AePW-4 High-Angle Working Group Meeting

Aeroelastic Prediction Workshop

August 14, 2025

Pawel Chwalowski
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Agenda, August 14

- AIAA Aviation 2025, Walt
- Summer/Fall 2025: New BSCW Experiment, Bret
- August 26, AePW-4 Organizing Committee Meeting
- Presentations today: NASA, RMIT, Technion, Duke
- Next Meeting, September 11
- AIAA SciTech 2026: no special session(s) planned
- AIAA Aviation 2026: DPW-8 and AePW-4 Workshop

AIAA Aviation 2025: four sessions dedicated to DPW-8/AePW-4

DPW-8/AePW-4: A Collaborative Approach to Drag & Aeroelasticity

Monday: Workshop Overview

3:30
Architecture, Scope, and Goals of the Multidisciplinary DPW-8/AePW-4 Workshop

3:50
DPW-8/AePW-4 Scatter Working Group: An Overview of Mini Workshops 1 and 2

4:10
DPW-8/AePW-4 Buffet Working Group: An Overview of Mini Workshops 1 and 2

4:30
Overview of the Finite Element Models for the DPW-8/AePW-4 Hybrid Working Groups

4:50
AePW-4 High-Angle Working Group: Overview of Progress and Future Directions

5:10
National Transonic Facility Public Geometry Release and Summary

Tuesday: AePW-4 High-Speed Working Group

3:30
AePW-4 High-Speed Working Group: Overview of Progress and Future Directions

3:50
ITA and Embraer Aeroelasticity Cooperation in Preparation for the AEPW-4

4:10
Correlation of Mathematical Model with AFRL RC-19 Aerothermoelastic Experiment

4:30
Computations of the HyMAX Experiment in Support of a New Aeroelastic Experiment

Wednesday: Buffet Hybrid Working Group

3:30
RANS, URANS and Hybrid RANS/LES Computations of the ONERA OAT15A Using CFD++

3:50
charLES Buffet Simulations of the ONERA OAT15A Airfoil for DPW-8/AePW-4

4:10
USM3D-ME Buffet Simulations of the ONERA OAT15A Airfoil for DPW-8/AePW-4

4:30
HPCMP CREATE-AV Simulations for the DPW-8/AePW-4 Buffet Working Group: Part 1

4:50
CHAMPS' Contributions to the Eighth Drag Prediction Workshop Buffet Working Group

5:10
Transonic shock Buffet URANS Simulations of the ONERA OAT15A Airfoil with SU2

Thursday: Further AePW-4 Applications

3:30
Embraer Contribution to DPW-8/AePW-4: Part I

3:50
Shock Buffet and Stall Flutter Modeling with Tunable Turbulence Parameters

4:10
Transonic Buffet and Stall Flutter Predictions with a Tunable Turbulence Model

4:30
Flutter and Limit Cycle Oscillation Envelope of the Pazy Wing using a ROM

Summer/Fall 2025: New BSCW Experiment, Bret

AePW-4 High-Angle WG Cases

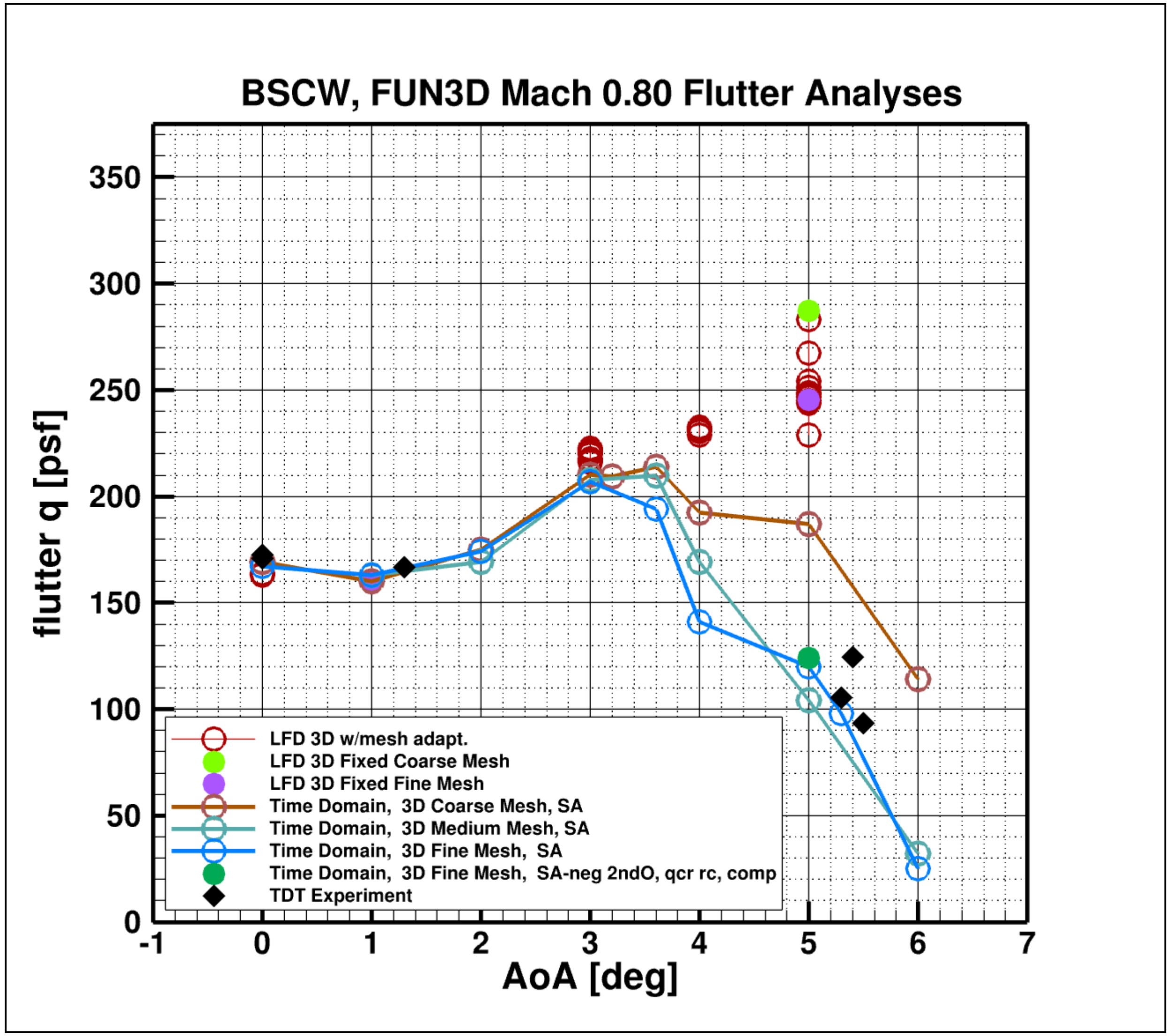
- Mandatory, Case 1
  - 3D BSCW model flutter prediction at Mach 0.80 and angle-of-attack sweep: 0° – 6°

- Optional, Case 2
  - 3D BSCW model flutter prediction at Mach 0.74, 0.76, 0.78 and angle-of-attack 3°

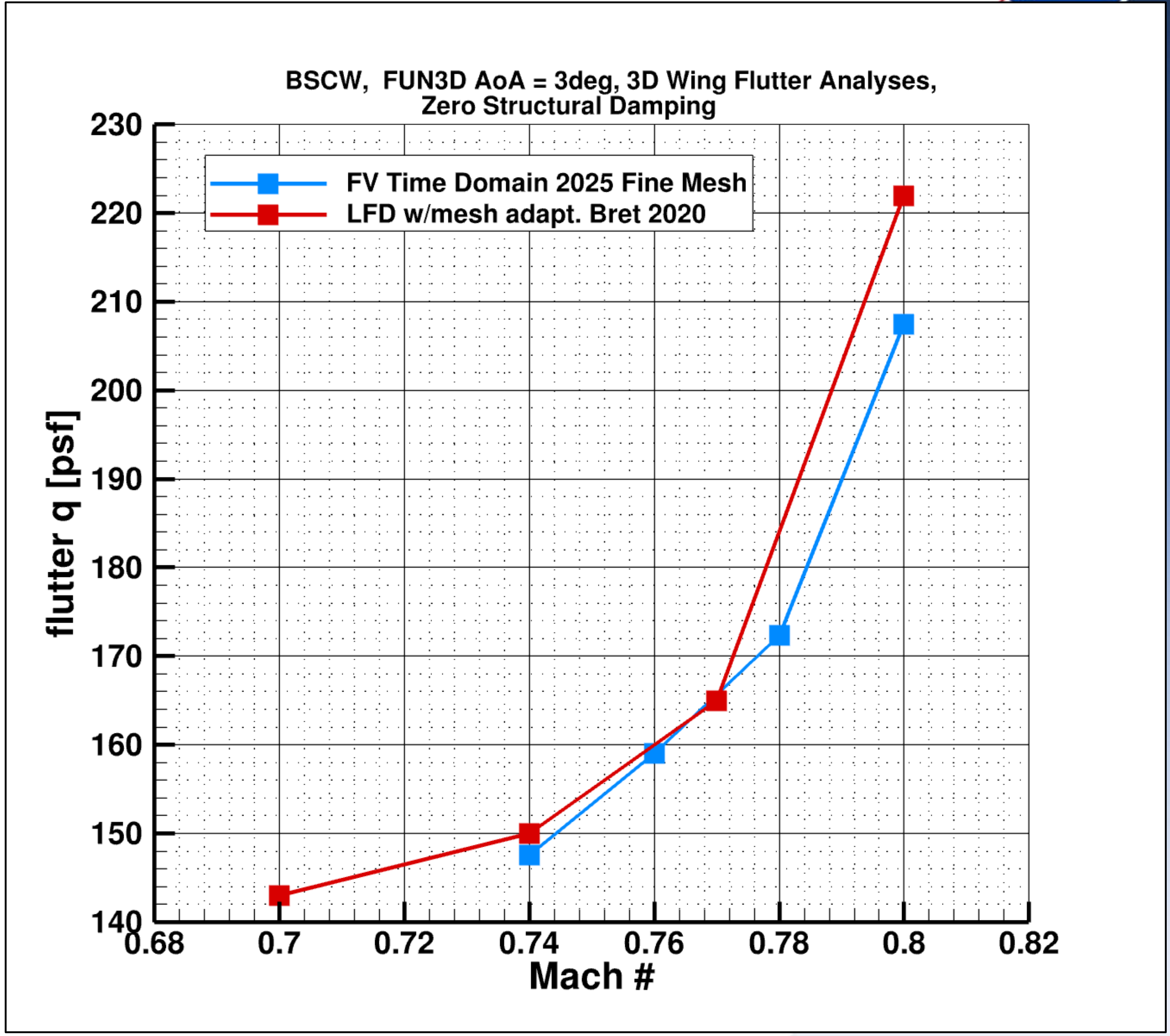
- Mandatory, Case 3
  - 2D BSCW flutter prediction at Mach 0.80 and angle-of-attack sweep: 0° – 6°

