

A Plan for a Common Research Model Buffet Investigation

Brent Pomeroy

Configuration Aerodynamics Branch

NASA Langley Research Center
Hampton, VA

NASA/CREATE-AV Technical Interchange Meeting

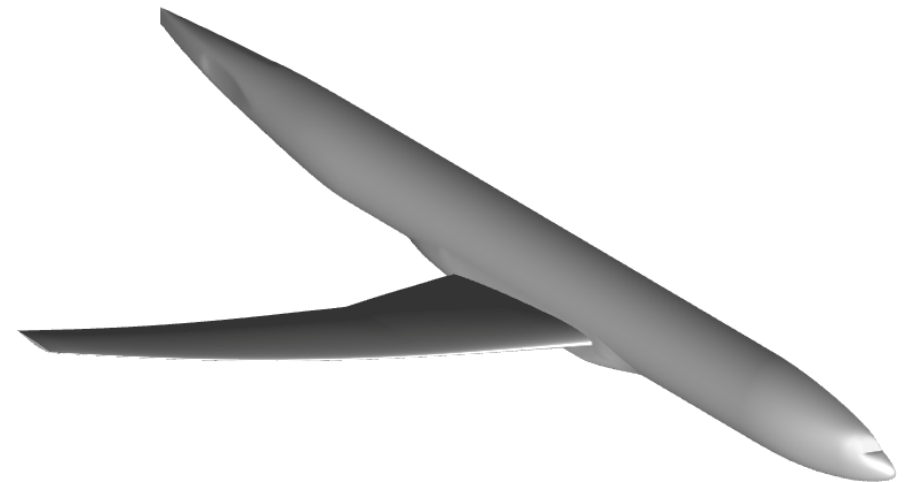
May 21-22, 2024

NASA Langley Research Center | Hampton, VA



History: DPW-7 (1/2)

- Held in 2022 at AIAA AVIATION
- Contributions from 18 organizations totaling 34 data sets
- **Focused upon edge-of-the-envelope conditions**
 - Cruise Mach number (0.85)
 - Pitchup prediction
 - Buffet onset
 - Shock-induced separation
- **Committee-generated grids were supplied with a known aeroelastic shape**



History: DPW-7 (2/2)

- 2022 workshop focused upon high-alpha range and into buffet
- Consistent results seen in linear range and into pitchup ($C_L \sim 0.61$)
- Significant spread in solvers post pitchup (all submissions plotted)

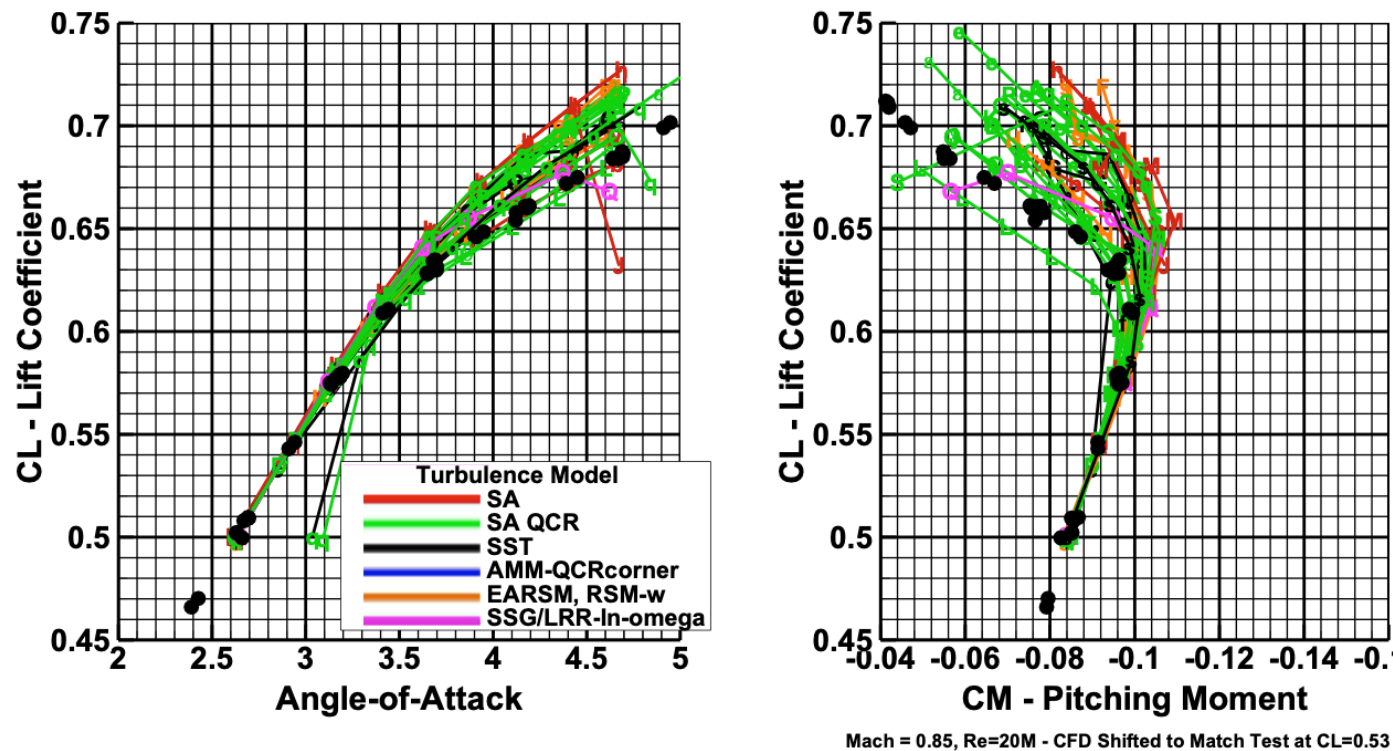
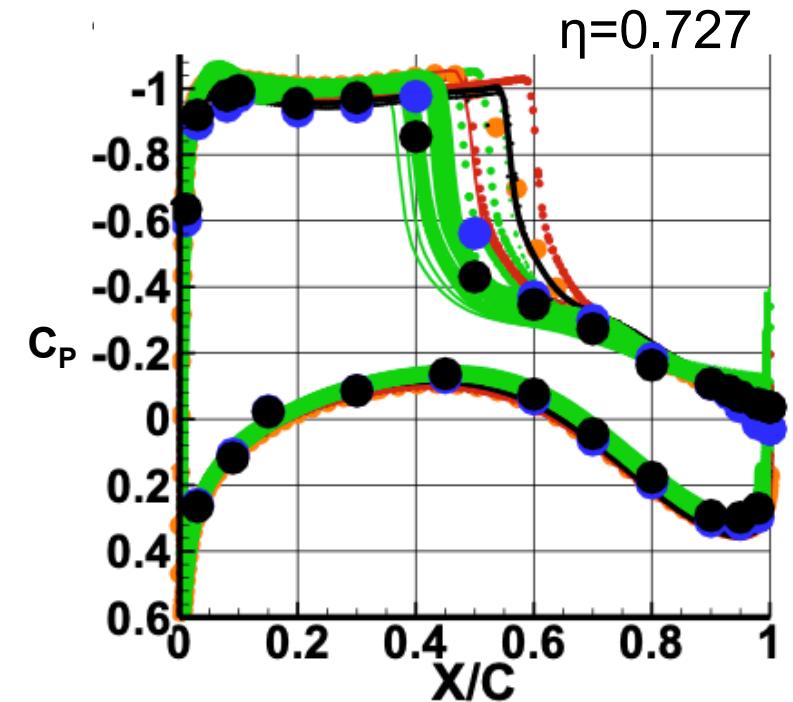


