Case 3.2: Turbulent Flow over the DPW III Wing Alone

Summary of Results

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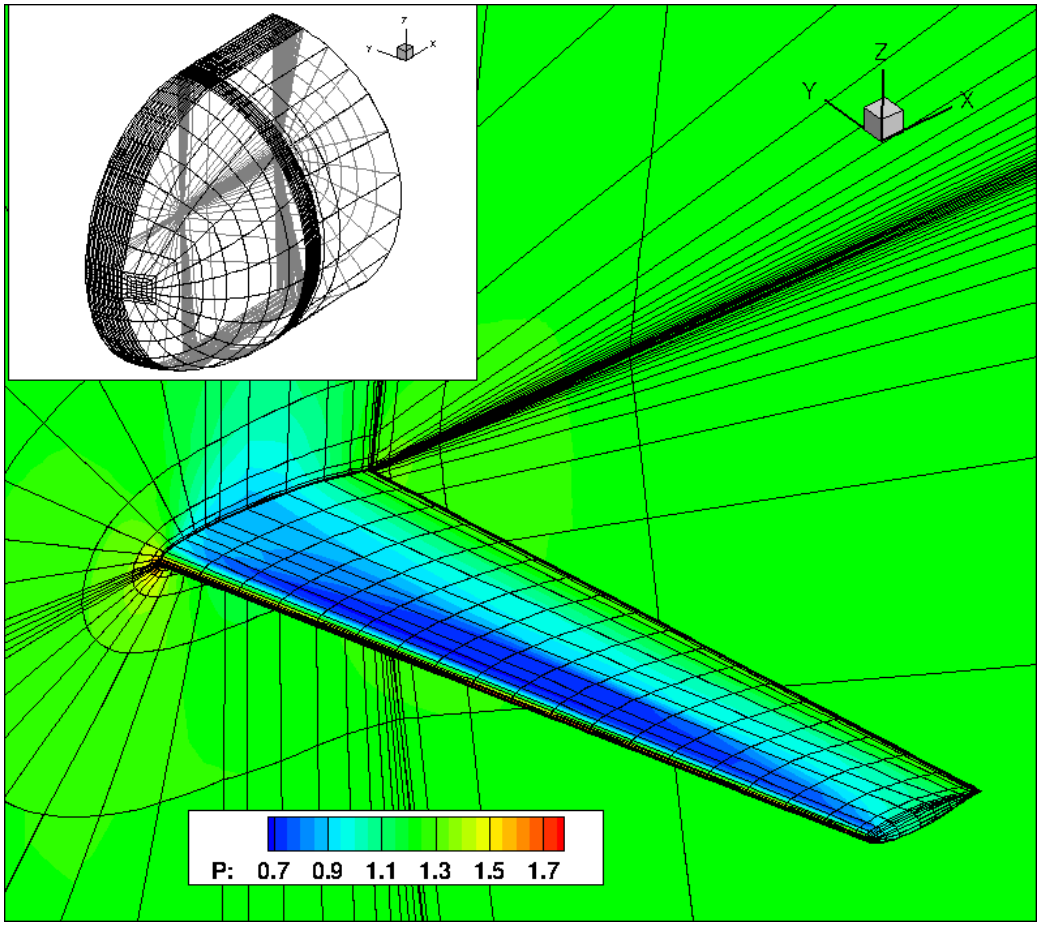
Case description

- **Objective:**
  - Test high-order methods in turbulent transonic flow in three dimensions.
  - Stiff discrete system poses a challenge for the nonlinear solver.
  - Outputs of interest are lift and drag.
- **Flow and boundary conditions:**
  - $M_\infty = 0.76$ at $\alpha = 0.5°$.
  - $Re = 5 \times 10^6$ based on $c_{\text{ref}} = 197.556$, fully turbulent.
  - Adiabatic no-slip wall, symmetry, characteristics-based farfield.
- **Gas properties:**
  - $\gamma = 1.4$ and $Pr = 0.71$.
  - Sutherland's law for viscosity.
  - SA or $k\omega$ suggested for turbulence modeling.

