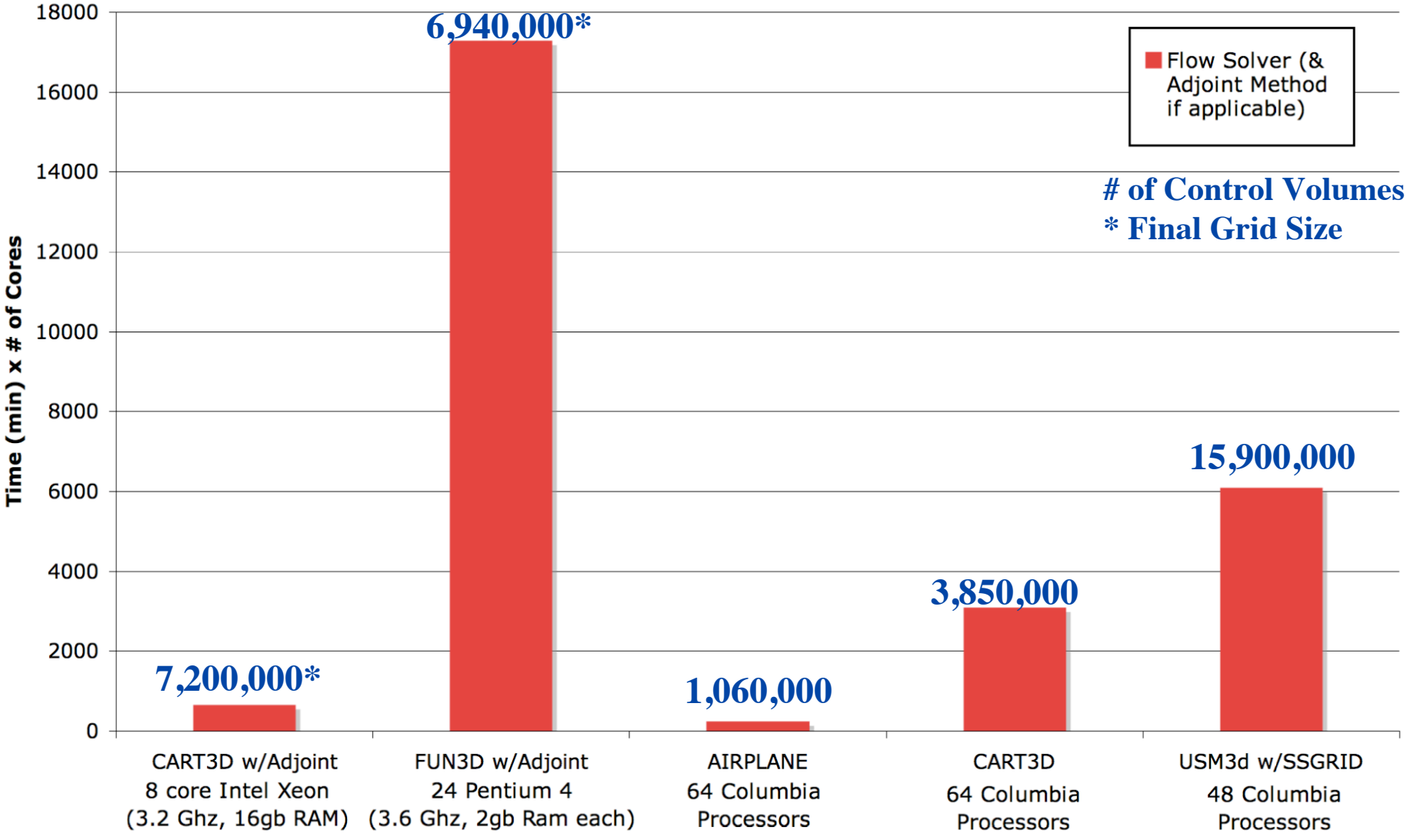

Summary

- Have signatures with a single shock, multiple shocks, wide variety of shapes and signatures
- Any one of the codes can produce reasonable results in hours
- Accuracy of the codes have improved
- Automation has improved

Future Work:

- LBWT is being retested to obtain better fidelity data
- Low boom aft-end models
- How far do we need to go to use propagation to ground?