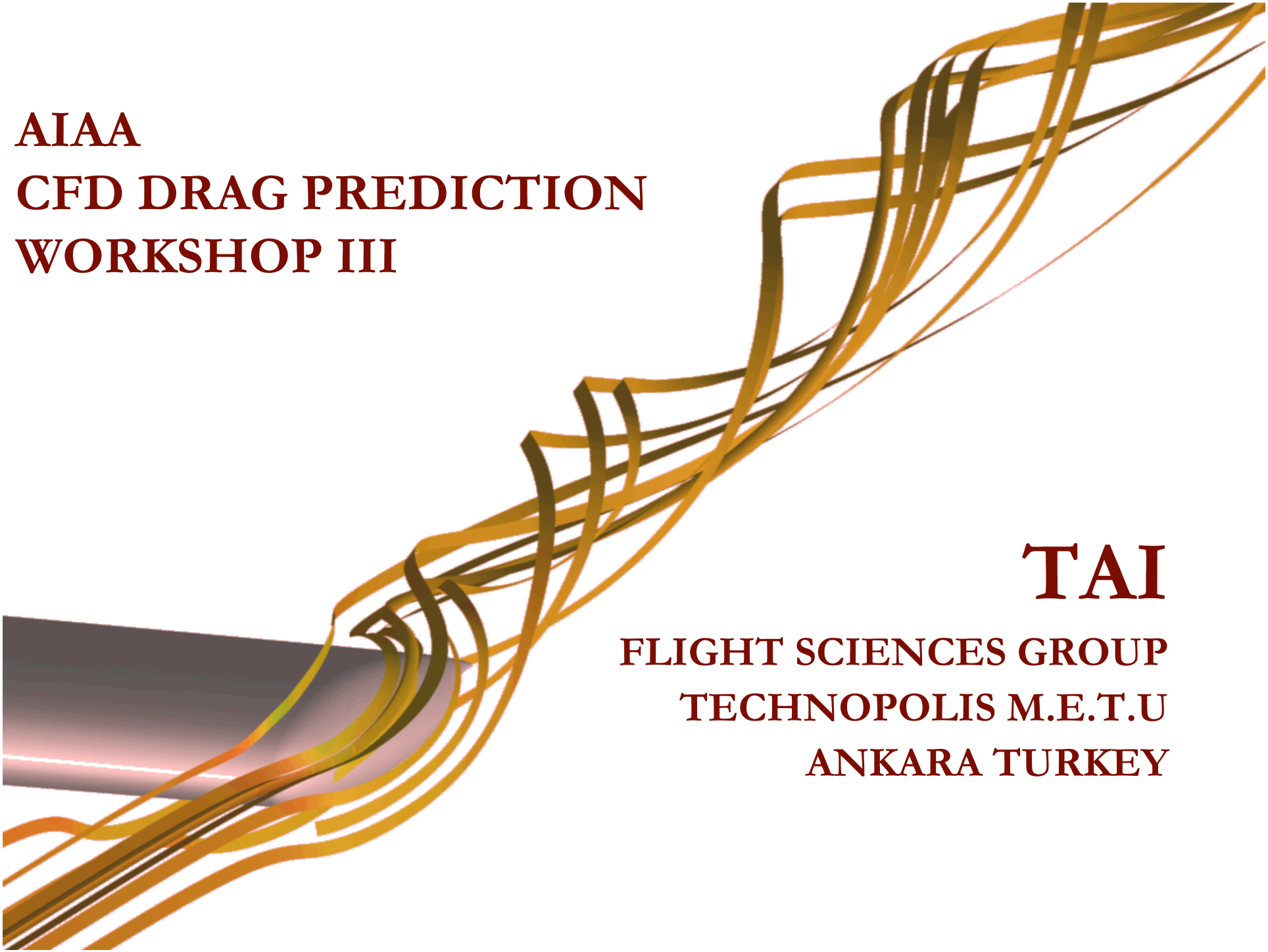
AIAA
CFD DRAG PREDICTION
WORKSHOP III



TAI

FLIGHT SCIENCES GROUP

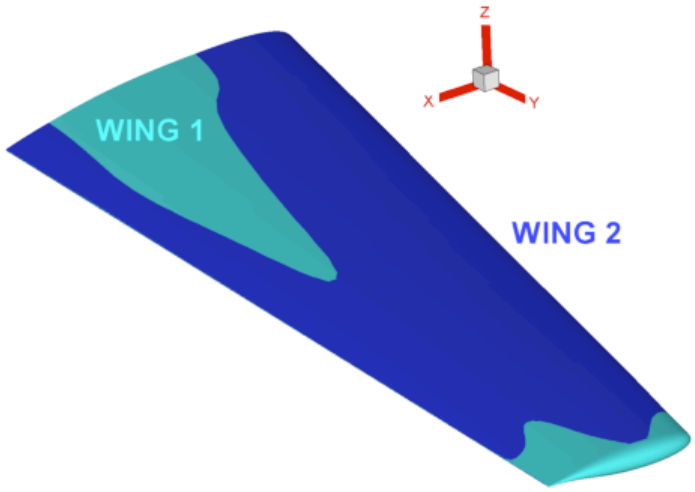
TECHNOPOLIS M.E.T.U

ANKARA TURKEY

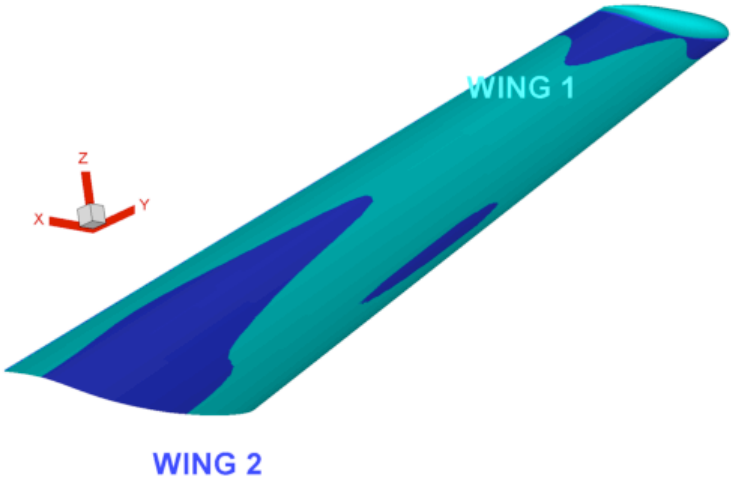
DPW-WING 1 AND WING 2 (TEST CASES)

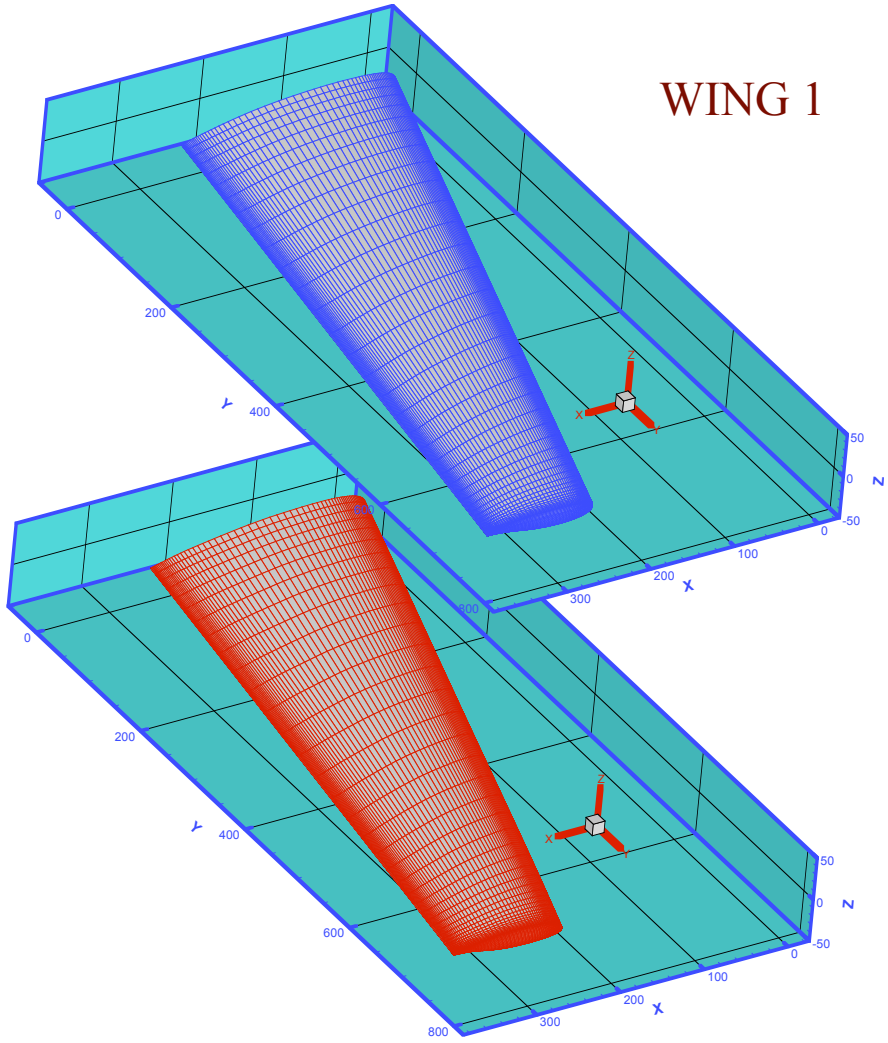
- Configuration : Wing alone comparisons
- DPW-Wing1 (baseline) and DPW-Wing2 (simple optimization)
- For all cases, Reynolds No. = 5x106 (Based on cref = 197.556 mm), free-stream Temperature 580R (322.22 Kelvin)
- Drag polar at Mach=0.76, alpha=-1, 0, 0.5, 1, 1.5, 2, 2.5, 3 (medium grid)
- Reference Geometry:
  Sref = 290322 mm2 = 450 in2
  cref = 197.556 mm = 7.778 in b = 1524 mm = 60 in
  AR = 8.0
  Mom. Center = (154.245,0.0,0.0) Relative to wing root l.e.

DPW-WING 1 AND WING 2 (GEOMETRIES)