Currently we have seven teams looking at 2D and 3D calculations

Mach 0.80, AoA Sweep, Case 1



AoA = 3deg, Mach Sweep, Case 2



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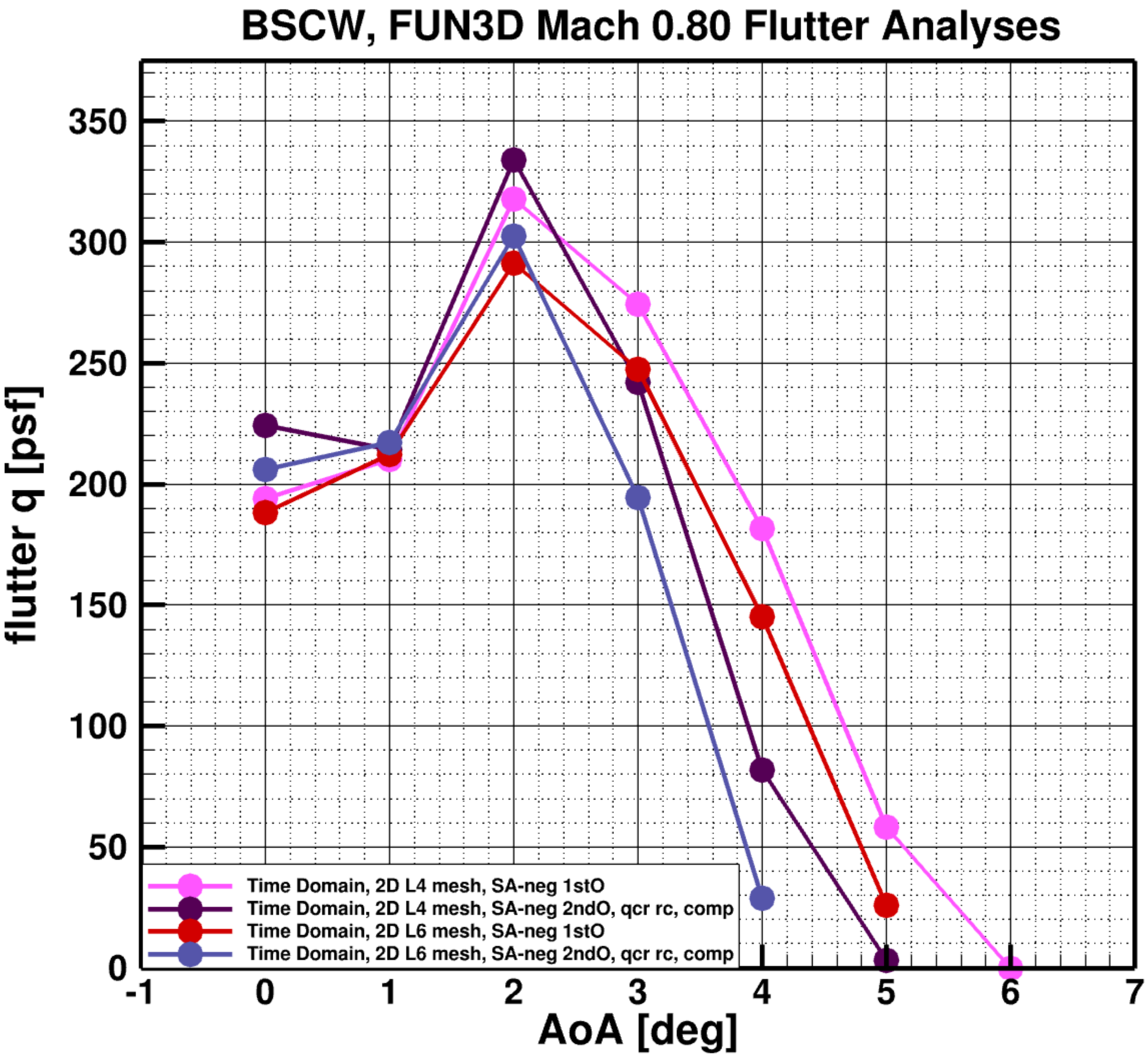
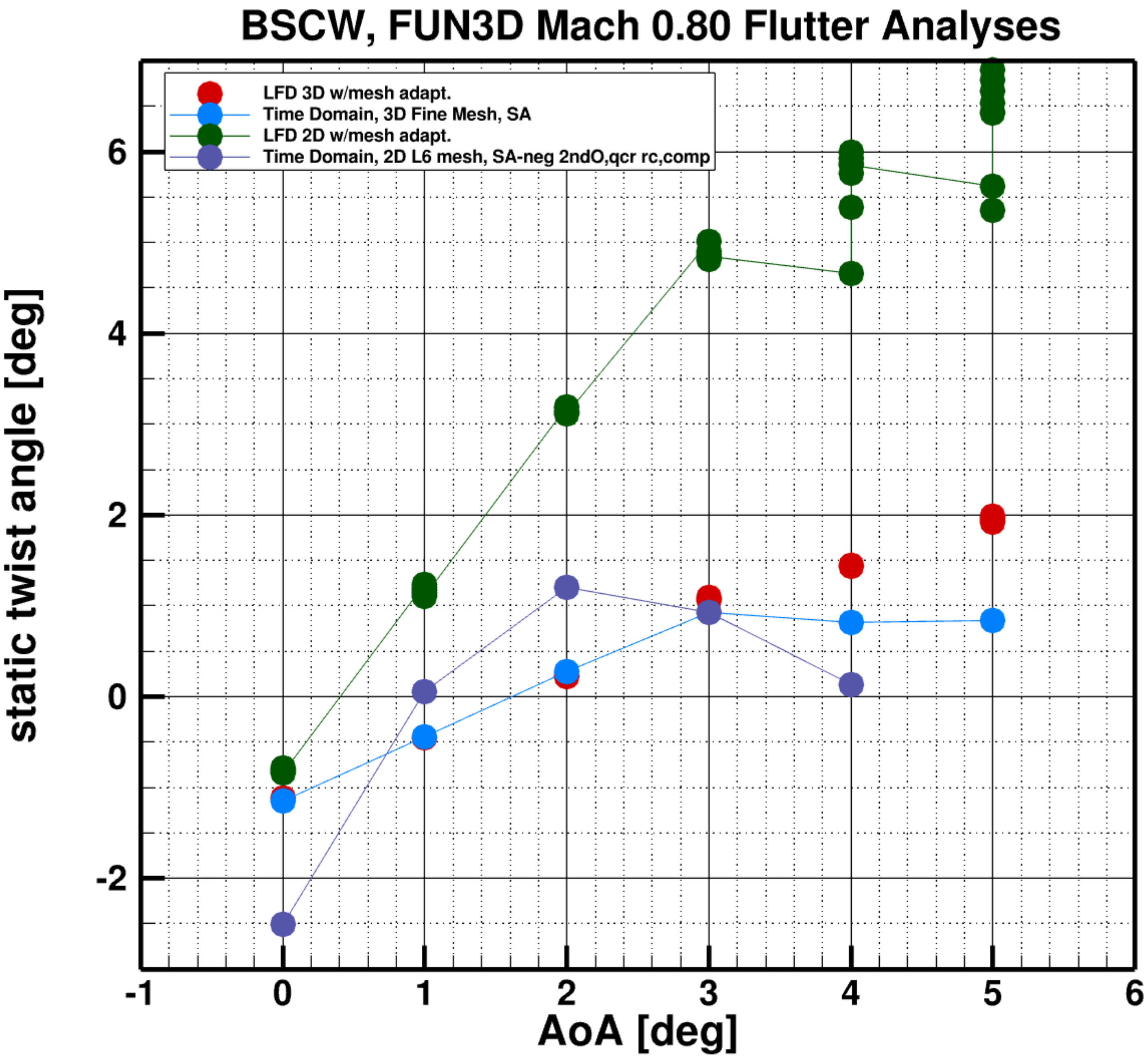
2D BSCW



