Drag Prediction Workshop

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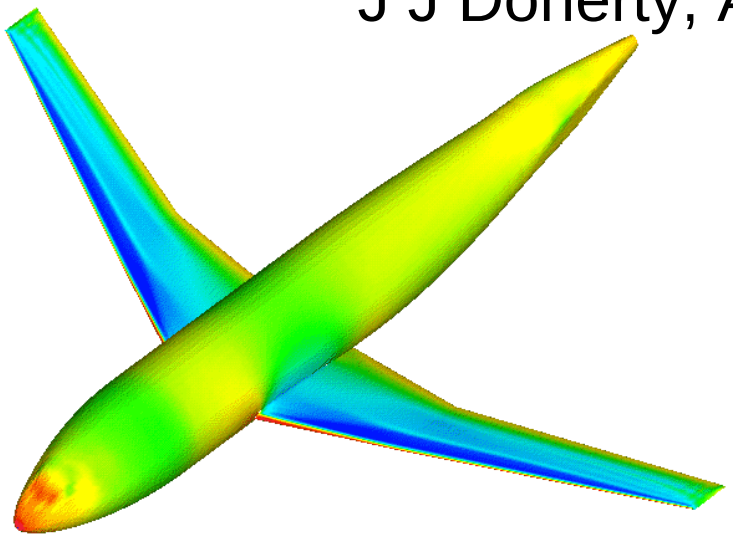
J J Doherty, A Shires, J E Alderman



Centre for Aerospace Technology
Future Systems Technology Division
DERA

CFD method

- CFD pre-processing
  - GEMS tool used to configure DLR F4 IGES geometry into definition suitable for CFD
- SAUNA™ grid generation and flow solver
  - Rapid, high accuracy modelling of aircraft aerodynamics in analysis and design using structured multi-block grids
  - Developed and validated by DERA
  - Central to aerodynamics work at DERA for the past 15 years
- Calculations performed
  - Case 2 drag polar, M = 0.75, α = -3°, -2°,-1°, 0°, 1°, 2°
  - unable to import provided grid

SAUNA grid generation 1

- structured, multi-block grid
  - surface elliptic grids generated at each of the airframe and far-field surfaces as well as ‘control’ planes in the field
  - surface grids are edited to maximise grid quality
  - an elliptic field grid is generated within the domain between the bounding surfaces
- ‘automatic’ wing/body Euler grid generated in approx. 20 minutes using AMESH tool
  - requires extension of rear fuselage using sting
- Euler field grid refined in blocks adjacent to wing and body for viscous calculations