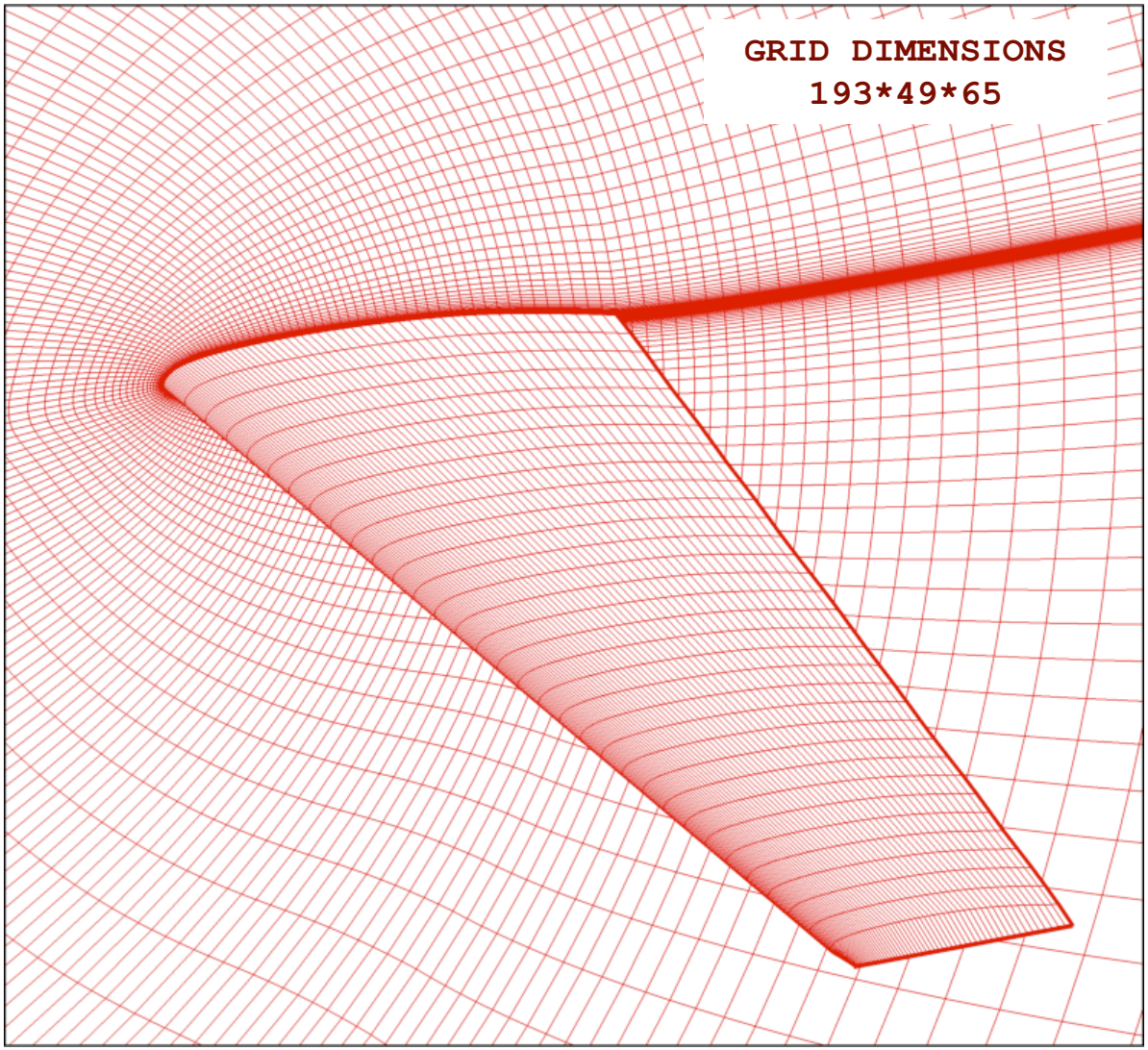


GEOMETRICAL COMPARISON OF WING 1 AND WING 2





W1&W2 MESH



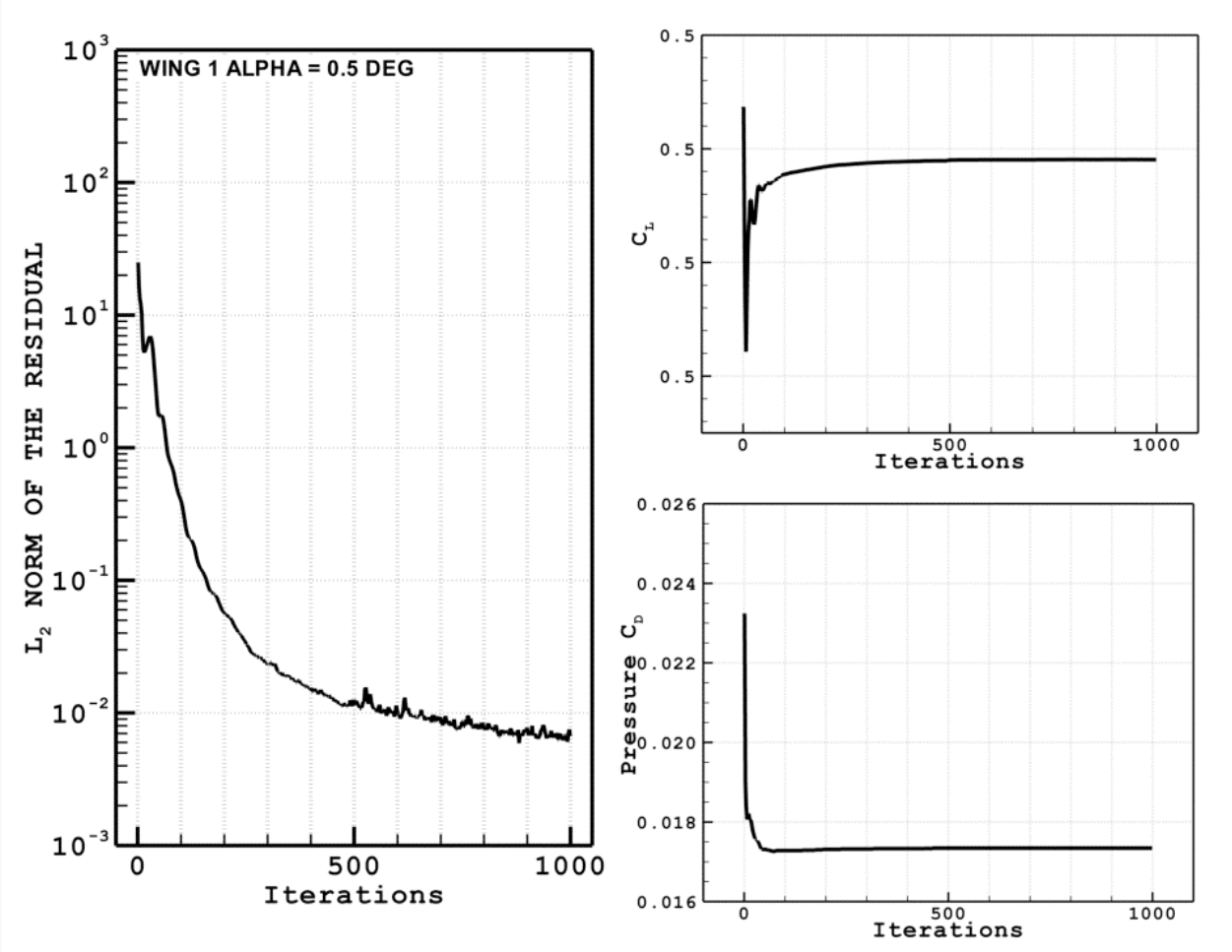
THE FLOW SOLVER : XFLOW

- Structured Finite Volume, explicit formulation
- Euler/NS (Algebraic Turbulence model : Baldwin-Lomax)
- Upwind-biased, central differencing