BSCW, FUN3D Mach 0.80 Flutter Analyses
flutter q [psf]
AoA [deg]
0
50
100
150
200
250
300
350
-1
0
1
2
3
4
5
6
7
Time Domain, 2D L4 mesh, SA-neg 1stO
Time Domain, 2D L4 mesh, SA-neg 2ndO, qcr rc, comp
Time Domain, 2D L6 mesh, SA-neg 1stO
Time Domain, 2D L6 mesh, SA-neg 2ndO, qcr rc, comp

2D BSCW



BSCW, FUN3D Mach 0.80 Flutter Analyses
LFD 3D w/mesh adapt.
Time Domain, 3D Fine Mesh, SA
LFD 2D w/mesh adapt.
Time Domain, 2D L6 mesh, SA-neg 2ndO,qcr rc,comp
static twist angle [deg]
AoA [deg]
-2
0
2
4
6
-1
0
1
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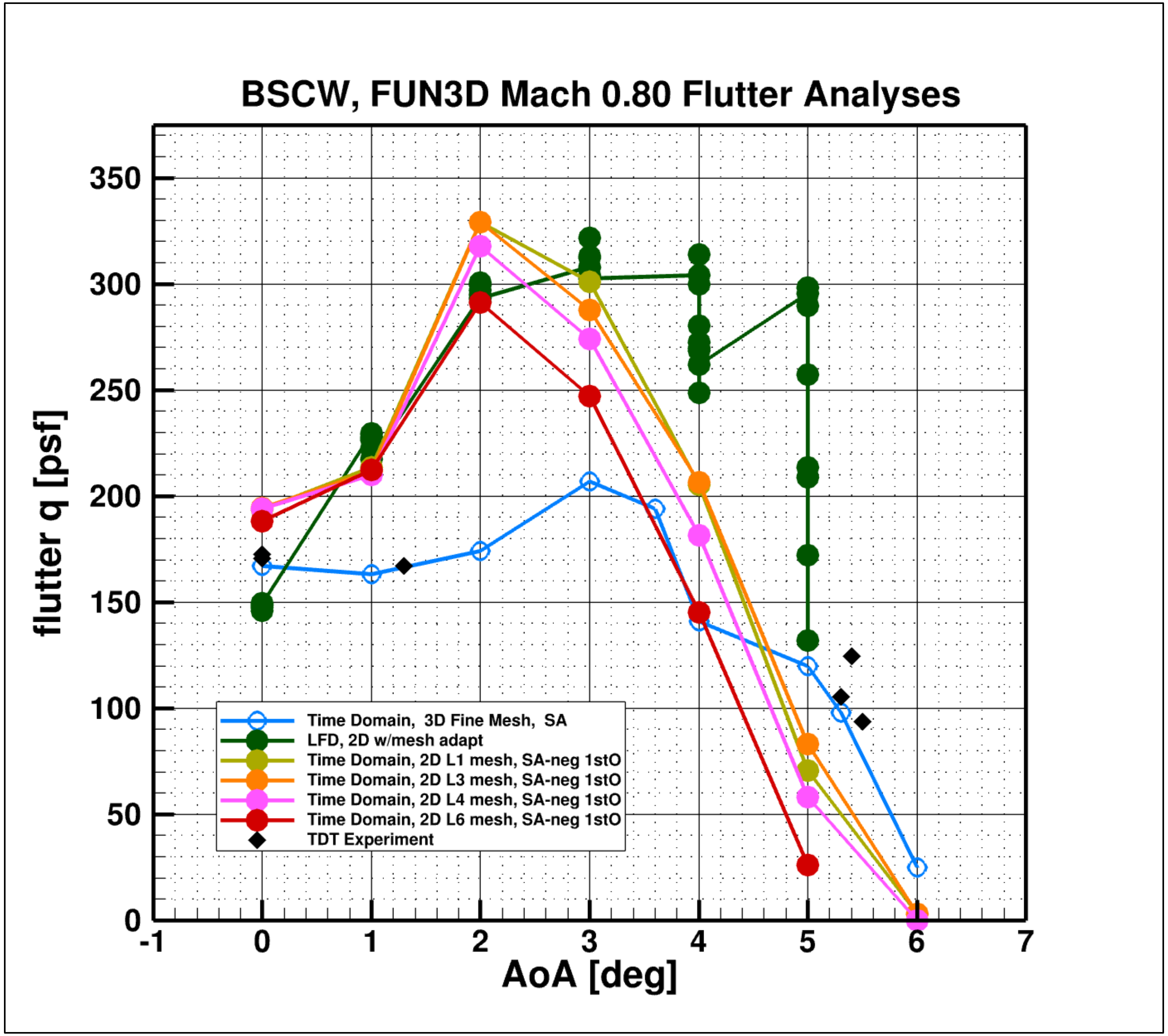
3
4
5
6


BSCW, FUN3D Mach 0.80 Flutter Analyses
flutter q [psf]
AoA [deg]
0
50
100
150
200
250
300
350
-1
0
1
2
3
4
5
6
7
Time Domain, 3D Fine Mesh, SA
LFD, 2D w/mesh adapt
Time Domain, 2D L1 mesh, SA-neg 1stO
Time Domain, 2D L3 mesh, SA-neg 1stO
Time Domain, 2D L4 mesh, SA-neg 1stO
Time Domain, 2D L6 mesh, SA-neg 1stO
TDT Experiment

Duke update….

AePW-4 High-Angle Working Group Meeting

May 8, 2025

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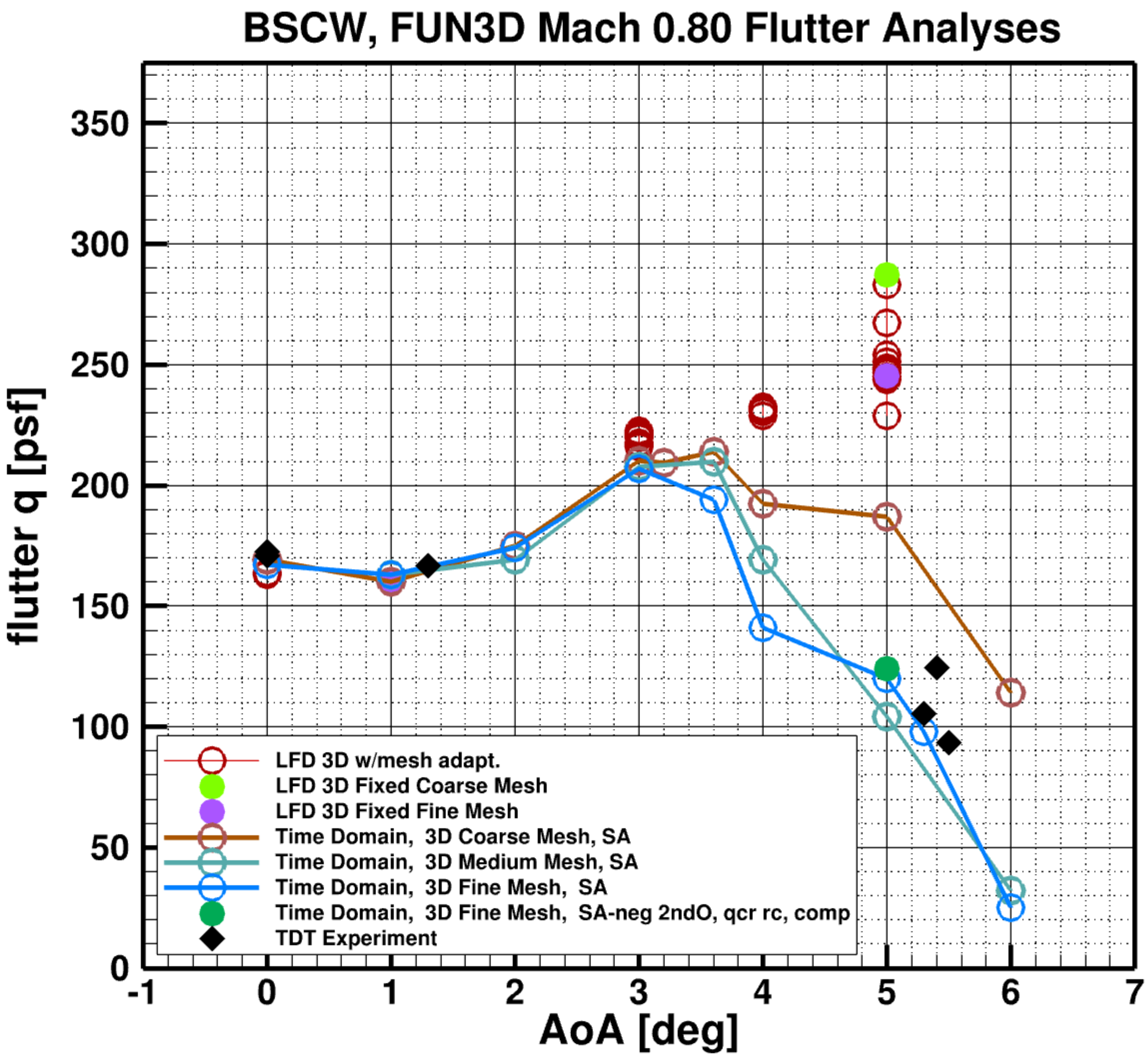
3D BSCW



