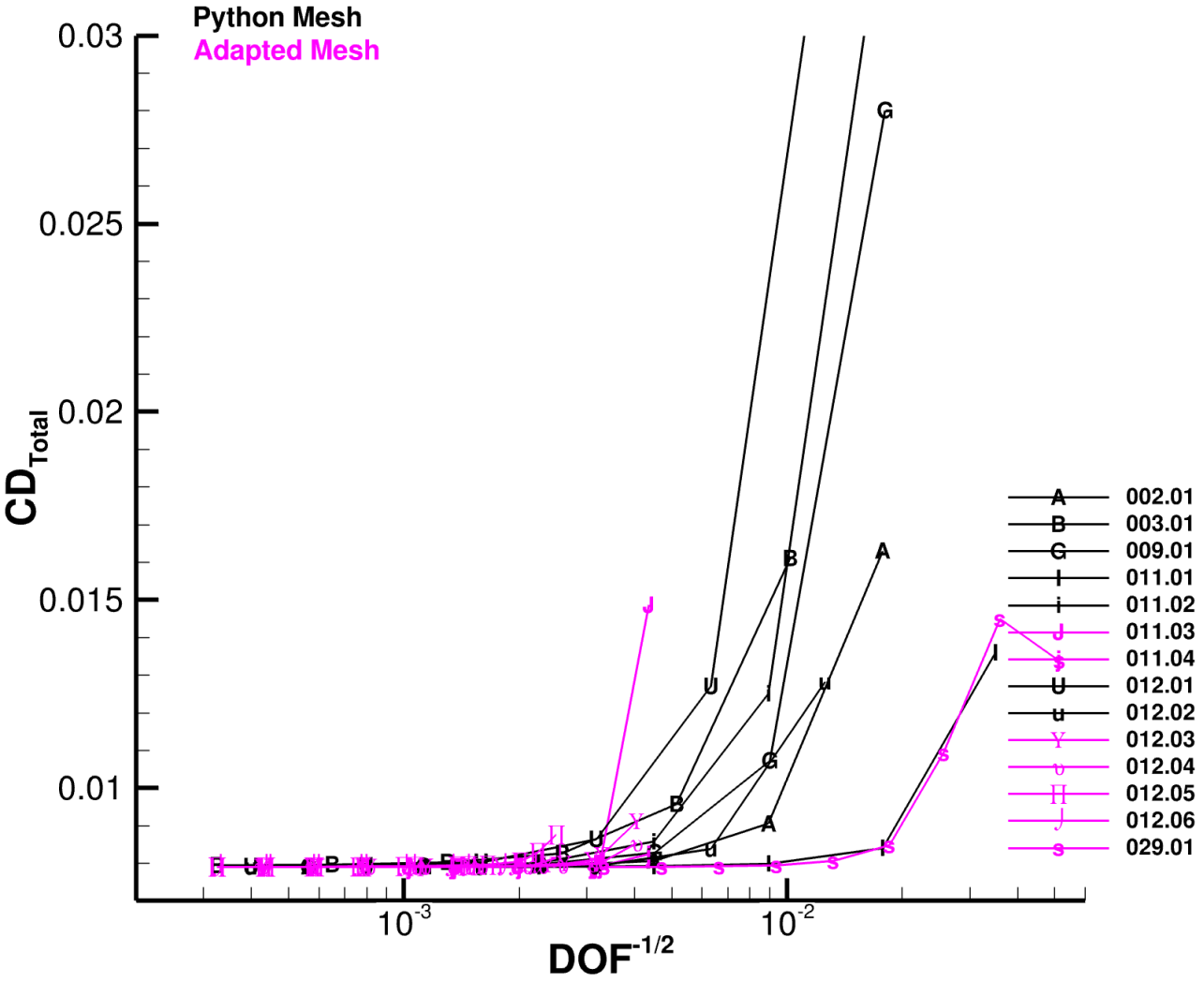
Scatter Working Group

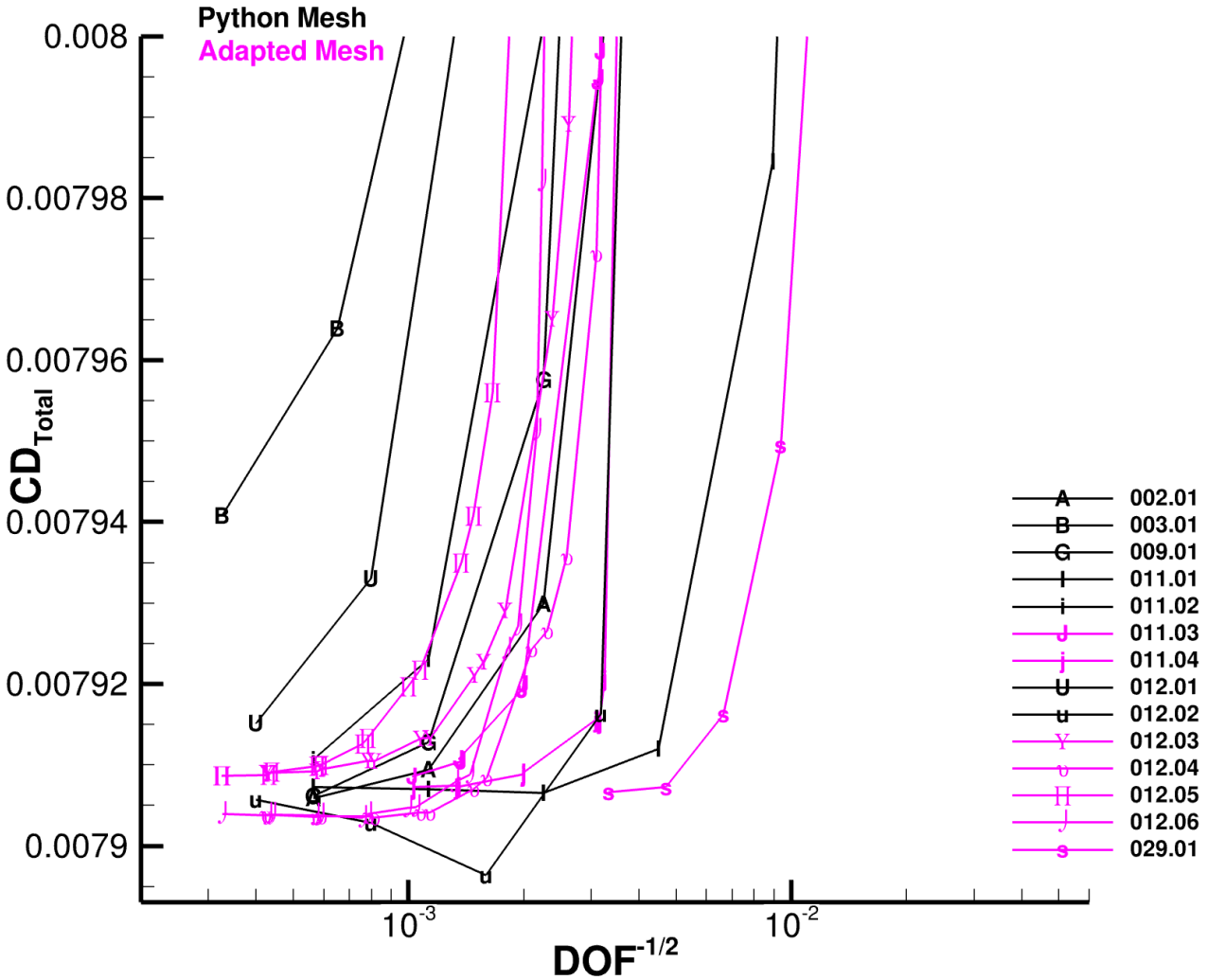
Joukowski and Test Case 1c Update

Version 3
April 22, 2025