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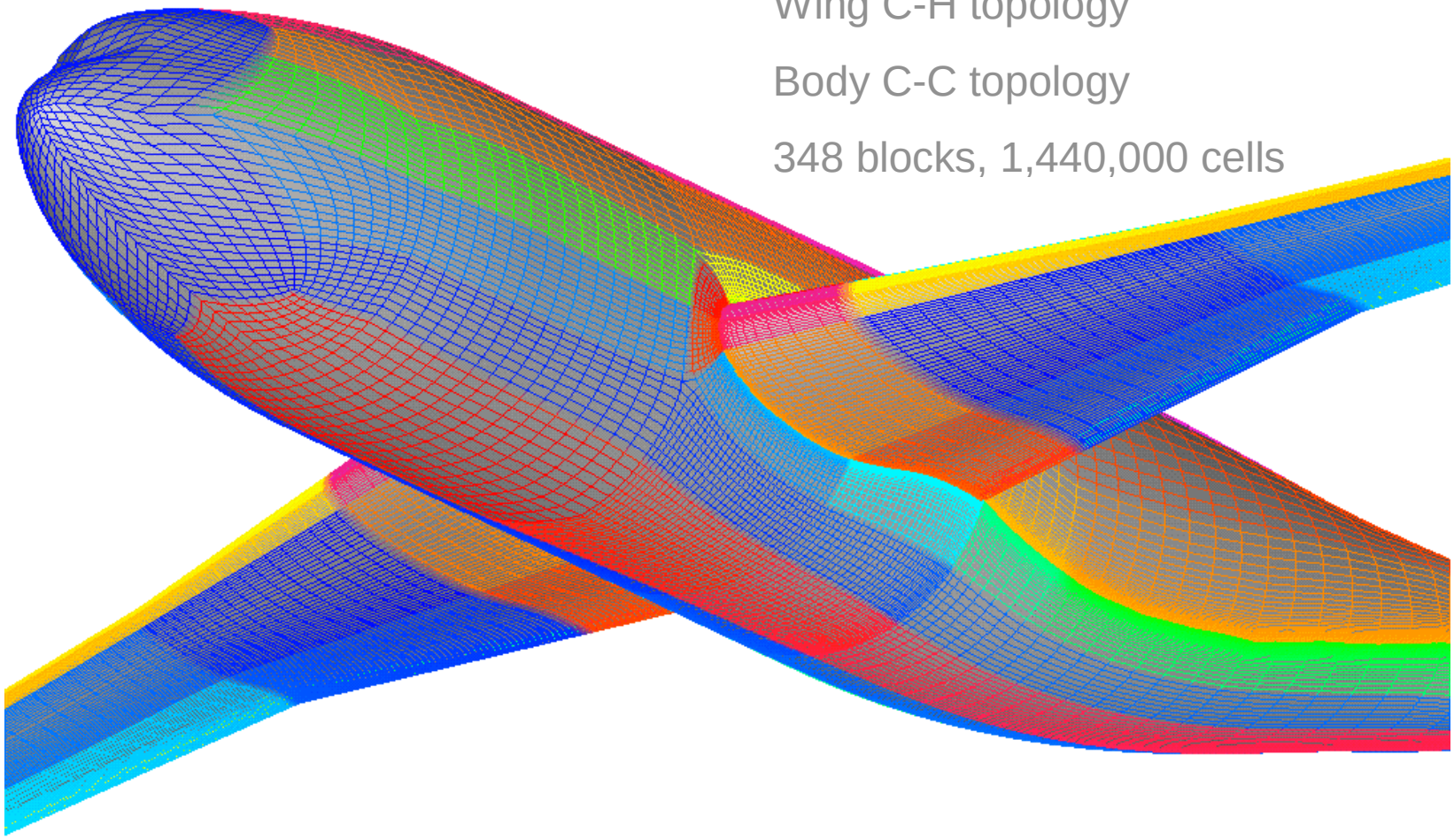
SAUNA grid generation 2

Wing C-H topology

Body C-C topology

348 blocks, 1,440,000 cells



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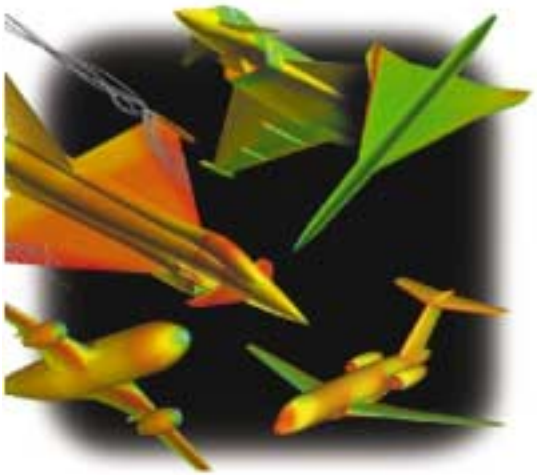
SAUNA flow solver

