DPW: Test Environments

- **Working Group High Level Goal:**
  – Increase understanding and quantify expectations for comparisons between free-air CFD and measured Wind Tunnel “truth”
  – Force/Moment balance and pressure tap measurements
- **Anticipated Timeline**
  – DPW-8
    - Phase 1: Tare and interference from Model mounting systems
      –NASA CRM (WBT, T at 0 degrees)
      –NASA CRM + Upper Sweep Strut & Sting
      –NASA CRM + Upper Sweep Strut & Sting + Arc Sector
  – DPW-8 +
    - Phase 2: Wind Tunnel Walls
      –NASA CRM
      –NASA CRM + Upper Sweep Strut & Sting
      –NASA CRM + Upper Sweep Strut & Sting + Arc Sector

Notes

1. For both phases, the configuration progression is:

- NASA CRM wing–body–tail (WBT), tail at 0 degrees
- CRM with upper sweep strut and sting
- CRM with upper sweep strut, sting, and arc sector

2. Configuration Decisions

Flow Conditions:

- Mach number fixed at 0.85
- Reynolds numbers: 5M (for now) and 20M (desired as an addon)
- Angles of attack: $-1.50°$, $0.00°$, $1.50°$, $2.50°$, $2.75°$, $3.00°$, $3.50°$, $4.00°$, $4.50°$degrees
- Wing deflection approximately 2.5 degrees (for AOA, 1.5 and 2.5 deg.), based on ETW deformation data

Notes

2. Configuration Decisions

Geometry:

- Wing–body geometry unchanged from DPW-7
- Tail geometry unchanged since DPW-4
- Tail inclusion: majority voted to include; simulations will be run with both tail on and tail off

Test Section:

- NTF configuration selected: 6 percent open (no data available at 2 percent and 4 percent open configurations)
- NTF data are not corrected for support-system interference, which is critical for CFD comparison context

Notes

3. Key Technical Issues Identified

Mounting System and Geometry Closure:

- Initial sting geometry had a blunt closure, raising concerns about RANS convergence
- Ben modified the geometry by closing off the back and smoothing the transition
  - It was discussed that wake closure impacts shock location, trailing-edge pressure recovery, and lift and pitching moment

Tripping and Transition:

- Uncertainty remains
- Trips used only at Re = 5M and below in NTF
- No trips applied to strut or sting
- Decision to avoid adding further complexity from trips at this stage

Notes

4. Solver and Modeling Strategy
- Baseline turbulence model: SA-QCR (used by approximately 80–90% of prior submissions)
- Other models and compressibility corrections acknowledged, particularly for URANS
- Strategy is to begin with a consistent baseline across participants, then allow solver variation later

5. CAD, Grids Status
Ben Rider:
- Producing CAD including CRM wing and body, tail on/off, sting, and wing deflection at 2.5 degrees AOA
- Generating multiple CAD versions for each wing deflection
- Ensuring smooth and convergent geometry closure

Notes

6. Agreed Initial Test Case

The first anchor case for all participants is:
- Mach 0.85
- Reynolds number 5 million
- Angle of attack 3 degrees
- Tail off
- Wing bending corresponding to 2.5 degrees

Follow-on cases include:
- Angle-of-attack sweep
- Tail-on configurations
- Higher Reynolds number cases

The 2.5-degree wing-deformed geometry should be reused for the 1.50 degree AOA case.

The jig wing (undeformed) geometry should be used for the 0.00 & -1.50 degree AOA cases.

Notes

7. Current Status:

- Geometry closure strategy implemented
- Initial CAD and grid alignment issues resolved
- Jeff Houseman (NASA, LAVA team) completed the first set of AOA sweep runs, steady-state RANS analysis using SA-neg
    - WingBodySting
    - WingBodyTail
    - WingBodyTailSting
    - Computed integrated loads deltas with and without sting
        - Addition of sting results in decreased lift caused by a shift in the shock location
        - Reduction in lift induced drag as well as static stability is also observed
        - Detailed charts will be released in near future

Discussed next steps 2/5/2026

8. Discussion Points:

Wing deformation incorporation:
- In Jeff's optimization workflow, wing morphing leads to an elongated wingspan. Ben will confirm the twist-axis location and investigate whether simplifications in deformation measurement techniques are contributing

Turbulence modeling sensitivity:
- Evaluation of SA-RC as an alternative turbulence model to assess rotation and curvature correction effects

Drag component breakdown:
- Examination of profile drag increase versus induced drag decrease due to test support elements

Mesh resolution study:
- Consideration of a dedicated mesh resolution study to quantify grid sensitivity