Geometry and provided mesh

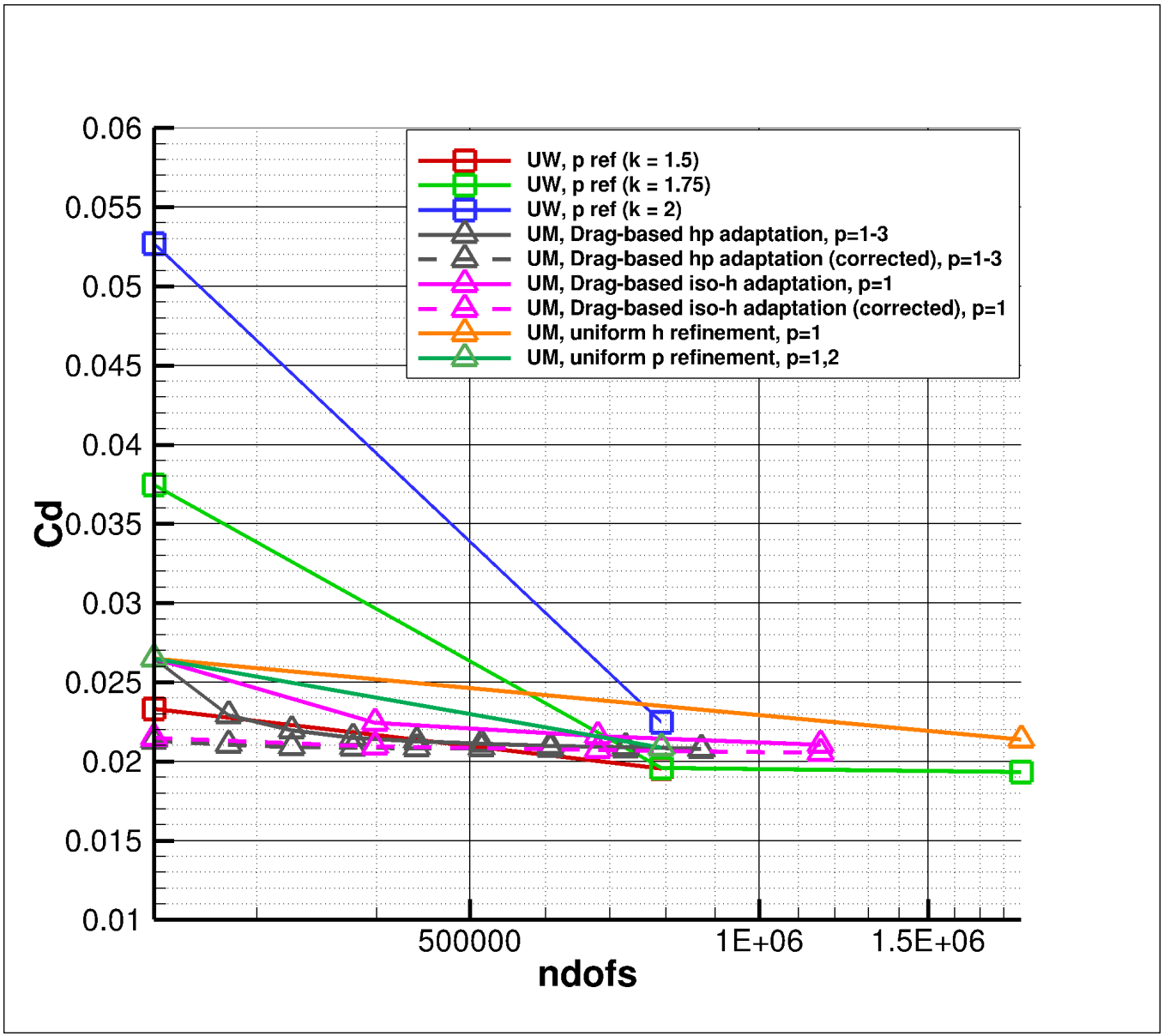
- 29310 (coasest) cubic hexas generated via agglomeration.
- Original geometry, *i.e.* blunt trailing edge.