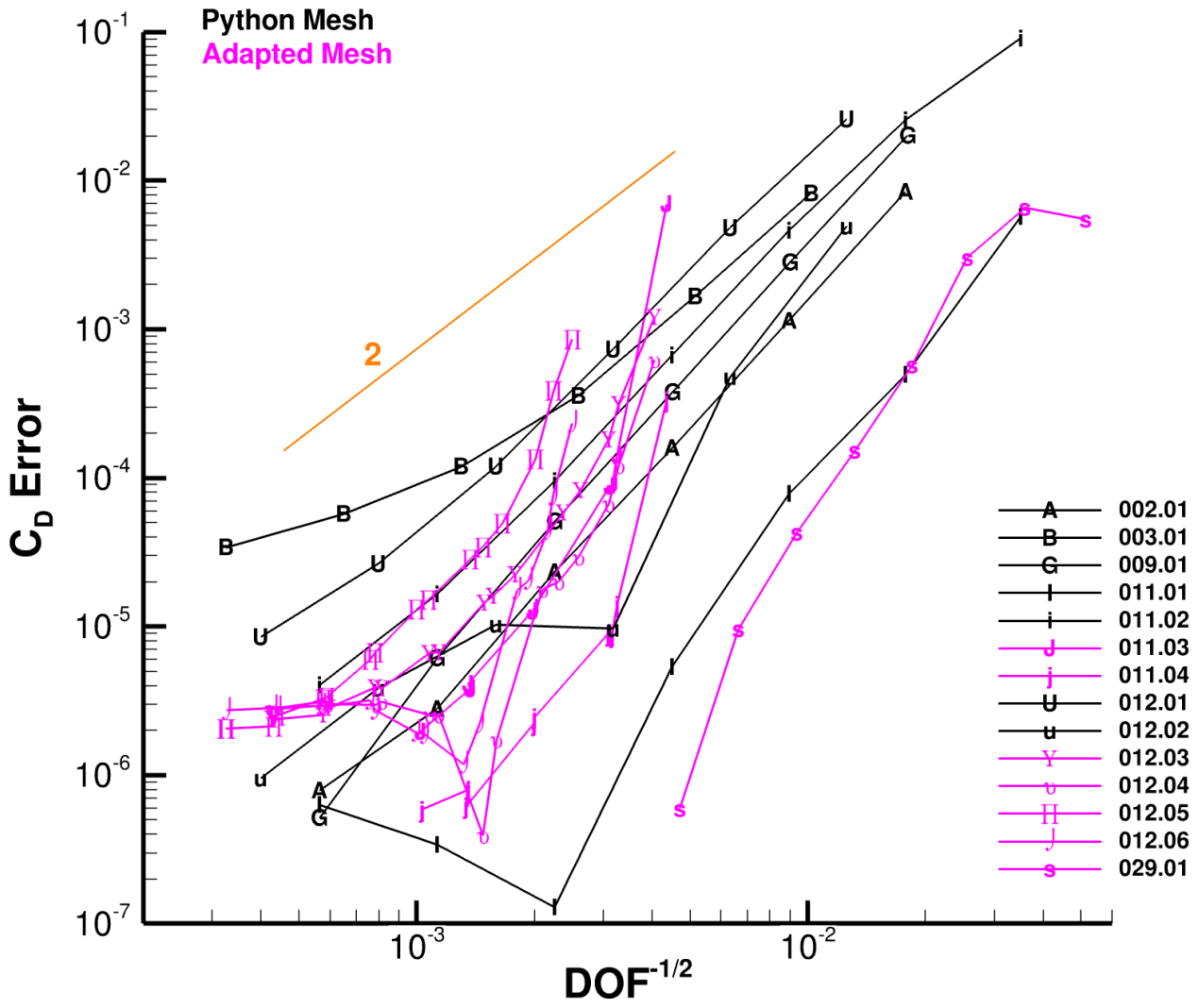
dpwaiaa@gmail.com

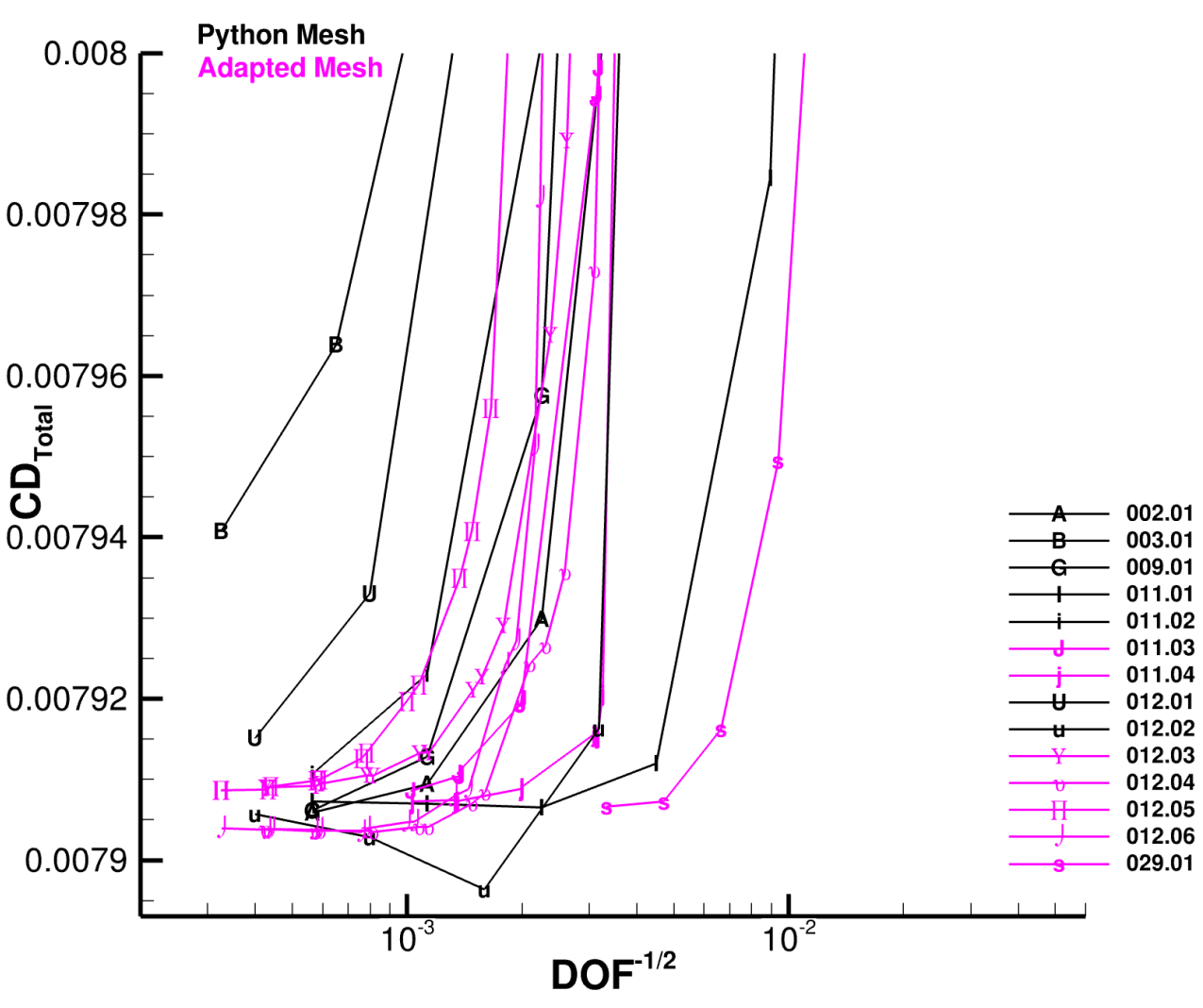
Joukowski Drag Convergence



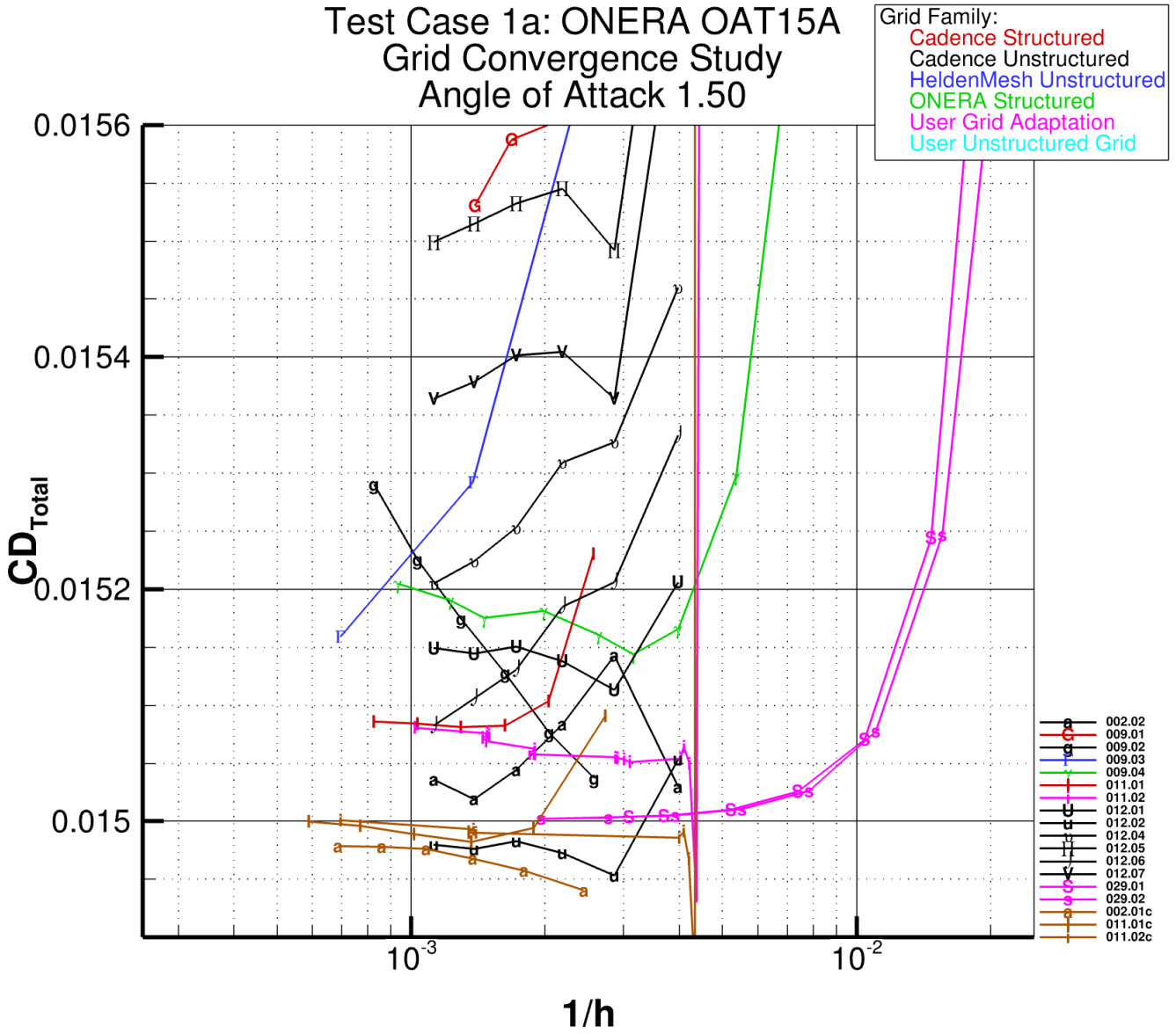


Joukowski Drag Error Convergence





OAT15A From Same Participants



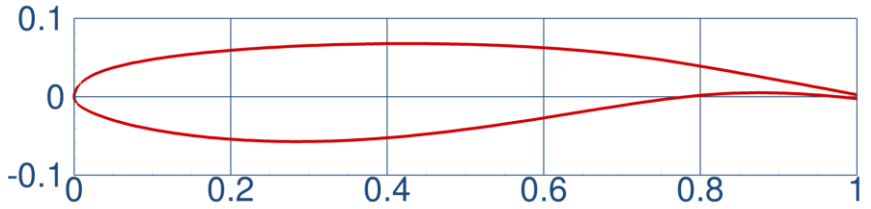
Test Case 1: ONERA OAT15A Geometry & Data

- **Geometry is available here: (it is very strongly desired to use the provided IGES file in the ONERA OAT15A zip file and not the raw coordinates)**
  https://aiaa-dpw.larc.nasa.gov/geometry.html
- **Committee-supplied RANS grids are available here**
  https://aiaa-dpw.larc.nasa.gov/grids.html
- **Experimental data are available here**
  https://aiaa-dpw.larc.nasa.gov/experiment.html