- explicit, time-marching
- finite volume, cell-vertex
- convergence acceleration using multi-grid and implicit residual smoothing
- k-ω turbulence model, no transition
- convergence monitored on mean residuals



platform used: SGI Origin 200, single processor

memory req: 772 MBytes

cpu time: 68 hours approx

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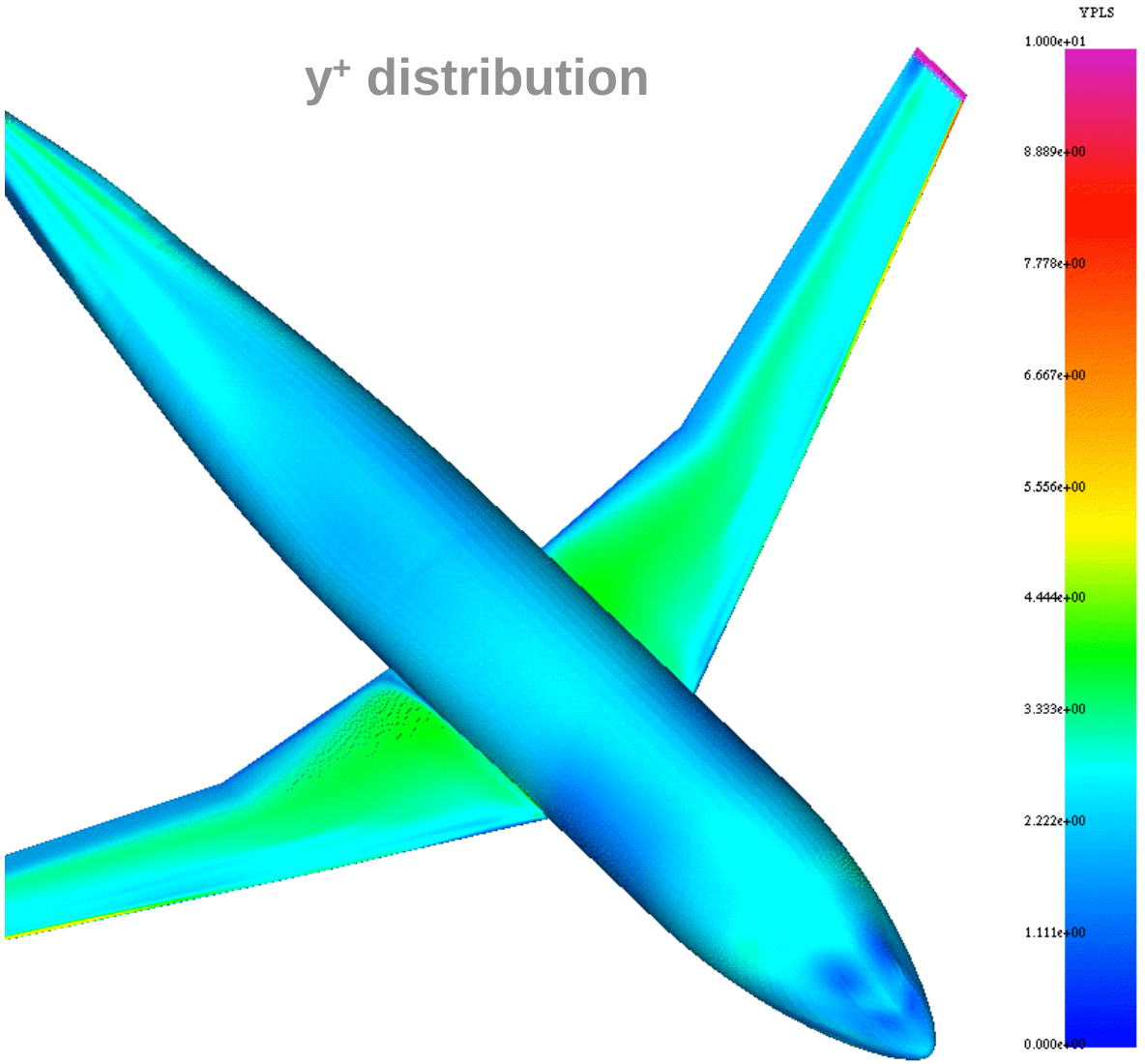
y^+ distribution