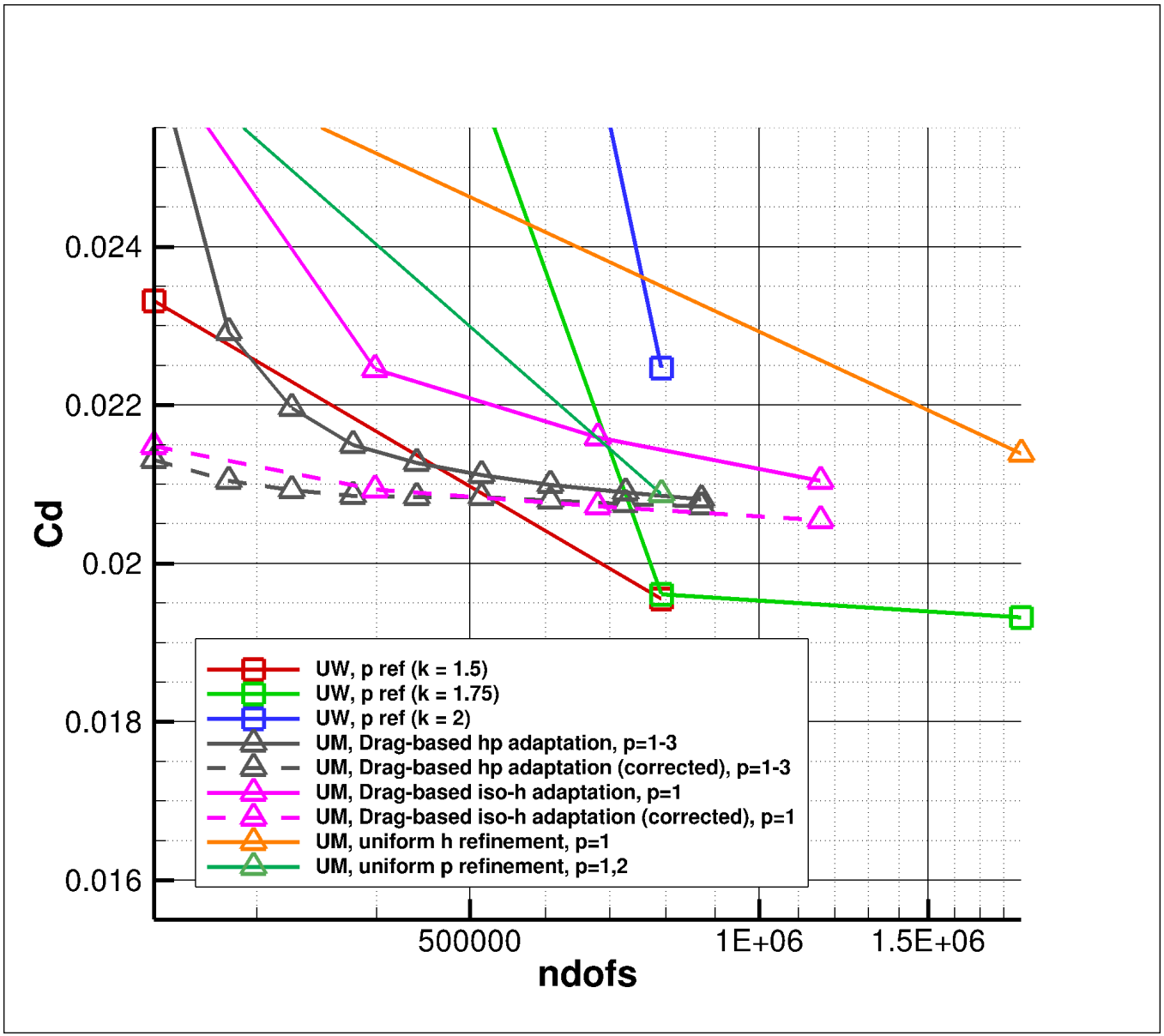
Participants codes and meshes

- **University of Wyoming:**
  - Spalart-Allmaras (ICCFD7 version) turbulence model.
  - DG, Lagrange basis, tensor-product on reference domain.
  - Roe solver for inviscid flux, SIP for viscous discretization.
  - Backward-Euler with exact Jacobian, fGMRES linear solver.
  - Uniform *p*-refinement on HOW mesh (various artificial viscosity parameters).
  - Runs performed on 1024 Sandybridge cores.
- **University of Michigan:**
  - Spalart-Allmaras (ICCFD7 version) turbulence model.
  - DG, Lagrange basis, tensor-product on reference domain.
  - Roe solver for inviscid flux, BR2 for viscous discretization.
  - CPTC, relaxed line-search, with in-house GMRES and line-Jacobi preconditioner.
  - Isotropic *h*, and *hp*-adaptation and uniform *h* and *p* refinement.
  - HOW initial mesh.
  - Runs performed on 240 Westmere cores.

