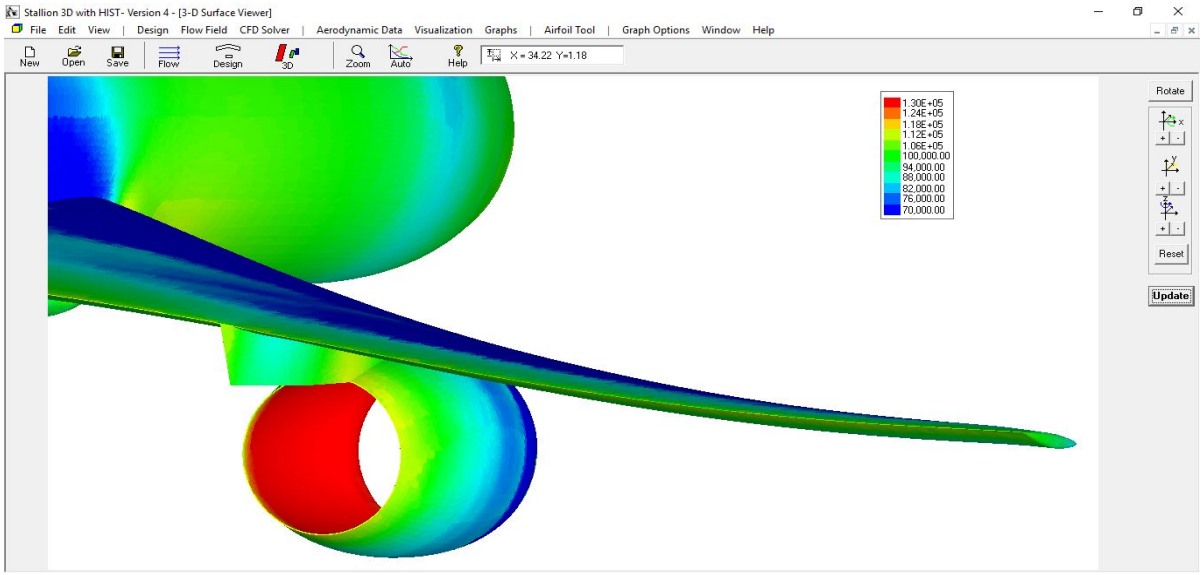
Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Stallion 3D with HIST Results

AIAA DPW-6



Patrick Hanley, Ph.D.
Hanley Innovations, Ocala FL, USA

Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Contents

1. Motivation
2. Stallion 3D Overview
3. Case 1
4. Case 2
5. Case 3
6. Conclusions

Motivation

1. DPW-6 is a Step Towards our Commitment to Make Accurate Drag Prediction Accessible for Aircraft/UAV Startups & Education Customers
2. Contribute to Drag Prediction Studies in the Area of Global Uniform Grid Shape about CL = 0.50
3. Study Effects of Changes in Geometry

What I Expected: Current version of s/w will do well around CL = 0.50. The behavior at higher AoA will be more challenging due to Re = 5M & wall function approach.

Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Stallion 3D with HIST

- H I S T: Hanley Innovations Surface Treatment
- 3D Compressible Euler and Navier Flow Solver
- 1st & 2nd Order Accurate Finite Volume Method
- k-e Turbulence Model
- Parallel Processing via OpenMP
- Automatic Hexahedral Grid Generation
- Feature to control Aspect Ratio of Cells
- Built-in Post Processing
- Runs under 64-Bit Windows

