DLR UPDATE: ADAPTIVE MESH REFINEMENT

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Spatial discretization

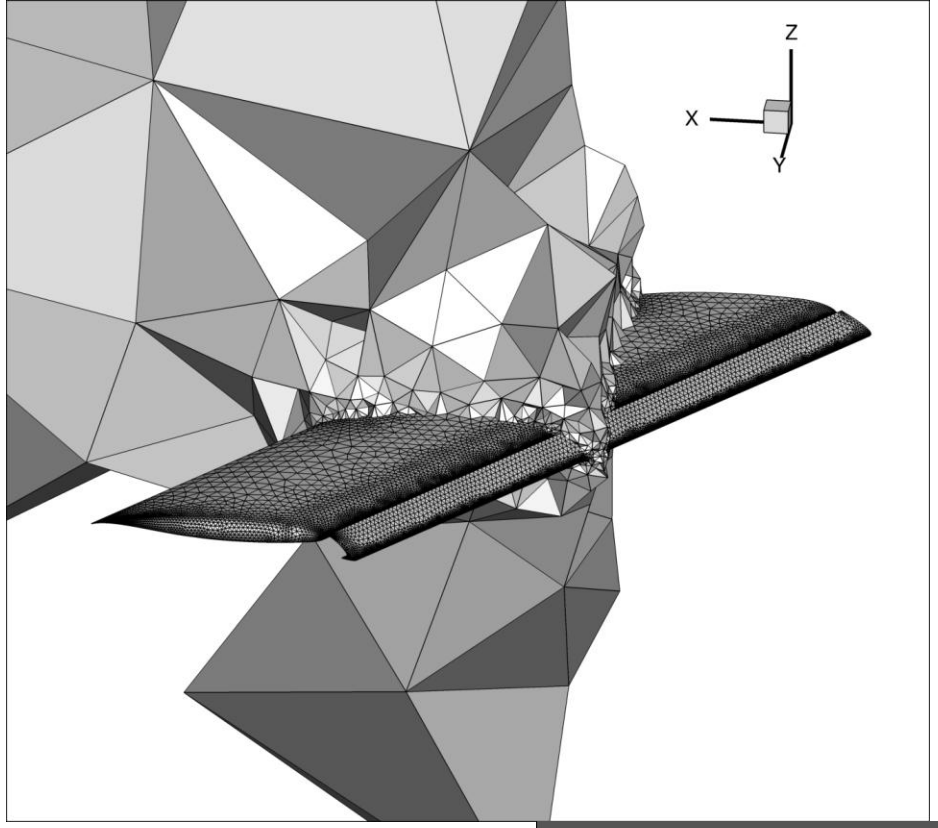
- CFD Software by ONERA, DLR and Airbus (CODA)
- SAneg turbulence model
- 2nd order FV cell-centered
- Extended Green-Gauss gradients
  - Spline quintic limiter for the mean flow with smooth region attenuation
  - Unlimited turbulence

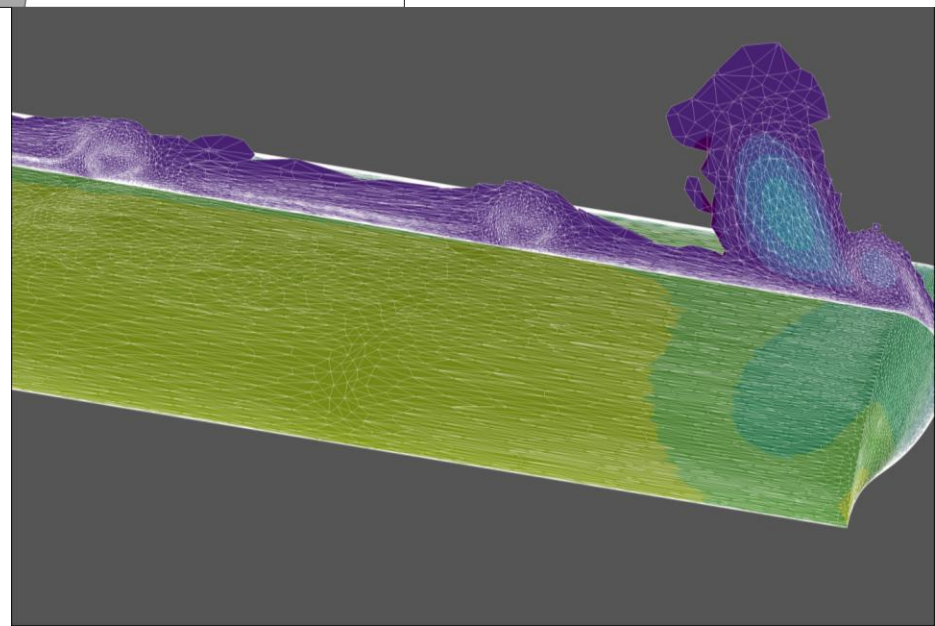
Mesh Adaptation

- Tucanos Remesher
  - Simplex meshes
  - Anisotropic adaptation based on a metric field
  - Geometry is included in the process by a very fine surface mesh
- Metric field is computed by the Mach Hessian scaled with a scalar indicator
  - Mesh anisotropy via the Mach Hessian
  - Mesh size via the scalar indicator
  - Residual-based indicator
  - Adjoint-based indicator
    - Exact adjoint obtained by AD (frozen limiters)
    - For all coefficients possible, focus on Lift here
- Warm start from the last adaptation step