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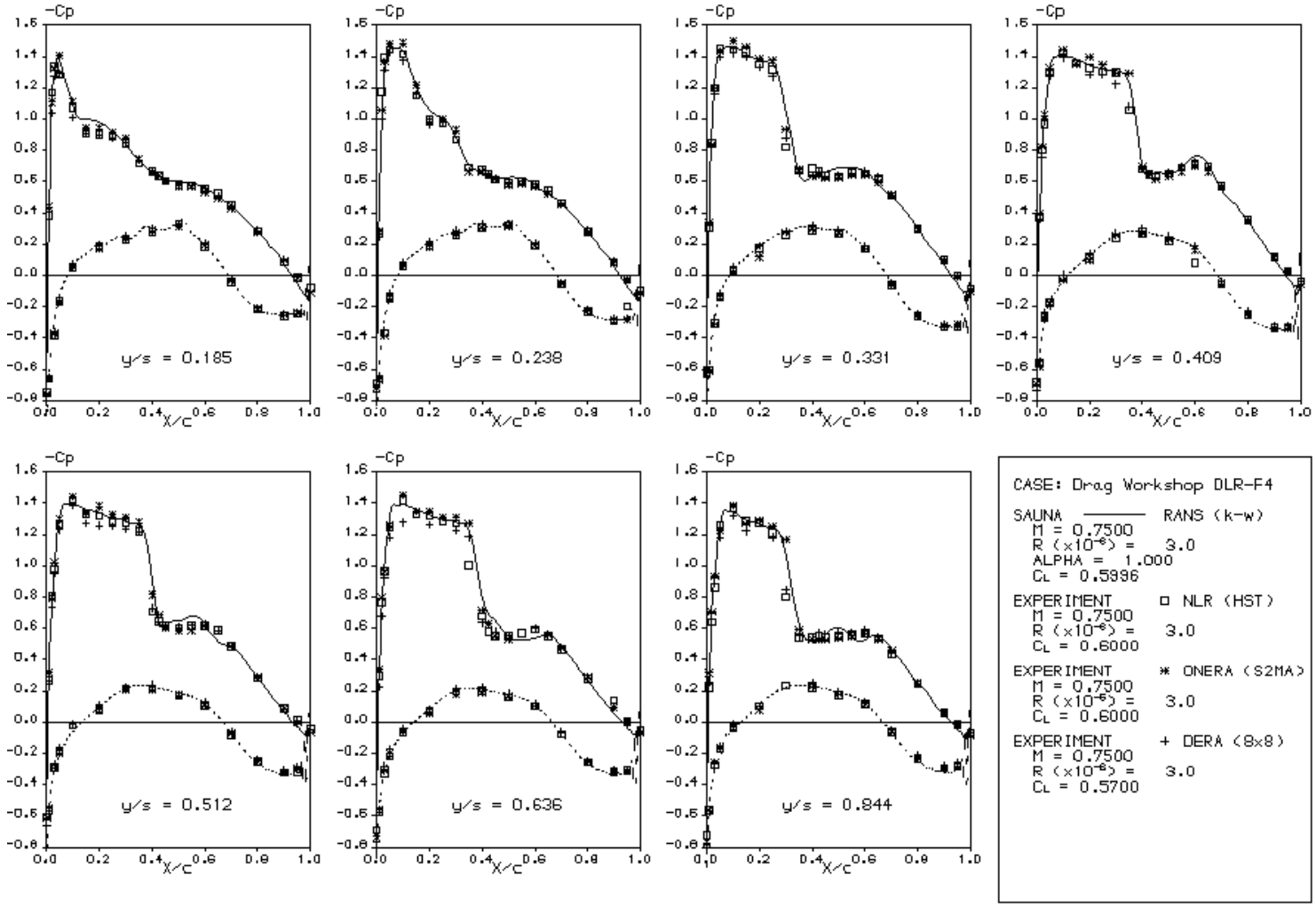
Measured and predicted pressure coefficient distributions