BSCW, FUN3D Mach 0.80 Flutter Analyses
flutter q [psf]
AoA [deg]
0
50
100
150
200
250
300
350
-1
0
1
2
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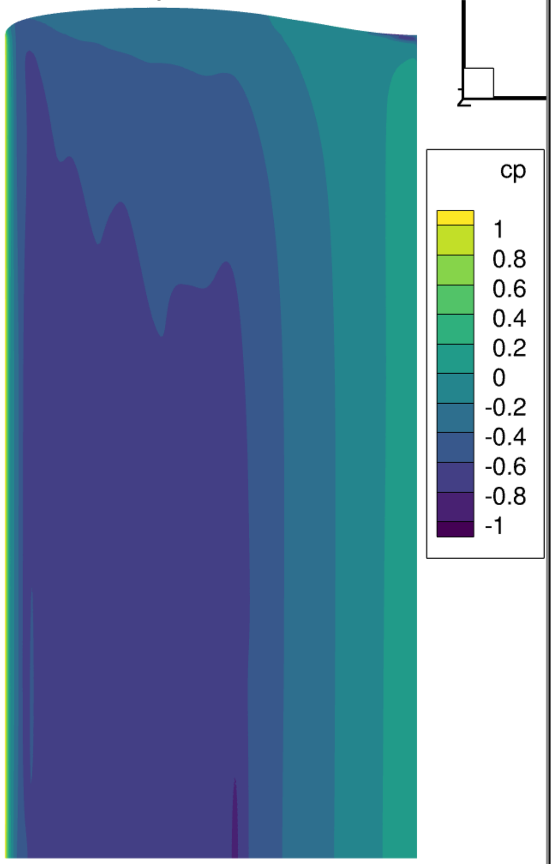
4
5
6
7
LFD 3D w/mesh adapt.
LFD 3D Fixed Coarse Mesh
LFD 3D Fixed Fine Mesh
Time Domain, 3D Coarse Mesh, SA
Time Domain, 3D Medium Mesh, SA
Time Domain, 3D Fine Mesh, SA
Time Domain, 3D Fine Mesh, SA-neg 2ndO, qcr rc, comp
TDT Experiment

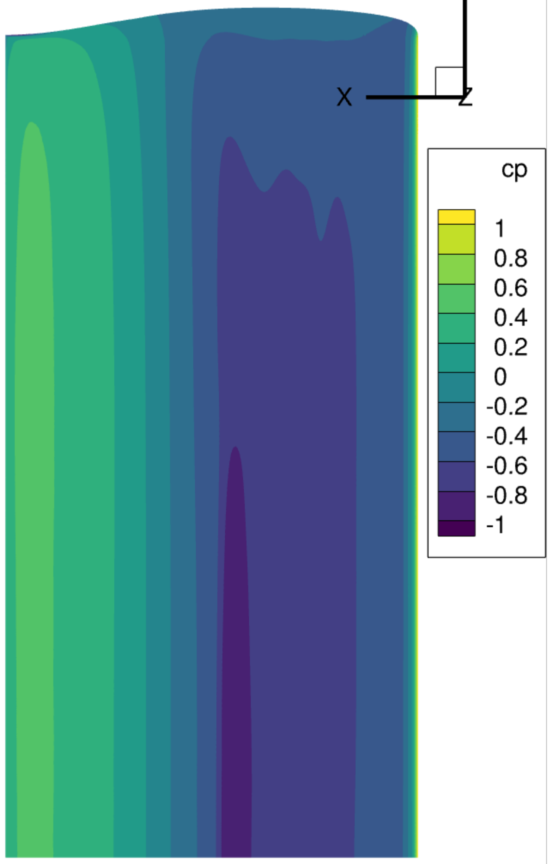
BSCW 2D vs 3D Aeroelastic Analysis, Mach 0.80 AoA = 0deg, q = 169 psf