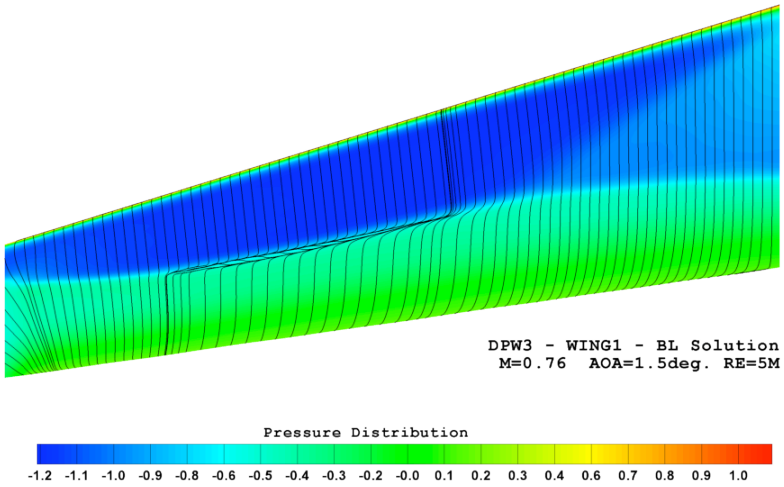
CONVERGENCE HISTORY

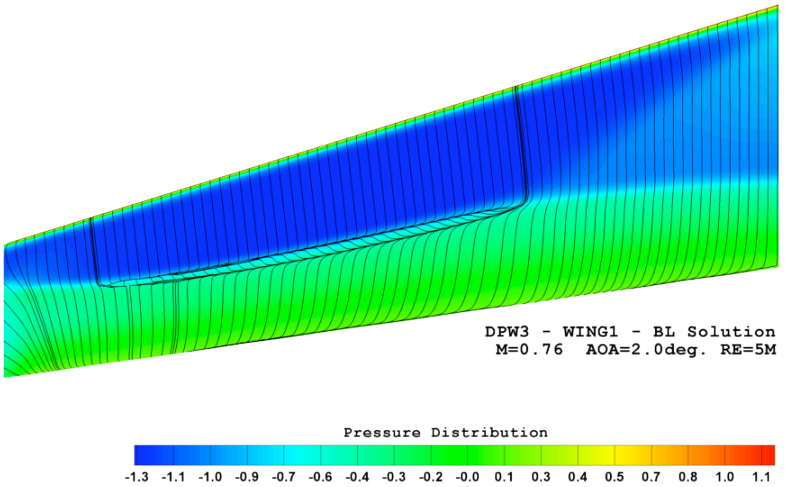
CFL = 5.0

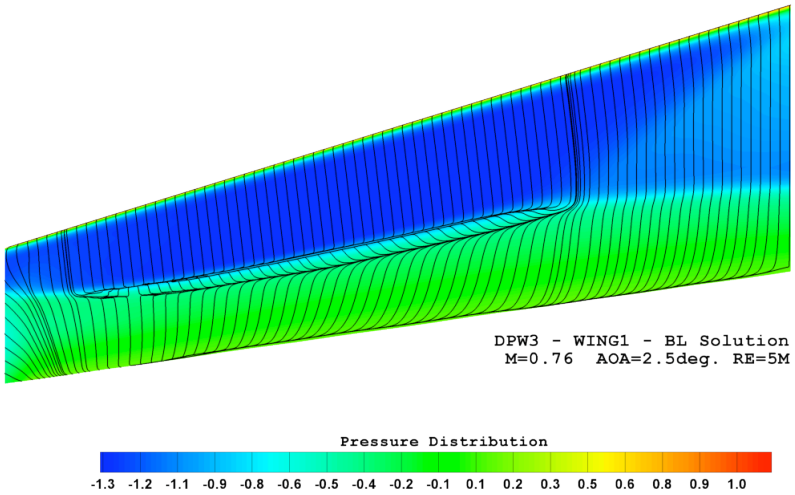
CPUTIME ~4 HOURS