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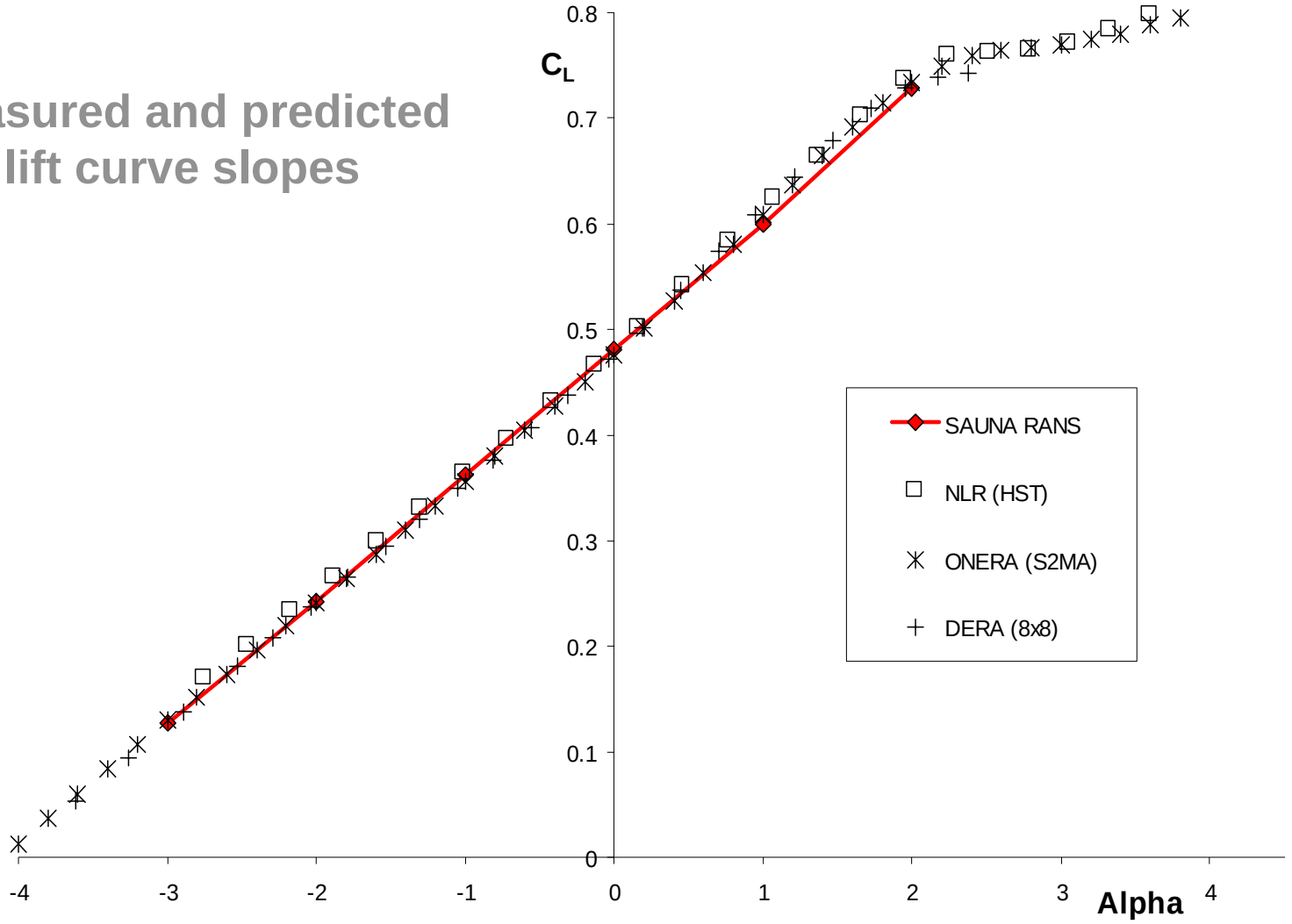
Measured and predicted lift curve slopes