3D Wing

Top Surface

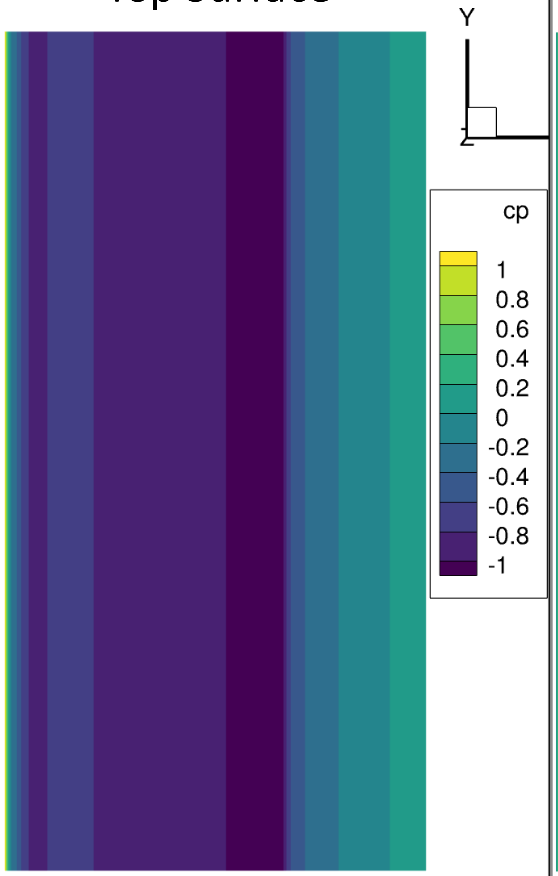


Bottom Surface

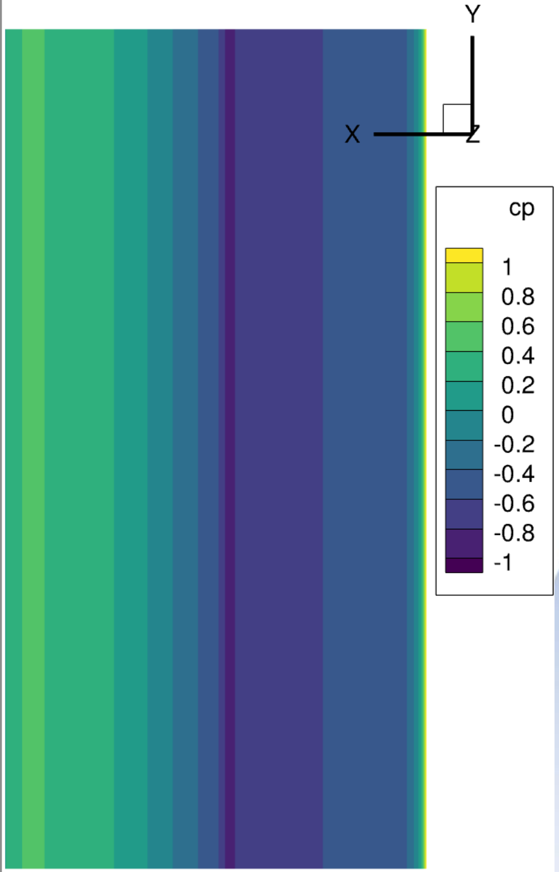


2D Wing

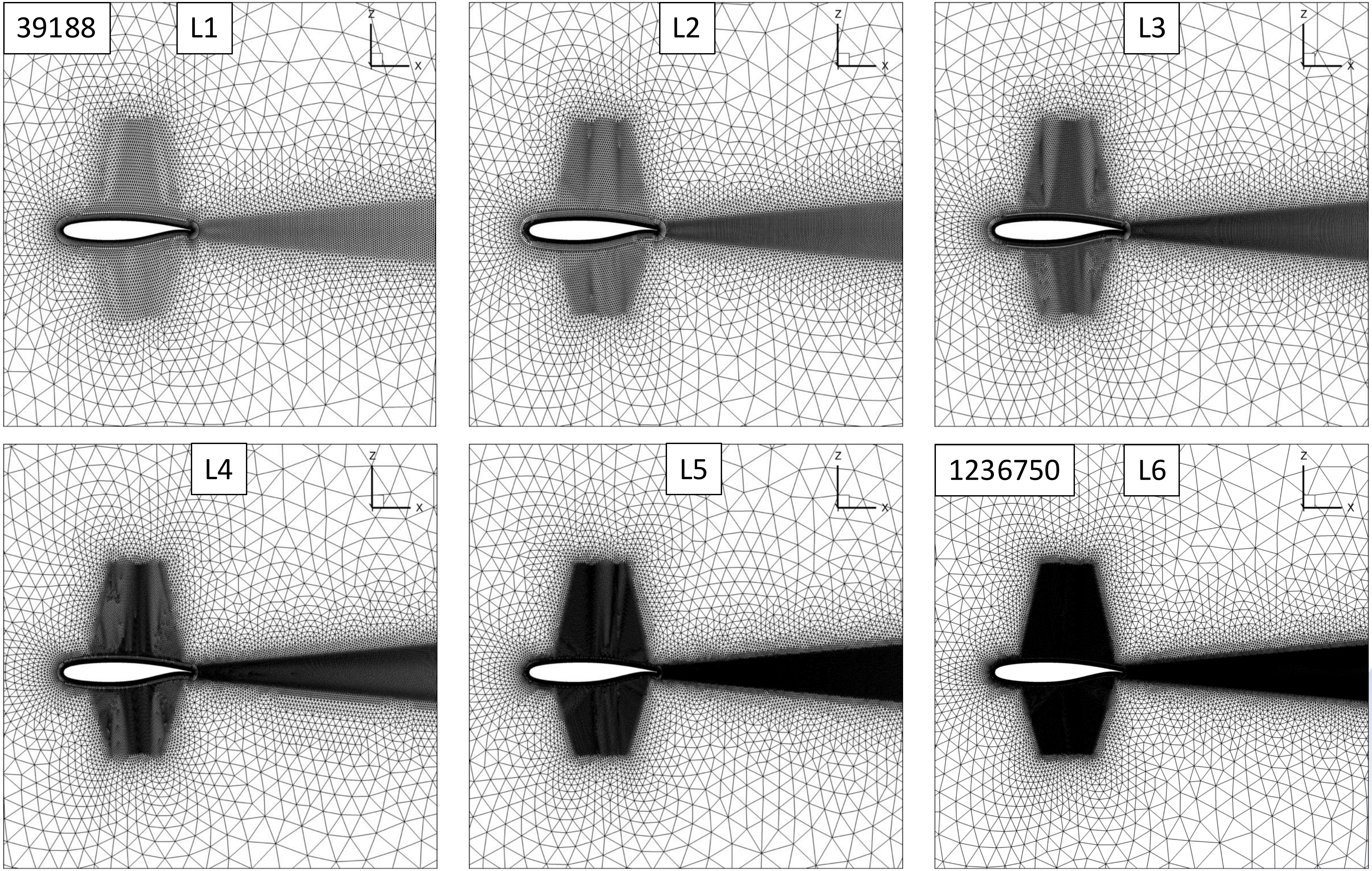
Top Surface



Bottom Surface



2D Mesh: 32-inch span wing with two symmetry planes



2D Mesh: 32-inch span wing with two symmetry planes

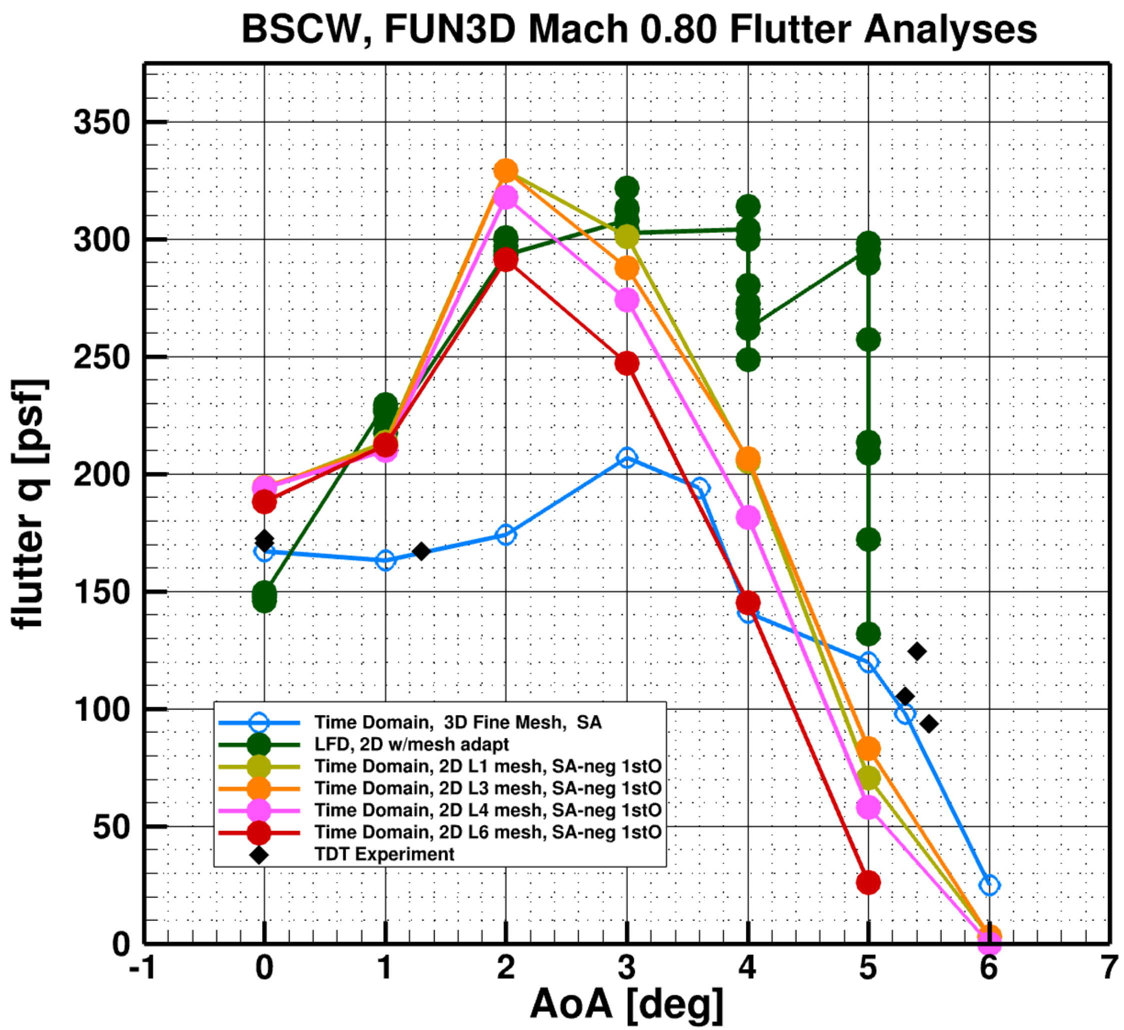
1. From the BSCW iges file (https://nescacademy.nasa.gov/workshops/AePW2/public/BSCW/analystsInfo), I have extracted airfoil profile at 60% wing-span station.

2. Using the airfoil profile above, I generated family of meshes using Heldenmesh. Heldenmesh allows for a one-cell depth mesh where y1= 0” and y2 = 32” are the symmetry planes.

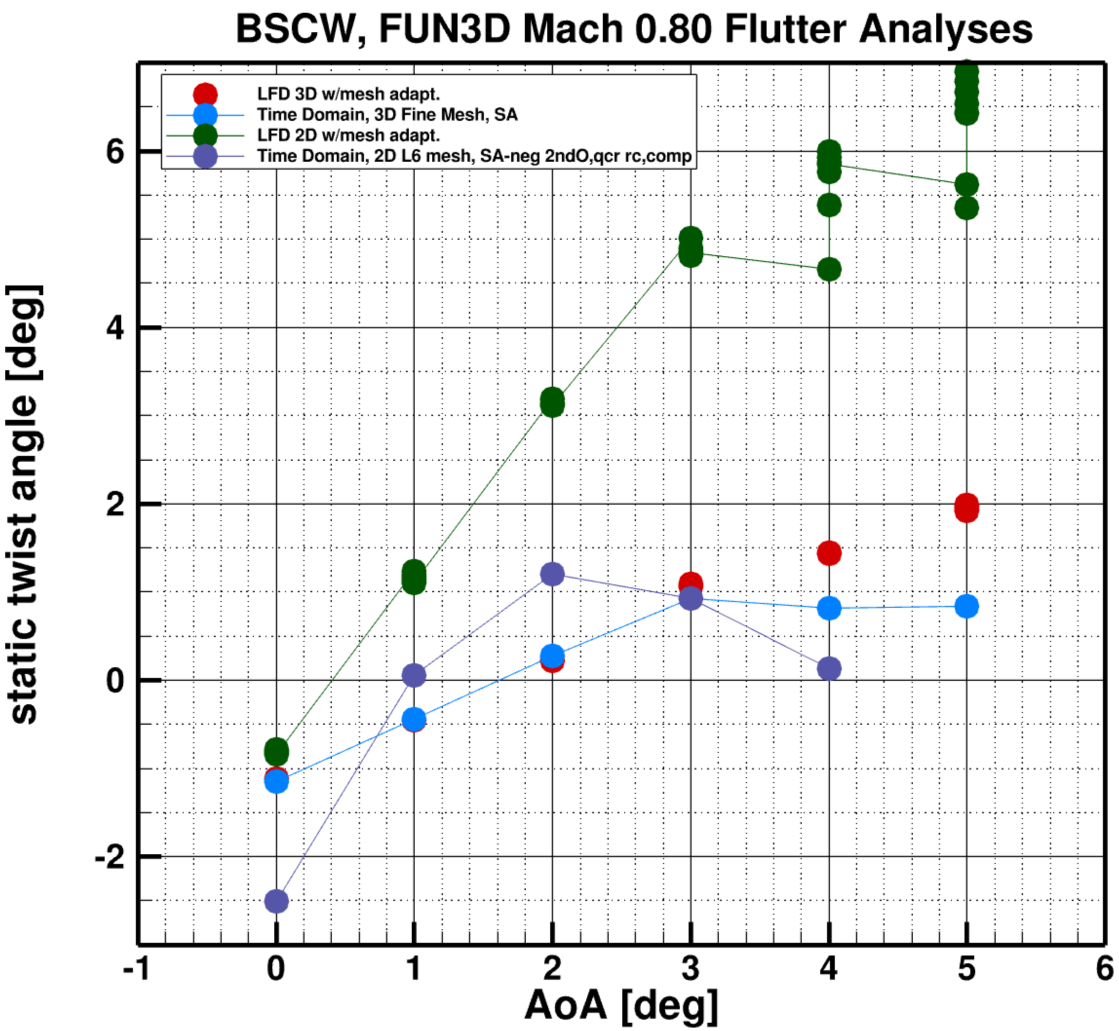
3. Family of six meshes was constructed based on the Drag Prediction Workshop meshing guidelines found on their website. However, I added two sources on the top and bottom surfaces to refine the mesh.

4. The link to these meshes in afrl stream .ugrid format is here https://nasa-ext.box.com/s/1py56597wunooq1tm58i74wfzj88ci4b There is a no requirement to use these meshes.