Setup

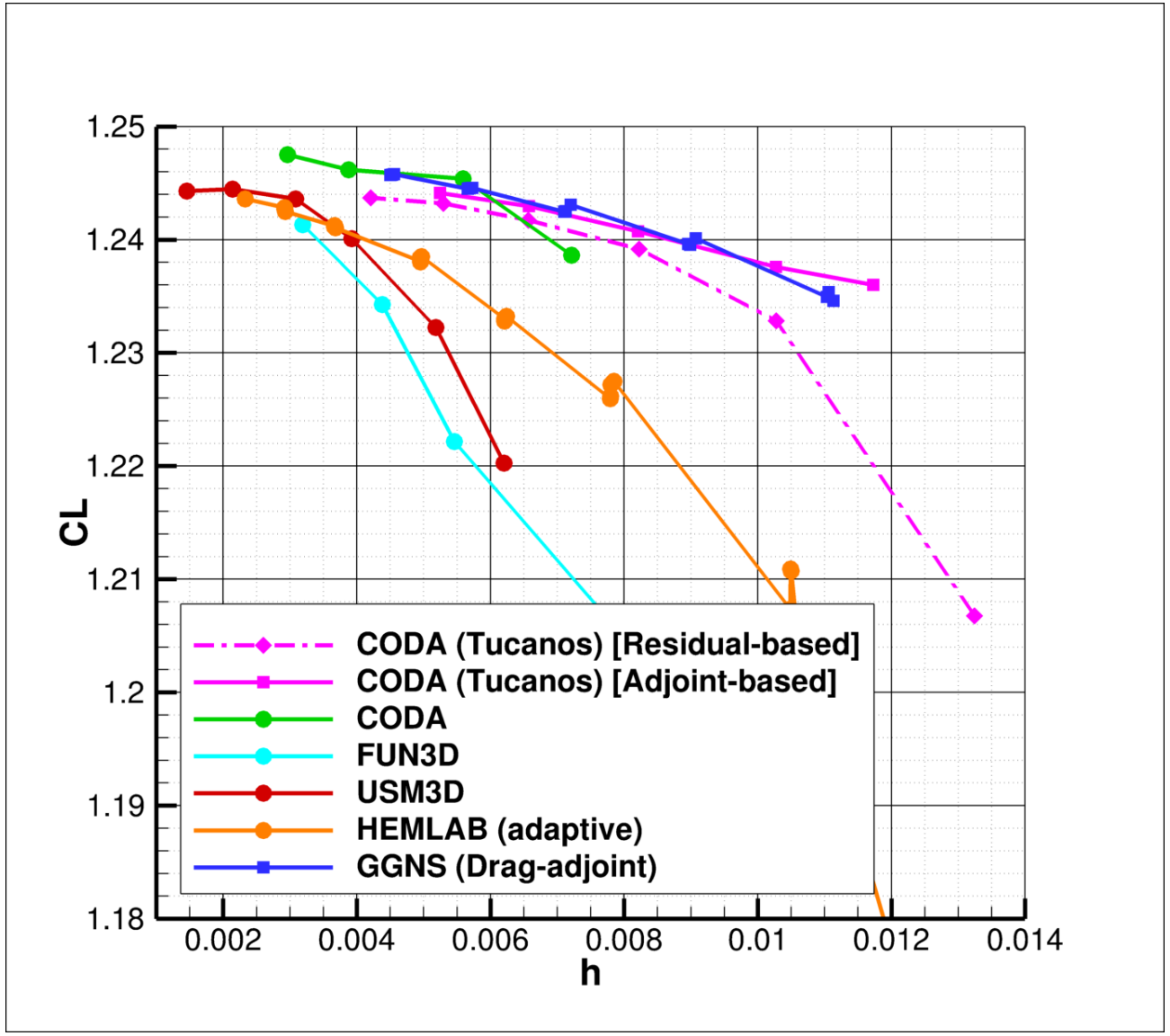
- Initial mesh by ANSA
  - ~ 300k elements
  - Isotropic tets
  - No boundary layer
- Excellent iterative convergence even on highly stretched tets (Aspect ratio of 10,000)
  - 8 orders of magnitude for both density and SA residual