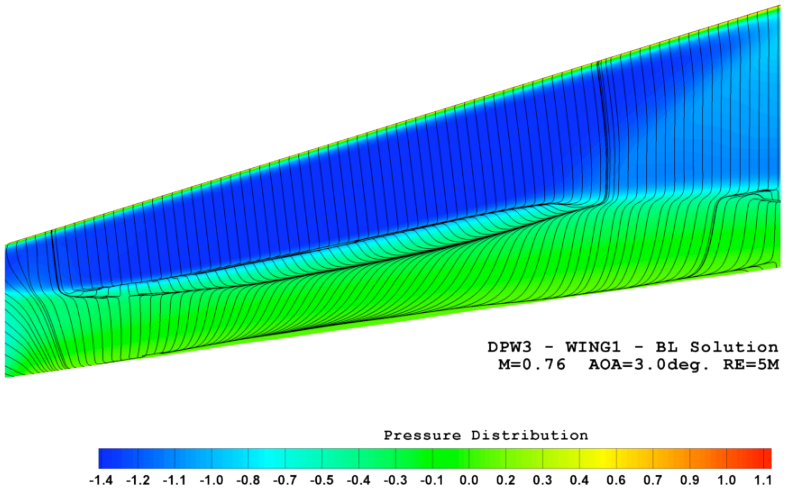


WING 1 SURFACE PRESSURE AND OILFLOW PATTERNS

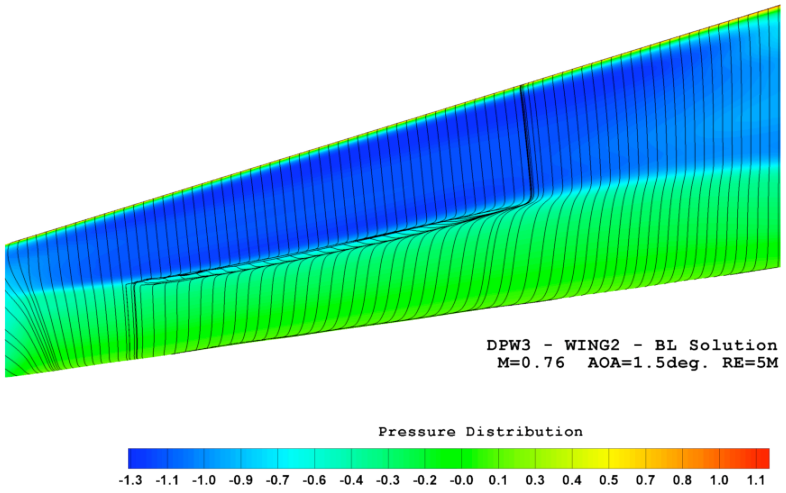


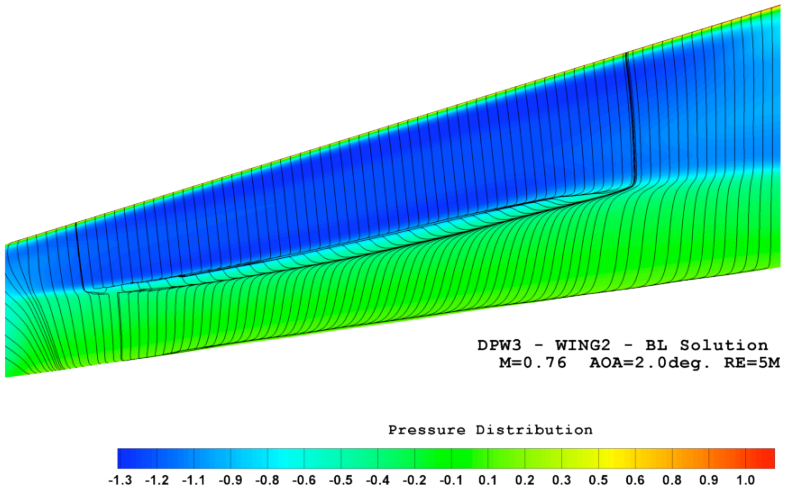