2D BSCW

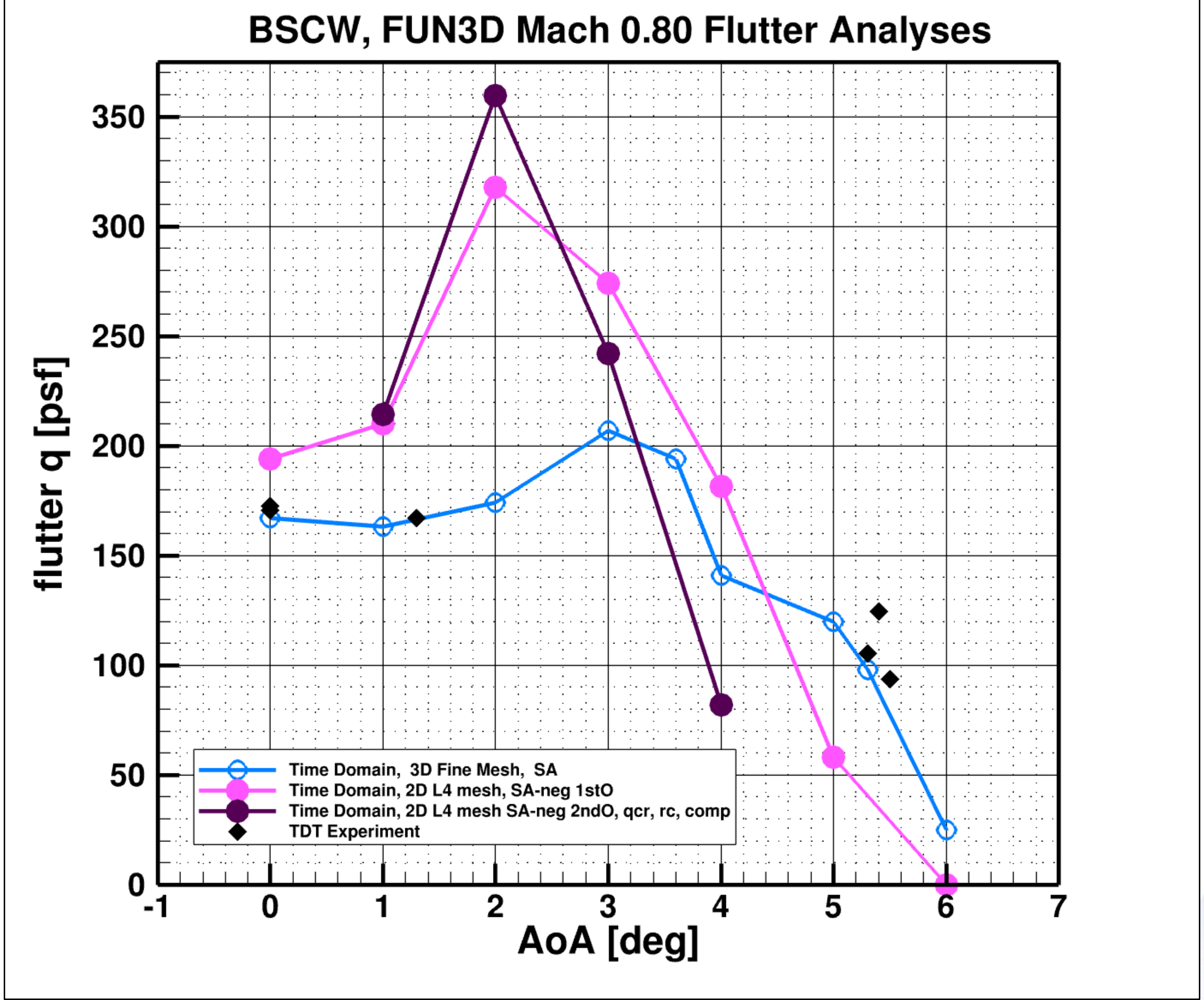


BSCW, FUN3D Mach 0.80 Flutter Analyses
flutter q [psf]
AoA [deg]
Time Domain, 3D Fine Mesh, SA
LFD, 2D w/mesh adapt
Time Domain, 2D L1 mesh, SA-neg 1stO
Time Domain, 2D L3 mesh, SA-neg 1stO
Time Domain, 2D L4 mesh, SA-neg 1stO
Time Domain, 2D L6 mesh, SA-neg 1stO
TDT Experiment



BSCW, FUN3D Mach 0.80 Flutter Analyses
static twist angle [deg]
AoA [deg]
LFD 3D w/mesh adapt.
Time Domain, 3D Fine Mesh, SA
LFD 2D w/mesh adapt.
Time Domain, 2D L6 mesh, SA-neg 2ndO,qcr rc,comp

2D BSCW


BSCW, FUN3D Mach 0.80 Flutter Analyses
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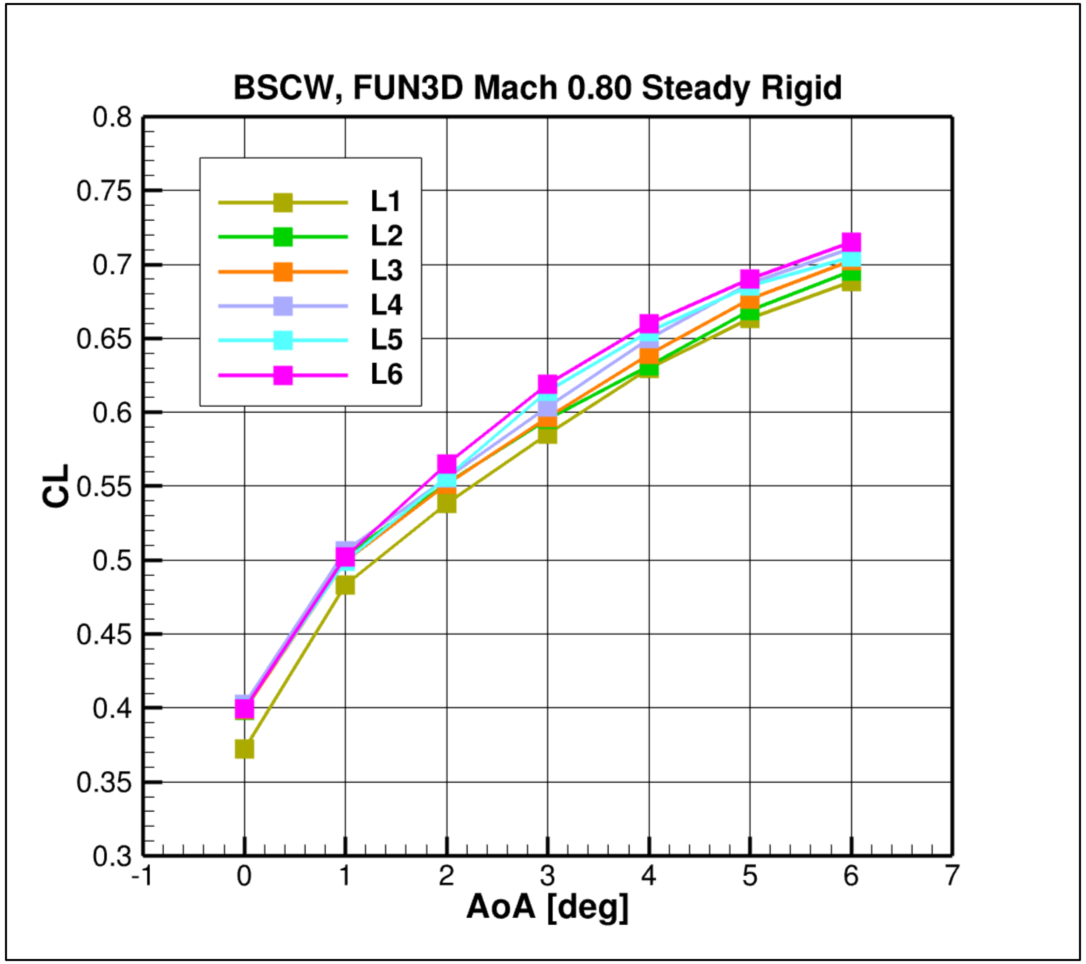
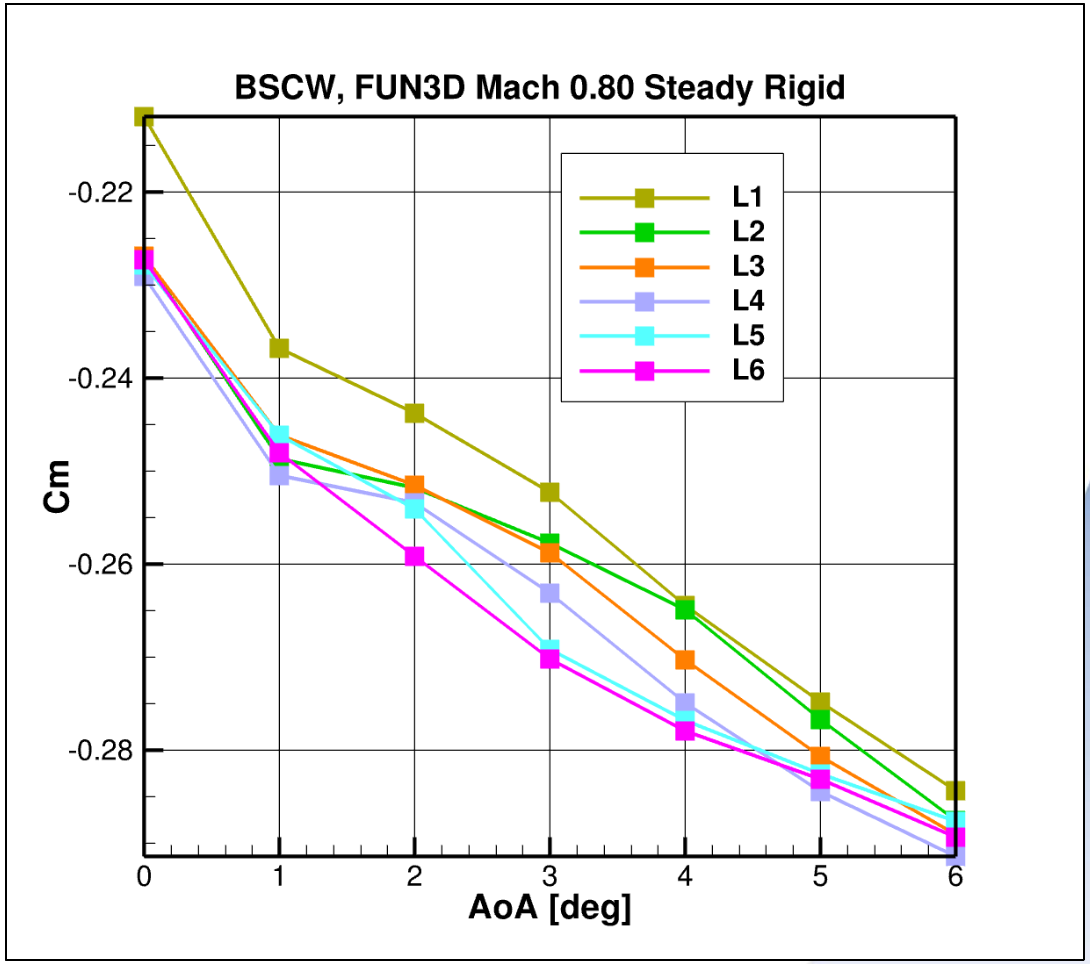
Time Domain, 3D Fine Mesh, SA
Time Domain, 2D L4 mesh, SA-neg 1stO
Time Domain, 2D L4 mesh SA-neg 2ndO, qcr, rc, comp
TDT Experiment