Stallion 3D with HIST

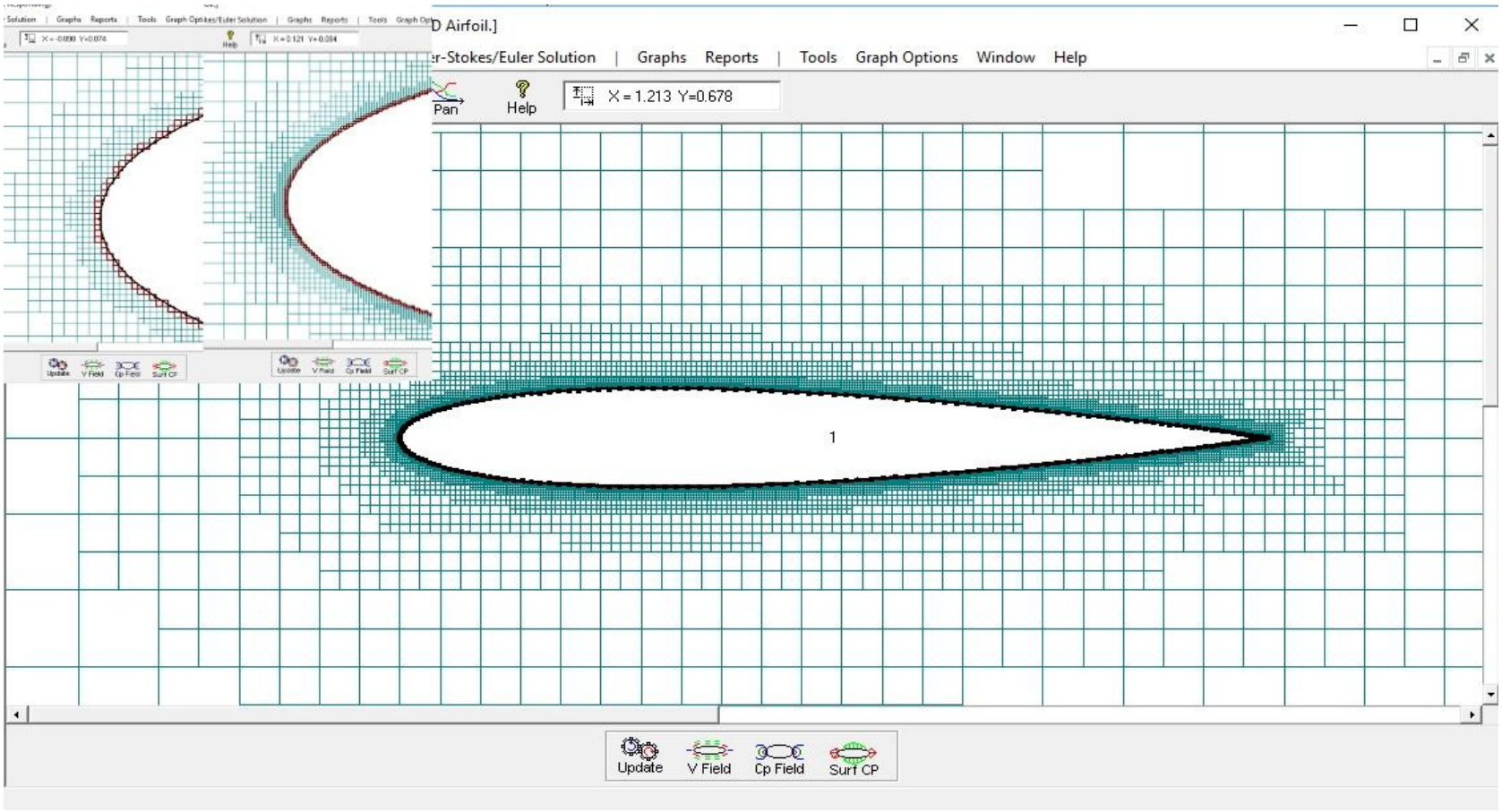
The cases were executed on a 4-core laptop & tower PC (2.1 & 3.7 GhZ respectively). Runtimes were between 12 & 24 hours..