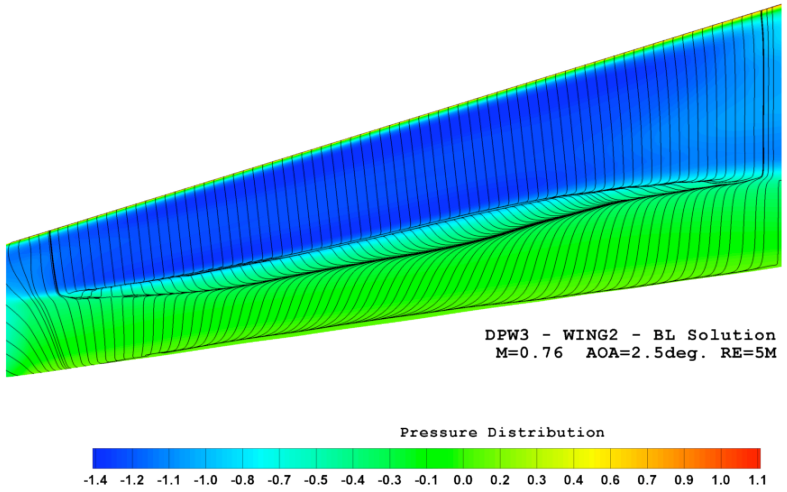


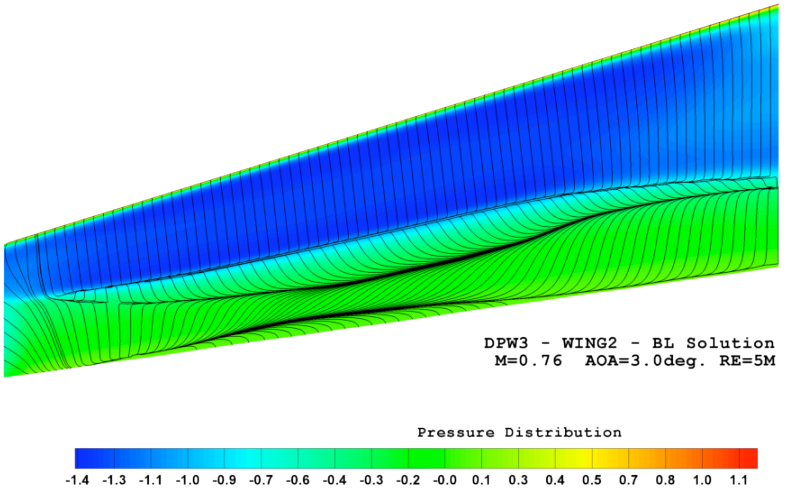


WING 2 SURFACE PRESSURE AND OILFLOW PATTERNS