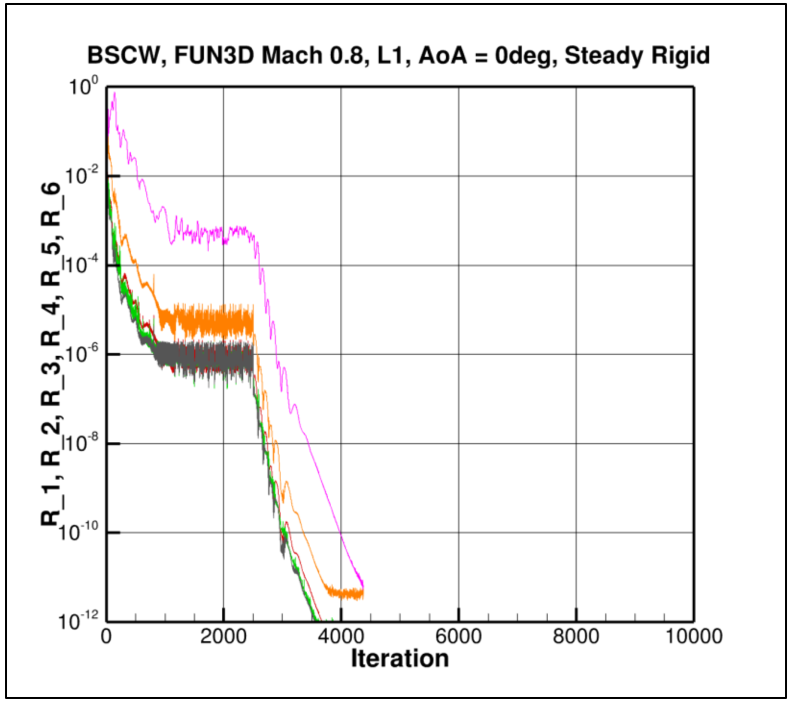
Aerodynamic Coefficients

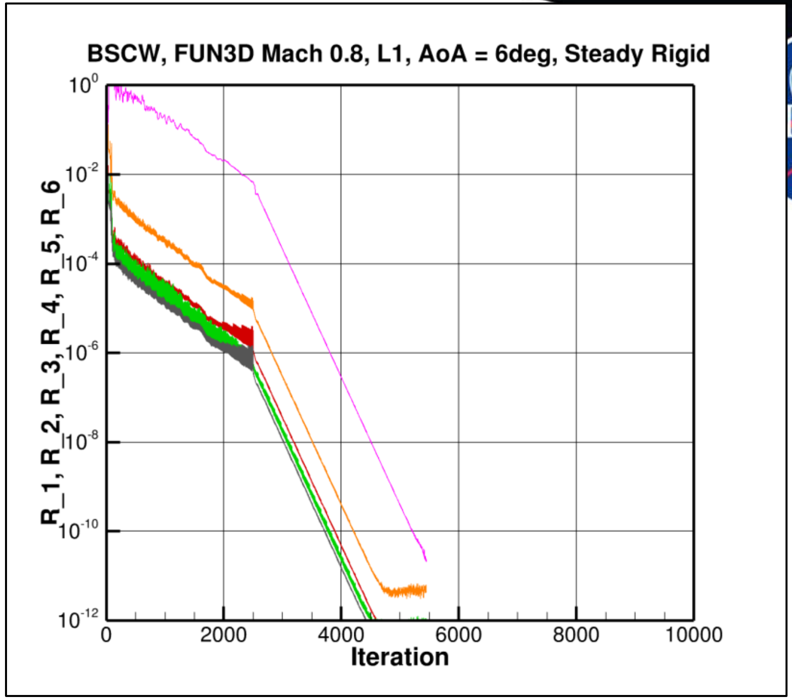




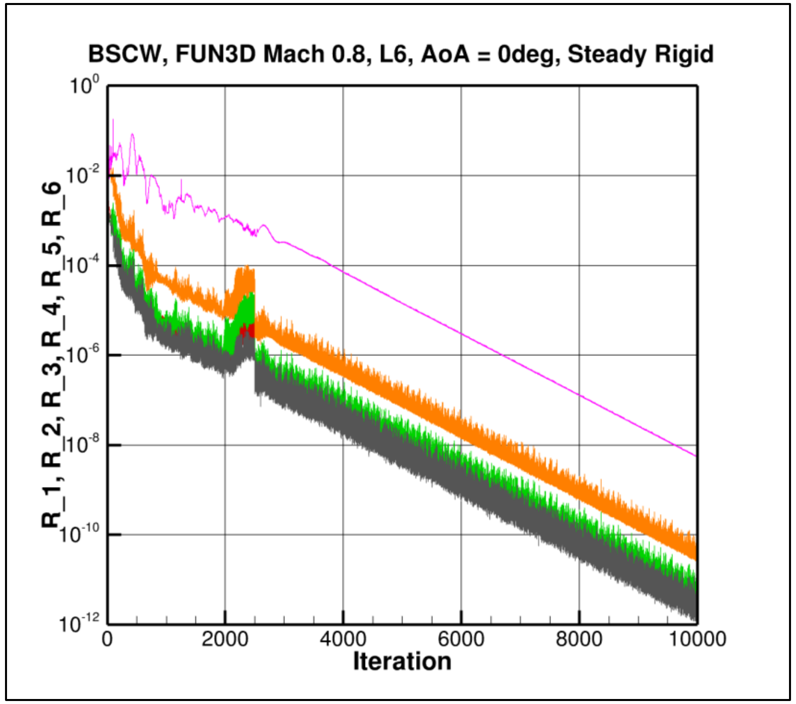
Convergence Plots
Steady rigid

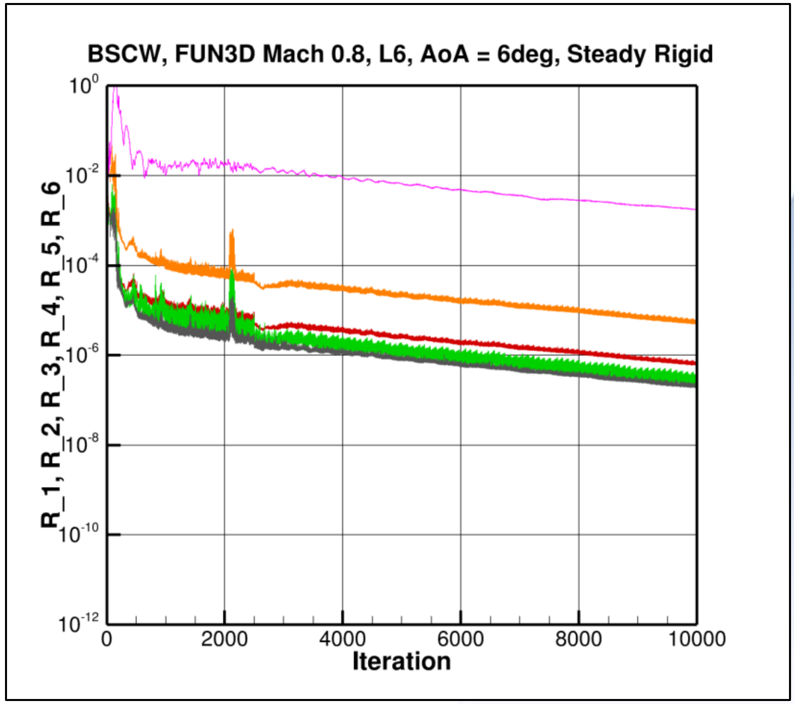
Mesh L1





Mesh L6





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April 10, 2025

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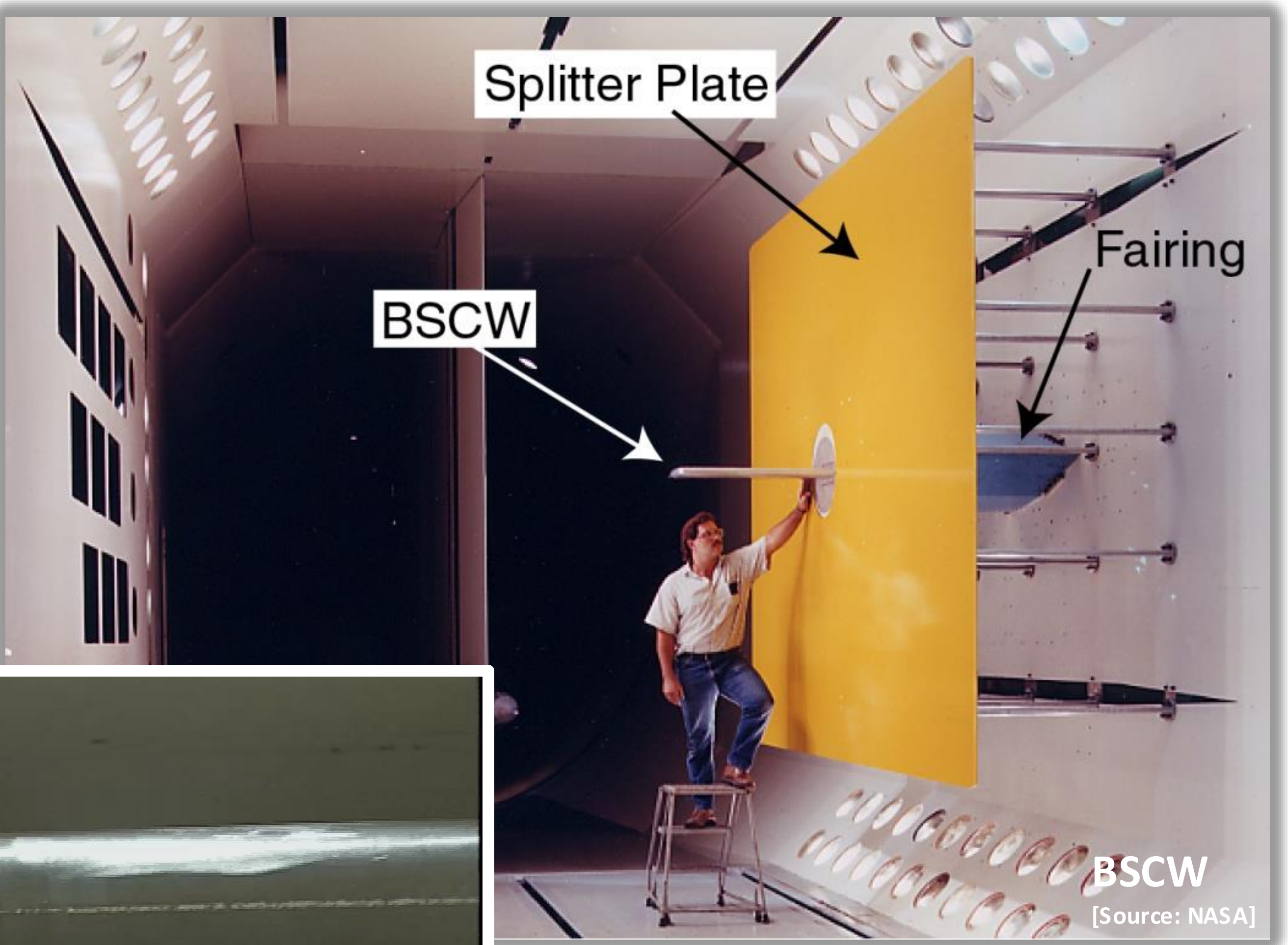
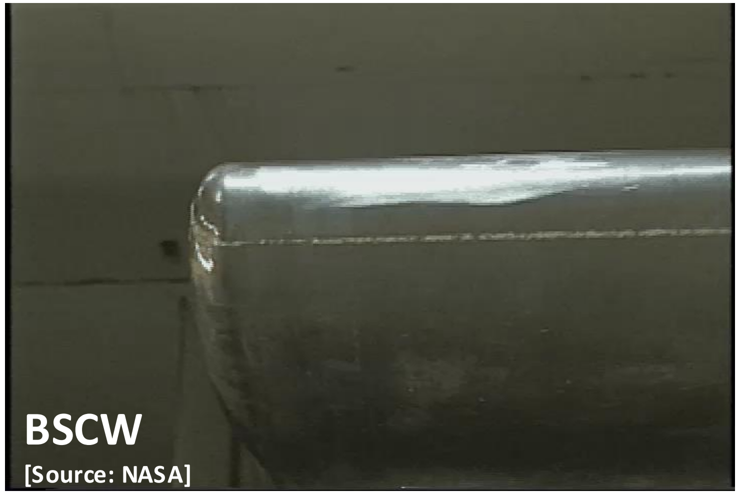
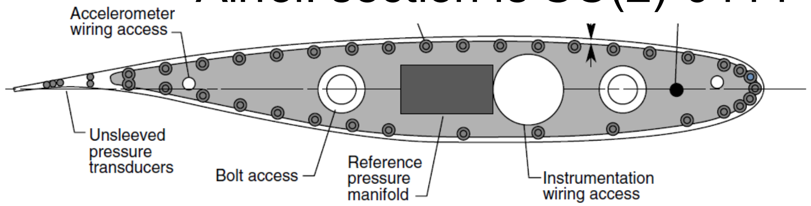
High-Angle WG: BSCW Wing Configuration

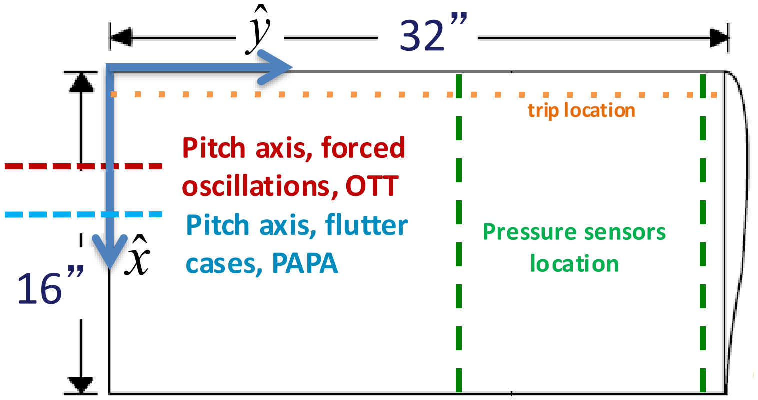




Airfoil section is SC(2)-0414



Cross-section at 60% span, showing the layout of the unsteady pressures.



Model planform. Dimensions are in inches.

Past Experimental Data

EXPERIMENTAL UNSTEADY PRESSURES AT FLUTTER ON THE SUPERCRITICAL WING BENCHMARK MODEL