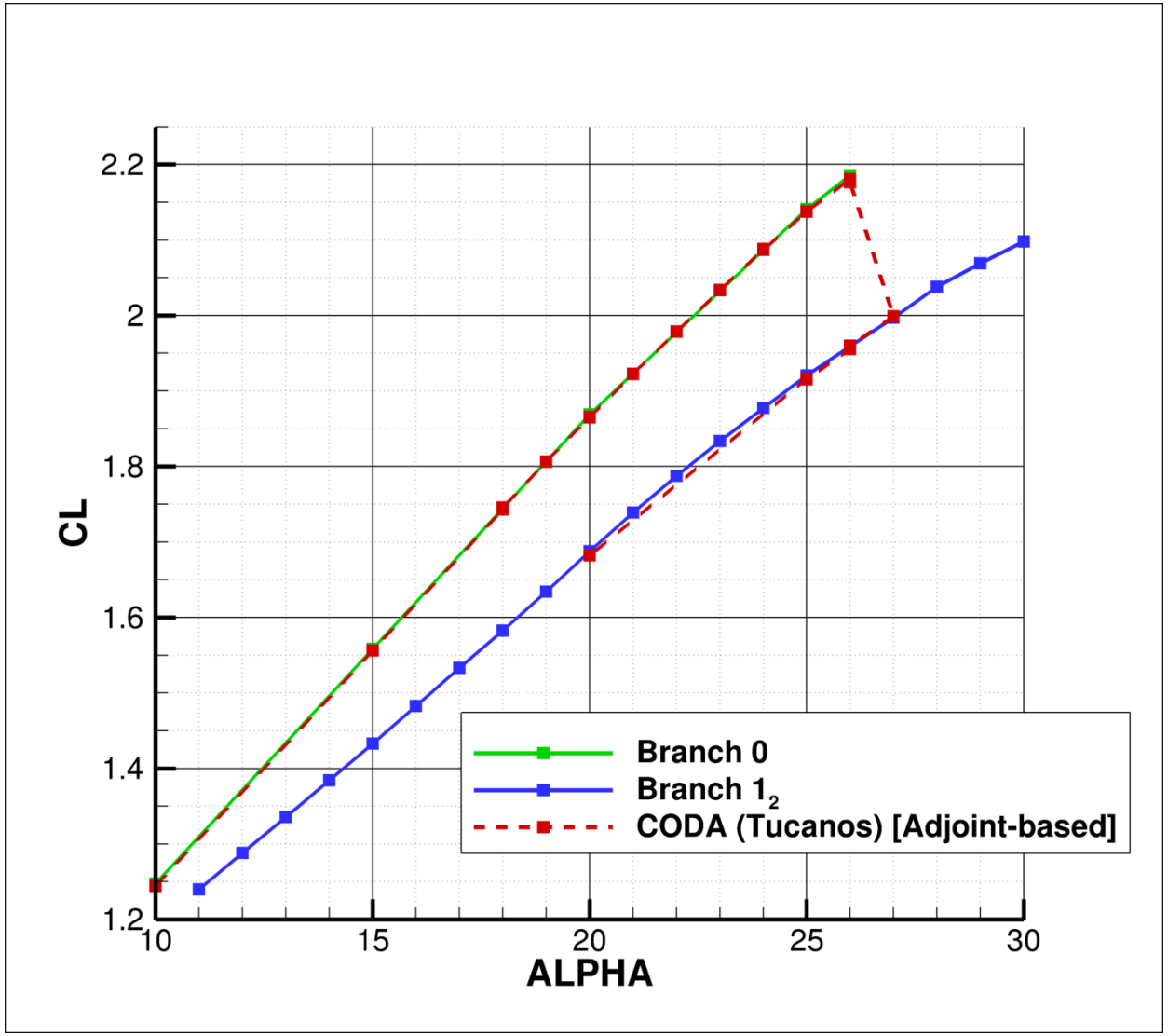
Spatial Convergence at 10 degrees

- Compare to subset of submitted high-quality solutions
- Very good spatial convergence
- Monotonic convergence when considering the final points at each mesh complexity level



Polar with adjoint-based adaptation

- Adaptive results match fixed grids on Branch 0 very well
- Switch to Branch 1_2 at 27 degrees
  - Consistent with observations made on the fine fixed grids
  - Sharp transition between branches
- Adaptive results match fixed grids on Branch 1_2 very well



Conclusion

- Mesh adaptation yields highly accurate solutions in terms of accuracy per degree of freedom compared to fixed grids
- Mesh adaptation was **not** able to retain the attached solution beyond 26 degrees for iteratively converged solutions
- Adaptive results match fixed grids results for both branches