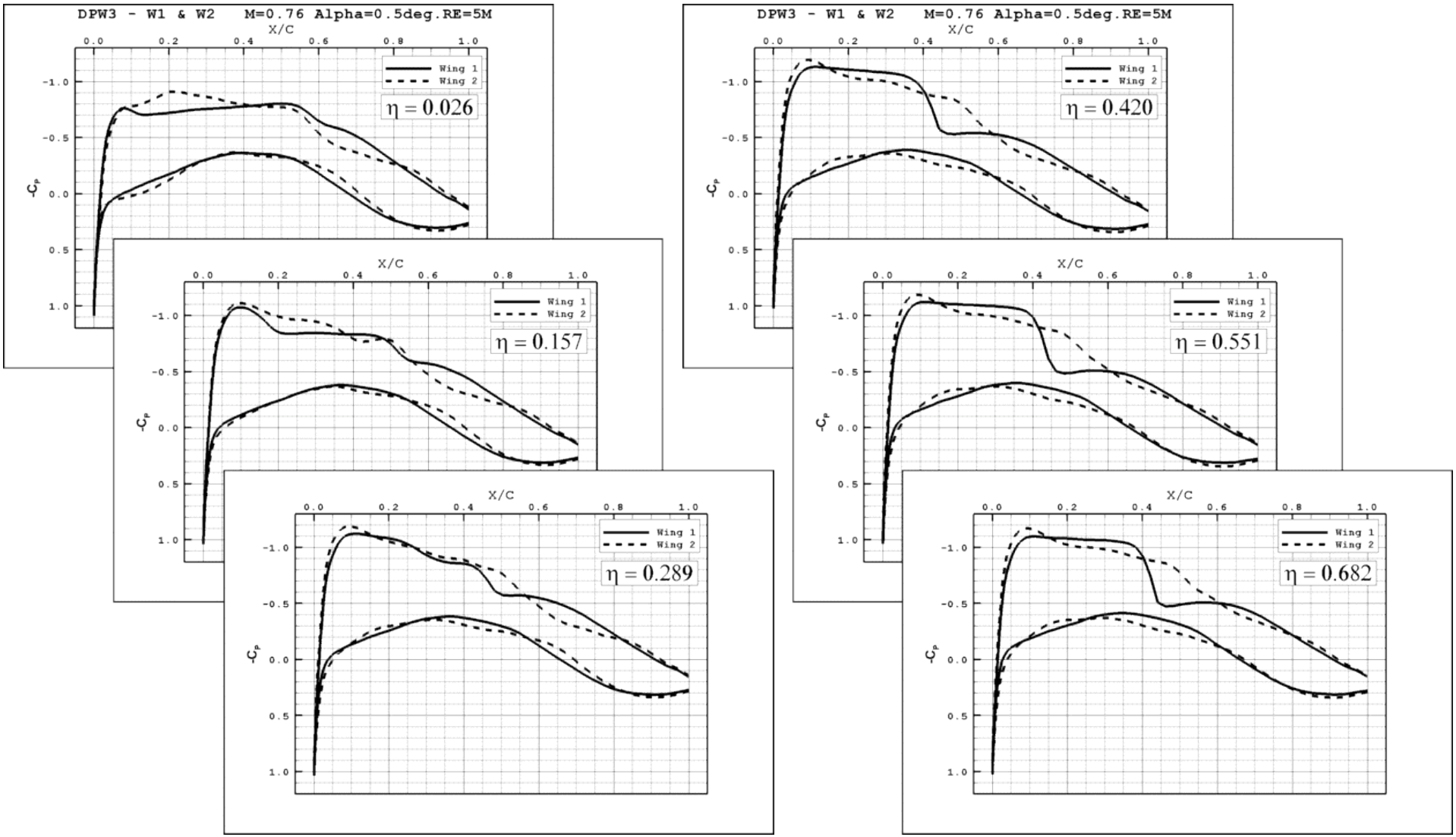




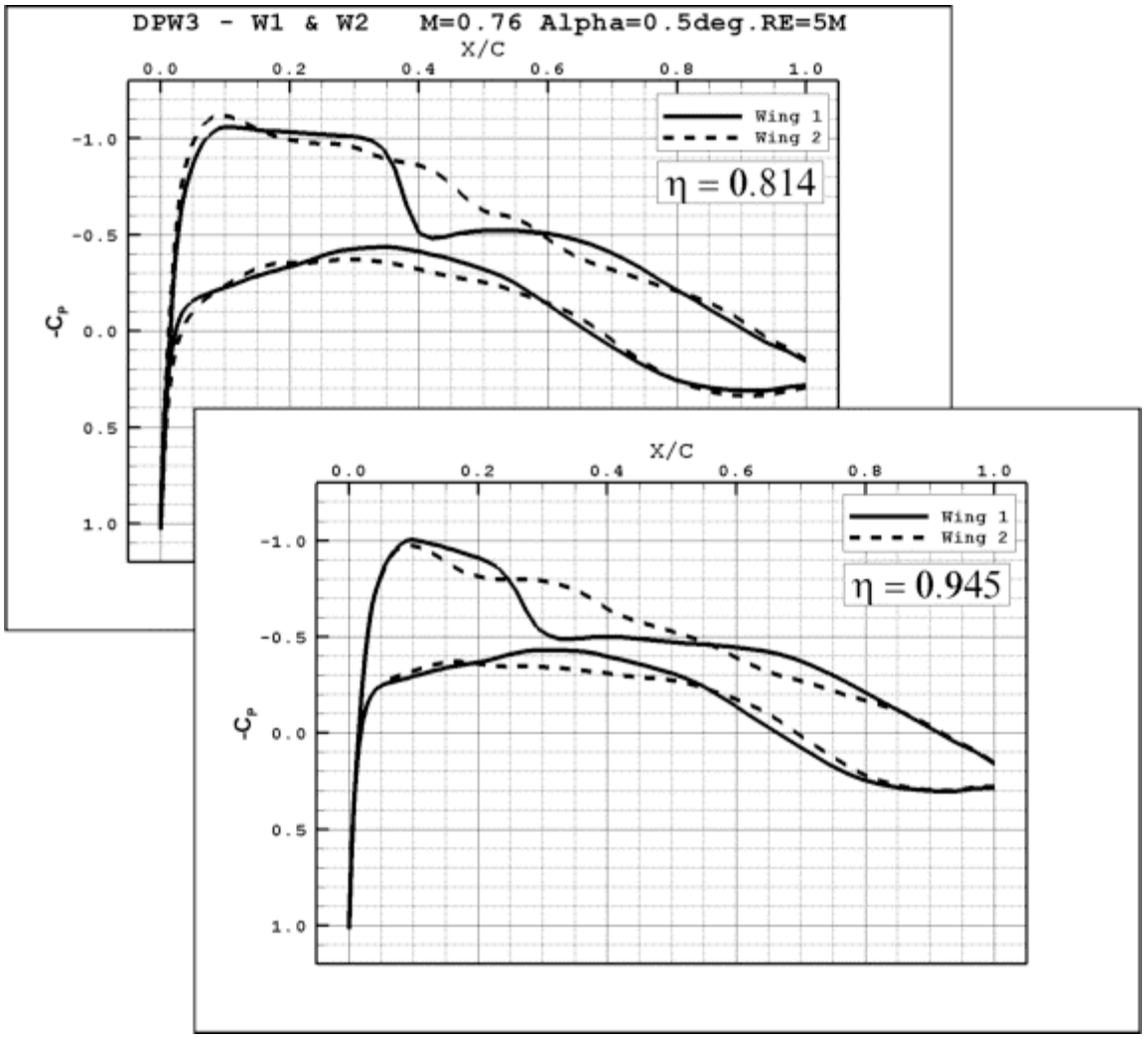




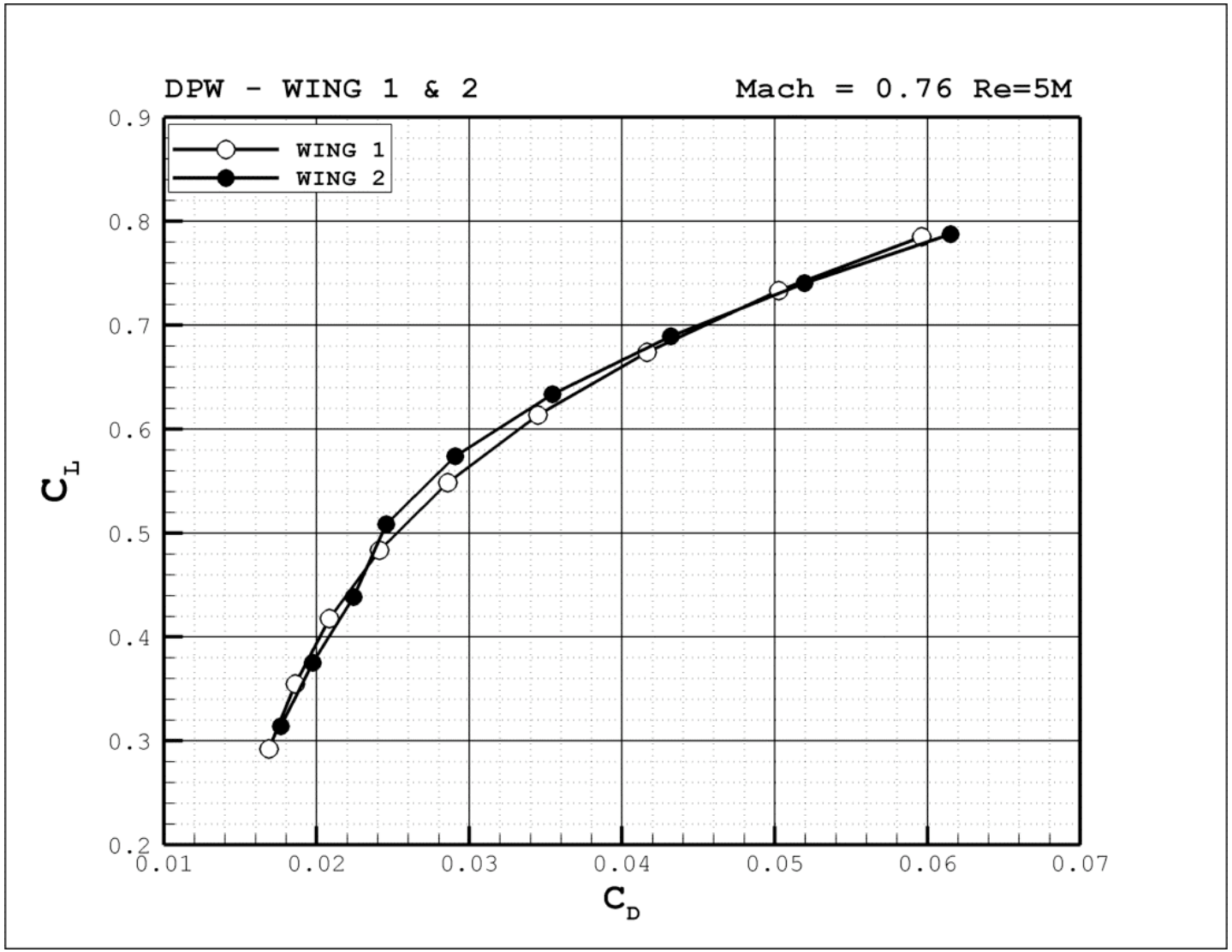
SURFACE PRESSURE COEFFICIENT (ALPHA = 0.5 DEG)