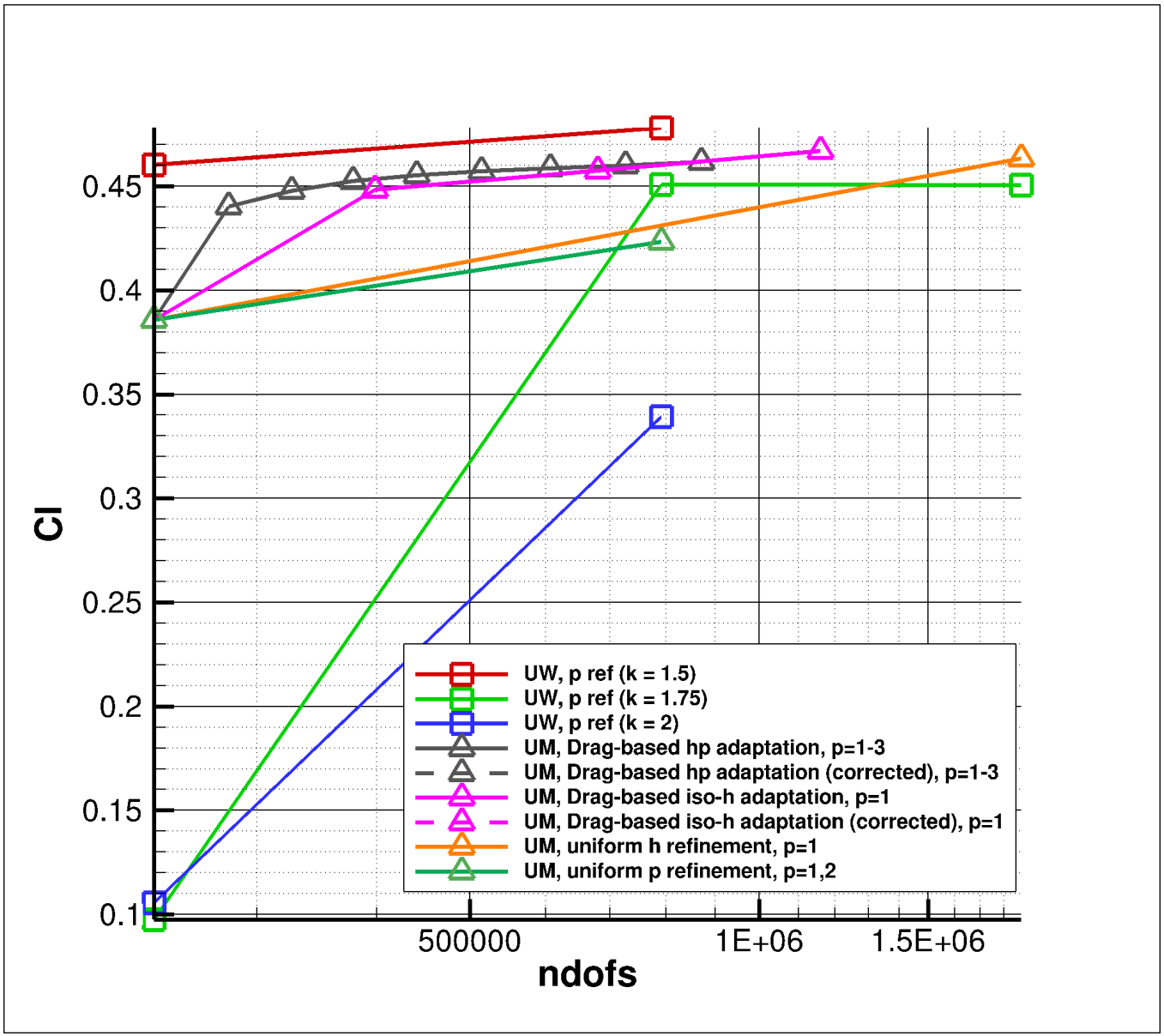
Drag convergence versus DOFs



Drag convergence versus DOFs - zoom



Lift convergence versus DOFs



Conclusions

- We seem to disagree on the output values.
- Possible causes: geometry representation, artificial viscosity term...
- This case is a good exercise for solvers.