Image source:
Tinoco, E., et al., "Summary Data from the Seventh AIAA CFD Drag Prediction Workshop," AIAA 2023-3492

Lessons Learned and Identified Weaknesses



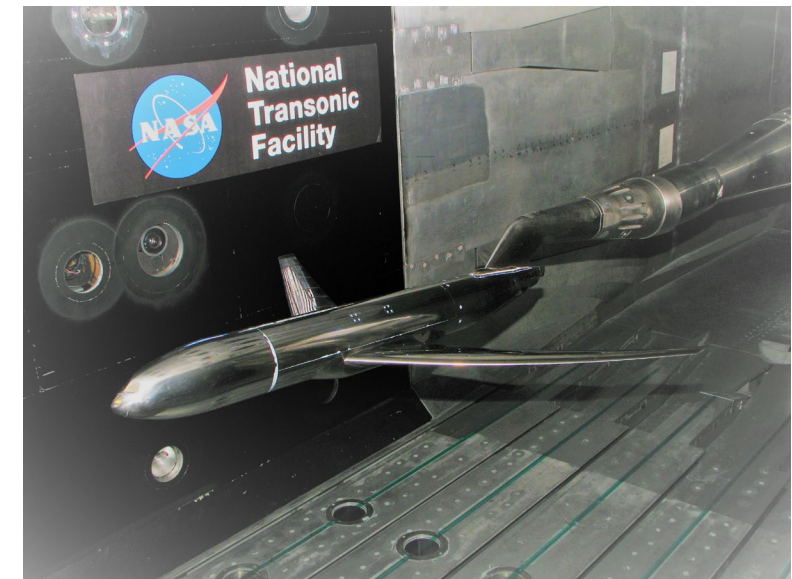
- **Potential sources of C_L/C_M spread have been hypothesized**
 - Significant differences in SA vs k-w models
 - Can RANS adequately capture early pitchup?
 - Grid resolution can affect shock location
- **Unresolved challenges for scale-resolving analysis**
 - Comparisons are limited to CFD-to-CFD solver
 - DES/LES grid requirements are different than RANS
 - Field is inconclusive regarding best practices for buffet investigation



Pressure cuts plotted for all submissions

Image source:
Tinoco, E., et al., "Summary Data from the Seventh AIAA CFD Drag Prediction Workshop," AIAA 2023-3492

- **Unique multidisciplinary workshop between DPW and AePW**
 - Centered on spread in DPW-7 results, static deformation, buffet, and test environments
 - Significant participant interest (~50%) in buffet group
 - Simulations will involve RANS, unsteady scheme, static geometry, and FSI
- **Identified lack of high-quality unsteady transonic experimental data**
 - Leverage recent JAXA data ($Re=1.5M$, lower than previous NASA tests at 5, 20, and 30M)
 - No high-quality coupled deformation and unsteady pressure data
 - No chordwise deflection measurements (infinitely stiff airfoil assumed)
 - No facility-to-facility comparisons
- **Can RANS or URANS resolve pitchup, or is a DES/LES scheme necessary?**



Source: NASA

NASA ARC 11-Foot Transonic Wind Tunnel Test



- **Coupled CFD buffet and technology demonstrator test**
 - Two weeks at NASA ARC 11-Foot Transonic Wind Tunnel
 - CFD community desires high-quality unsteady data
 - Experimentalists seek uPSP demonstration on transonic aircraft
- **Simultaneous surface pressure and aeroelastic deformation measurements**
- **Blind comparisons for DPW-8/AePW-4**
 - Time series C_p data can be compared at multiple spanwise locations
 - Integrated F&M will be compared against RANS simulations

Questions?