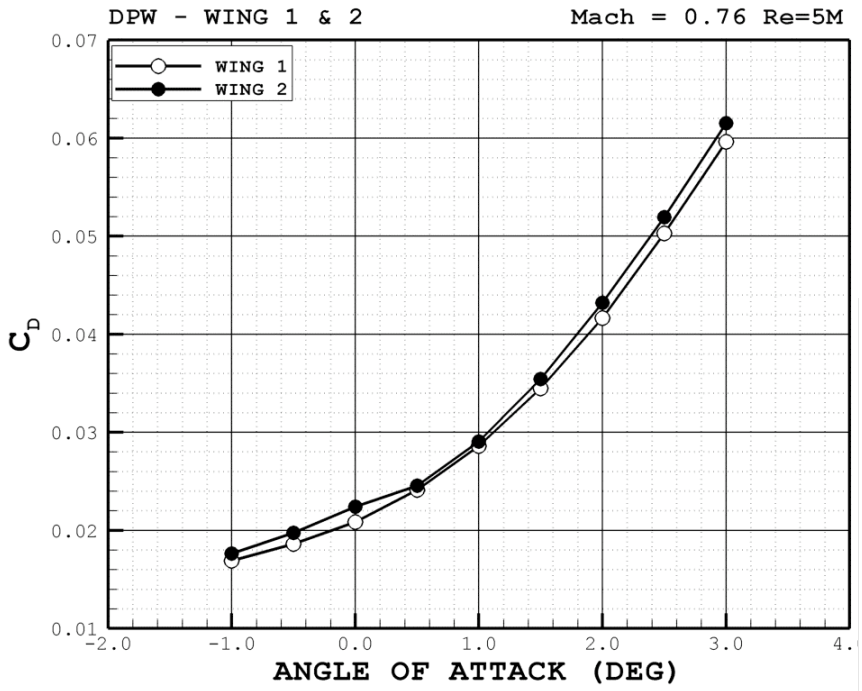
SURFACE PRESSURE COEFFICIENT (ALPHA = 0.5 DEG)

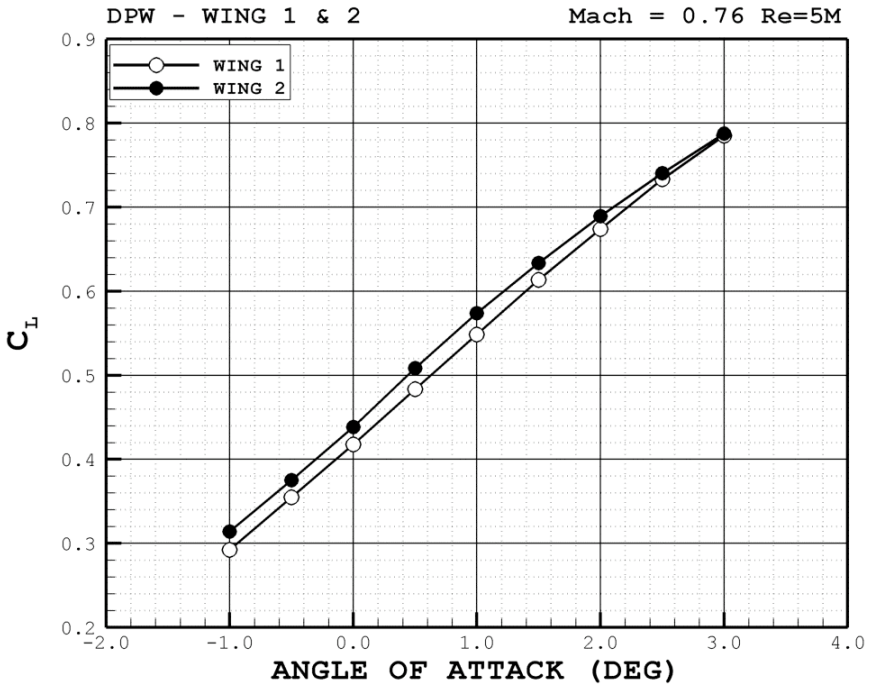


FORCE COEFFICIENTS



FORCE COEFFICIENTS





SKIN FRICTION METHODOLOGY

- Coordinate transformation
  (x,y,z)→ (ξ,η,ζ) orthogonal
- Calculation of Stress Tensor
  (Surface mesh cell center)
- Calculation of Traction Force **T**
- Surface shear force **S**

$$\tau_{i,j} = \mu\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) + \delta_{i,j}\lambda\frac{\partial u_k}{\partial x_k}, \lambda = -\frac{2}{3}\mu$$

$$T_i = \tau_{i,j} n_j$$

$$S_j = T_j - \left(T_j n_j\right) n_j$$

$$S_j = S_x\vec{i} + S_y\vec{j} + S_z\vec{k}$$