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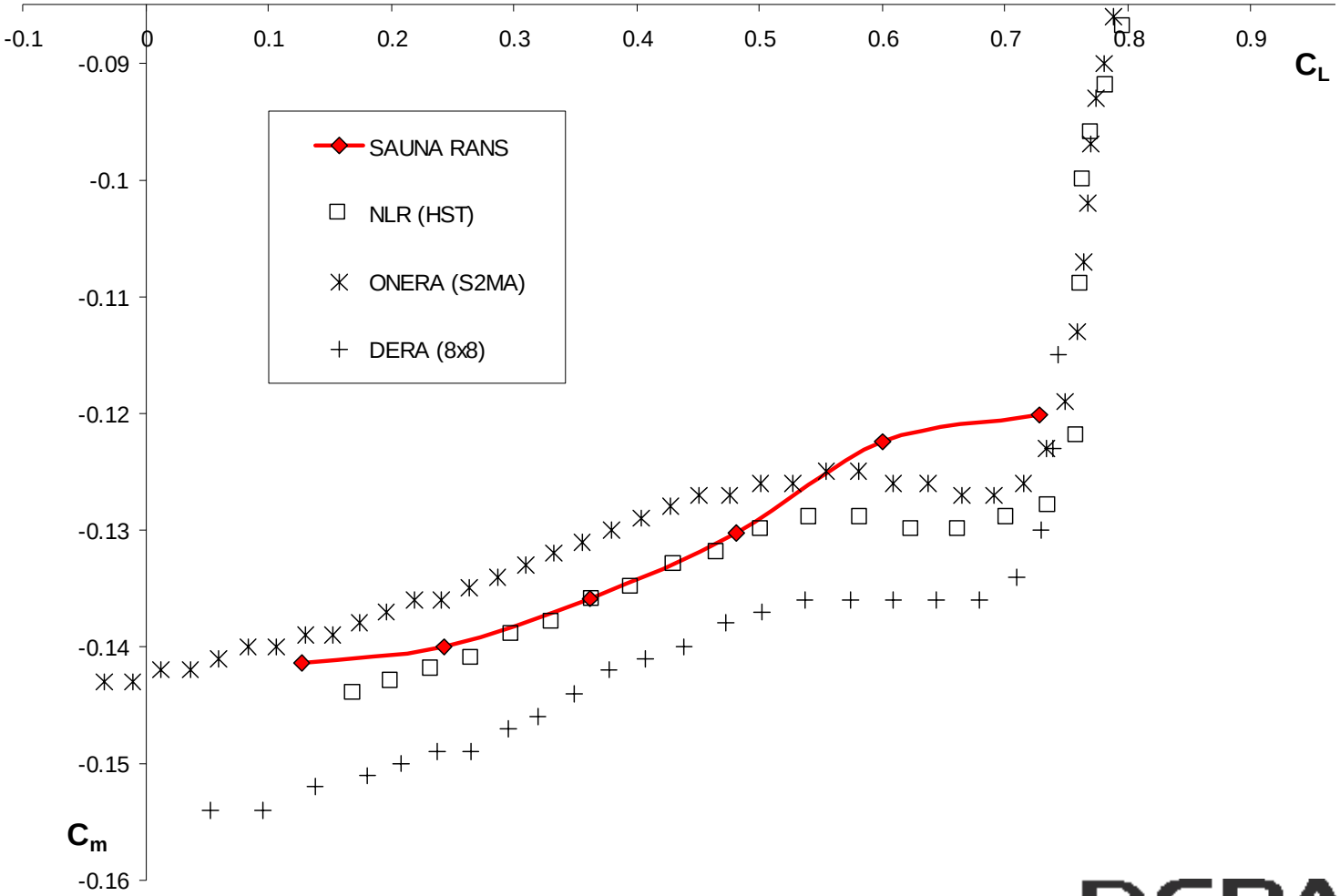
Measured and predicted pitching moment coefficient