AIAA-93-1592-CP

Bryan E. Dansberry, Michael H. Durham*, Robert M. Bennett**, José A. Rivera*, Walter A. Silva*, and Carol D. Wieseman*; Structural Dynamics Division, NASA Langley Research Center, Hampton, VA 23681-0001 and David L. Turnock*
Lockheed Engineering and Sciences Corporation

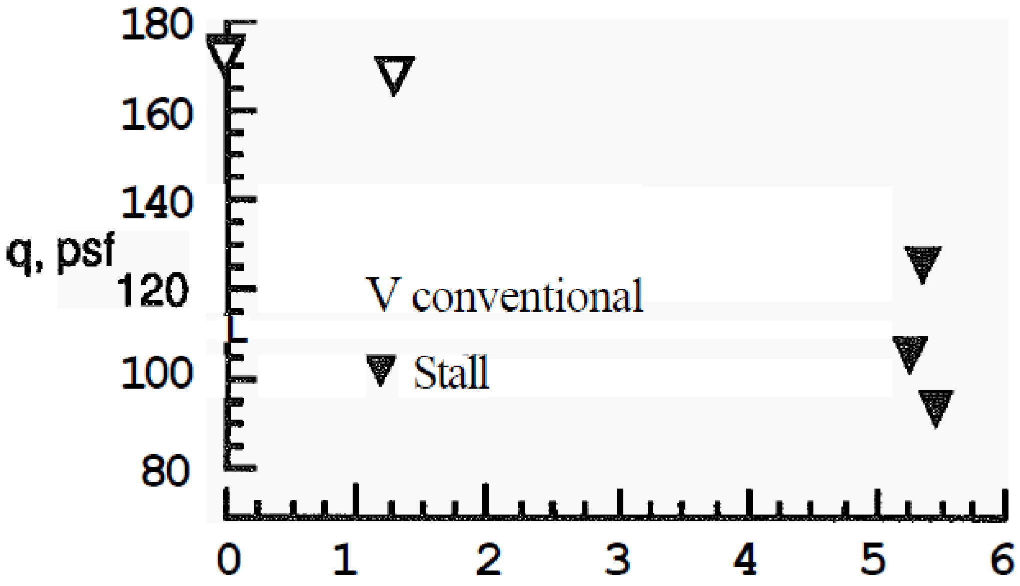


Figure 9. Stall flutter boundary in R-12 at M = 0.80.

BSCW Wing Configuration Past Workshop Conditions

- AePW-1:
  - Steady-rigid and forced-oscillation cases at Mach 0.85, AoA = 5° ✓
- AePW-2:
  - Forced-oscillation case at Mach 0.70, AoA = 3° ✓
  - Flutter prediction at Mach 0.74, AoA = 0° ✓
  - Unsteady-rigid, forced-oscillation, and flutter cases at Mach 0.85, 5° ✓ ✓ ✓
- AePW-3:
  - <u>Flutter prediction at Mach 0.80, AoA = 5°</u> ✓
  - Shock-buffet case at Mach 0.80, AoA = 5° ✓