Test Case 1a: Workshop-Wide Validation

- **Validation of steady CFD analysis, required**
- **Users are encouraged to employ best practices**
- **Settings**
  - Steady CFD (e.g., RANS)
  - Prefer some version of SA, multiple turbulence models can be submitted
  - Use periodic boundary conditions for sidewall boundary conditions
- **Grids**
  - Six-member grid family; four are required, six are desirable
  - Encourage use of committee-supplied grids; user-generated grids are acceptable
  - Three committee-supplied once-cell-wide grid topologies are provided
- **Conditions**
  - Mach 0.73, Re_c=3m (based on chord length), T_{static}= 271 K (487.8 R)
  - Alpha: 1.36, 1.50, 2.50, 3.00, 3.10
  - Experimental conditions (for reference): P_{total}=102.4 kPa; P_{static}=71.8 kPa

Jaquin, et al. "Experimental Study of Shock Oscillation over a Transonic Supercritical Profiles." AIAA Journal, Vol. 47, No. 9, 2009. Pages 1985-1994.

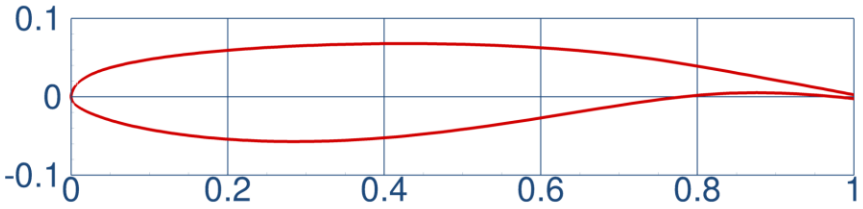


ONERA OAT15A Transonic Airfoil

Test Case 1c: Workshop-Wide Verification

- **Verification of steady CFD analysis, required**
- **Settings**
  - Steady CFD RANS **French Vanilla SA-[neg] (All terms!)**
    - Adiabatic Wall (not isothermal)
    - Characteristic Farfield
    - Use periodic boundary conditions for sidewall boundary conditions
  - Converge residuals to machine precision (~1e-10)

Jaquin, et al. "Experimental Study of Shock Oscillation over a Transonic Supercritical Profiles." AIAA Journal, Vol. 47, No. 9, 2009. Pages 1985-1994.



ONERA OAT15A Transonic Airfoil

- **New grids for case 1c with 1000c far field**
  - Six-member grid family; four are required, six are desirable
  - Encourage use of committee-supplied grids; user-generated grids are acceptable
- **Conditions**

Mach	Re_c	T_{static}	α	γ	Pr	Pr_t	Farfield $\chi = \tilde{\nu}/\nu$
0.73	3×10^6	271 K (487.8 R)	1.5°	1.4	0.72	0.9	3

- **Sutherland's Law**

$$\mu(T) = \mu_0 \left(\frac{T}{T_0}\right)^{3/2} \left(\frac{T_0 + S}{T + S}\right)$$

$\mu_0 = 1.716 \times 10^{-5} \frac{\text{kg}}{m\ s}$

$T_0 = 491.6°\ R$

$S = 198.6°\ R$

$$\frac{\mu(T)}{\mu_{ref}} = \left(\frac{T}{T_{ref}}\right)^{3/2} \left(\frac{1 + S/T_{fef}}{T/T_{fef} + S/T_{fef}}\right) \quad T_{ref} = 487.8°\ R$$

Test Case 1: Data Submission

- **Please follow these instructions**
  https://aiaa-dpw.larc.nasa.gov/postprocessing.html
- **Required data**
  - Forces and Moments
    `DPW8-AePW4_ForceMomentAveraged_v1.dat`
  - Surface cuts
    `DPW8-AePW4_SectionalCutsAveraged_v1.dat`
  - Convergence data (in work)
    `DPW8-AePW4_Convergence_v1.dat`
- **Optional data set supplement**
  - Boundary layer profile data (in work)
    `DPW8-AePW4_BoundaryLayerAveraged_v1.dat`

dpwaiaa@gmail.com