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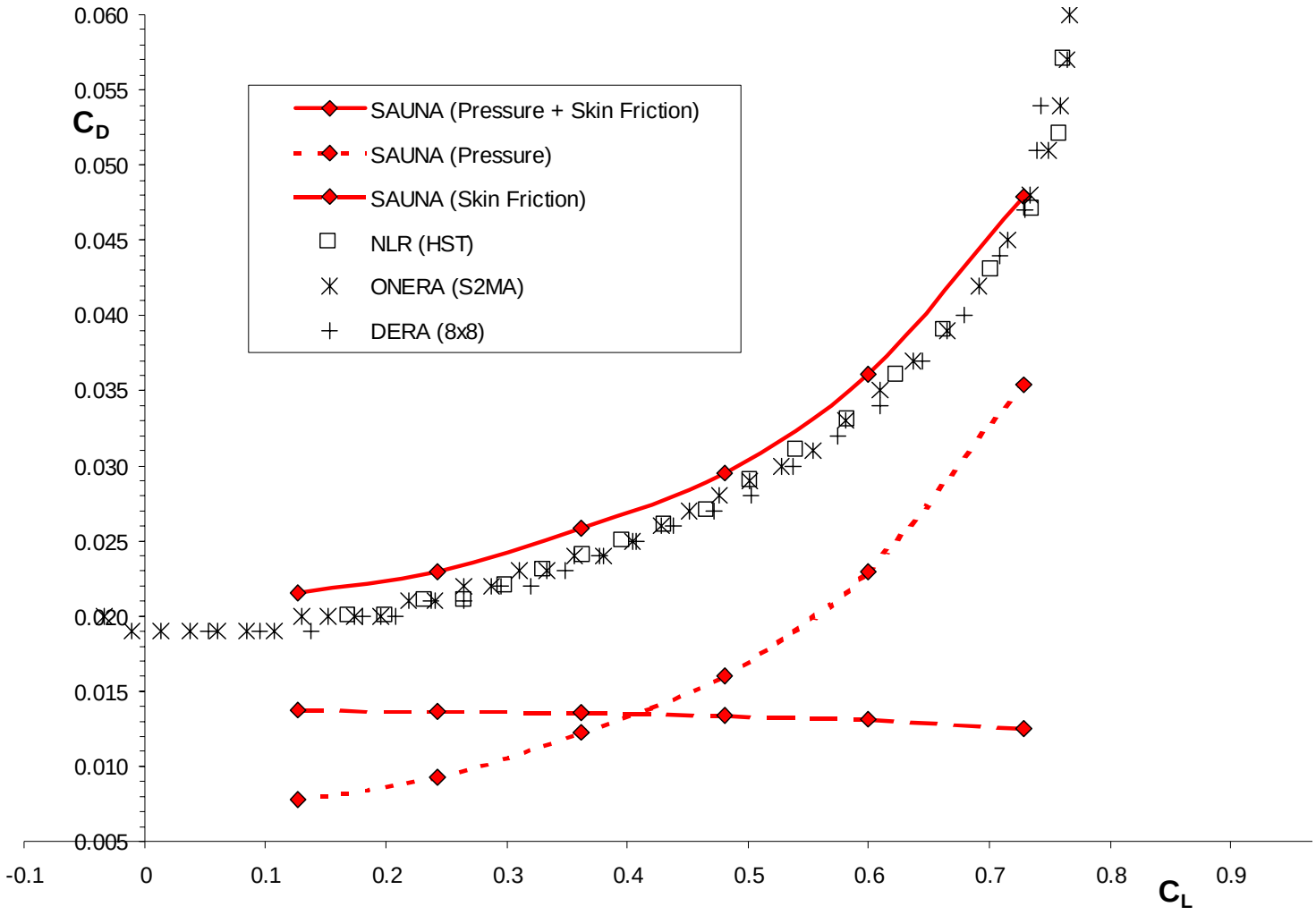
Measured and predicted drag coefficient



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Summary

- ‘automatic’ grid generated rapidly using minimum effort
- grid contains 1,440,000 field cells, significantly smaller than provided grid
- very good agreement between predicted and experimental pressure distributions, lift curve slopes, and pitching moment coefficients
- drag trends are well represented, with predicted drag approximately 15 counts higher than experiment