Case 1 - NACA 0012 Analysis

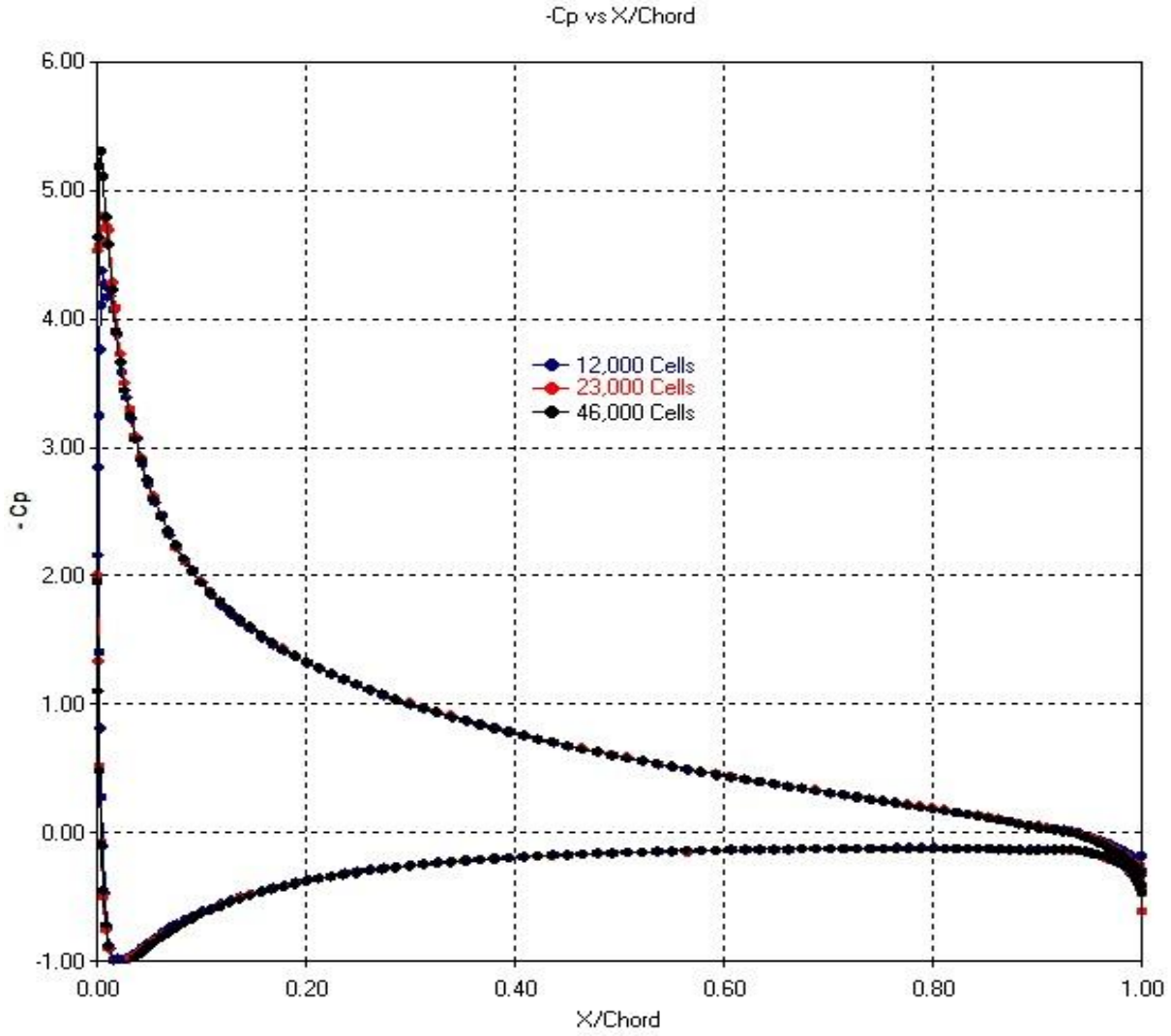
- Validate H I S T Solution for angle of attack = 10 degrees
- 2-D Compressible Euler Equations/Boundary Layer Solution
- Mesh Sizes: 12,000; 23,000; 46,000
- Cl: 1.06; 1.11; 1.13
- Cd_total: 0.00927; 0.0106; 0.0106
- Cm: 0.0467; -0.0144; -0.0068

Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Case 1 - NACA 0012 Analysis

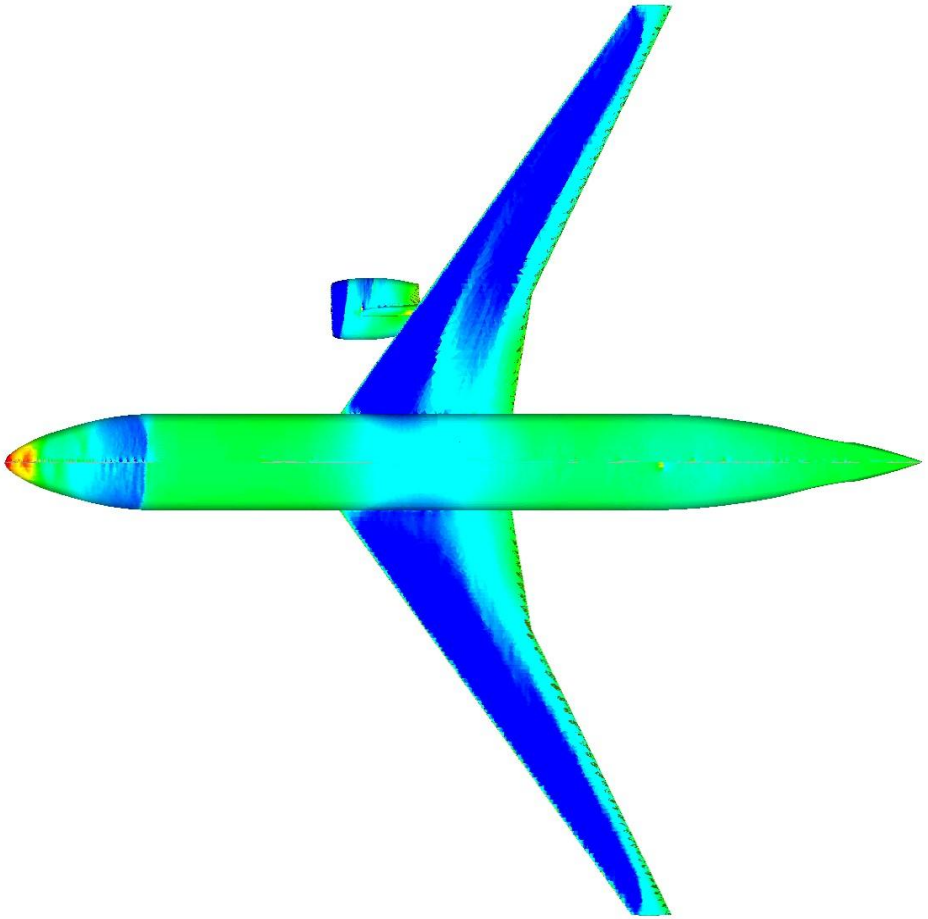


Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658



Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Case 2: Grid Study



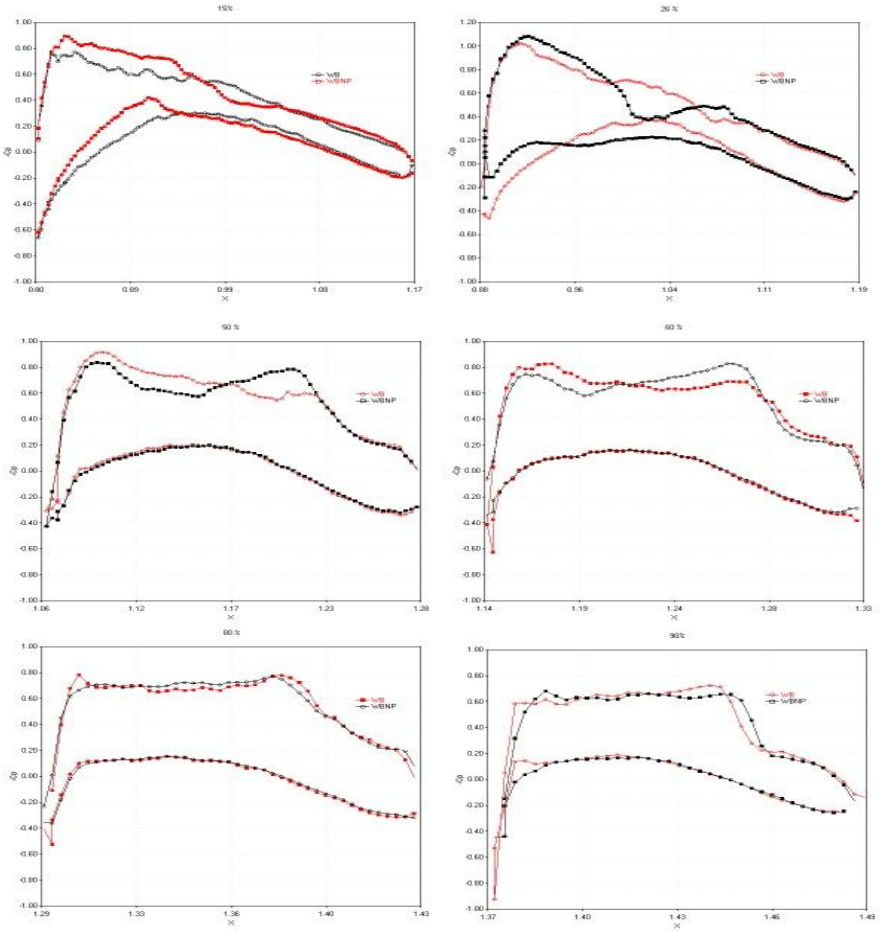
Two Grid Sizes

1. 1,100,000 Cells
2. 3,200,000 Cells

Cell AR = 3 in x-y plane and 1 in the x-z plane.

Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Case 2: Grid Study

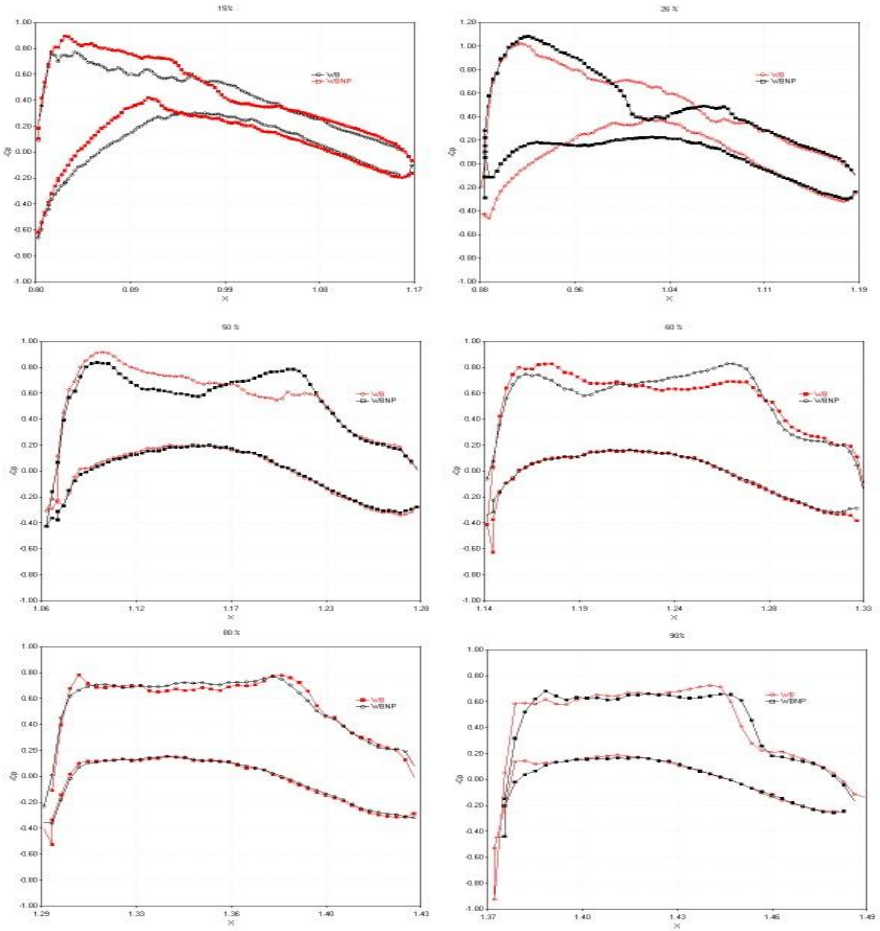


WB Grid Study (Grid1; Grid2)

- CL: 0.499; 0.506
- CD_tot: 0.0247; 0.0232
- CD_pr: 0.0166 ; 0.0158
- CD_v : 0.00808; 0.00738
- CD - …: 0.0159; 0.0144
- CM: 0.0342; 0.0321 ?

Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Case 2: Grid Study

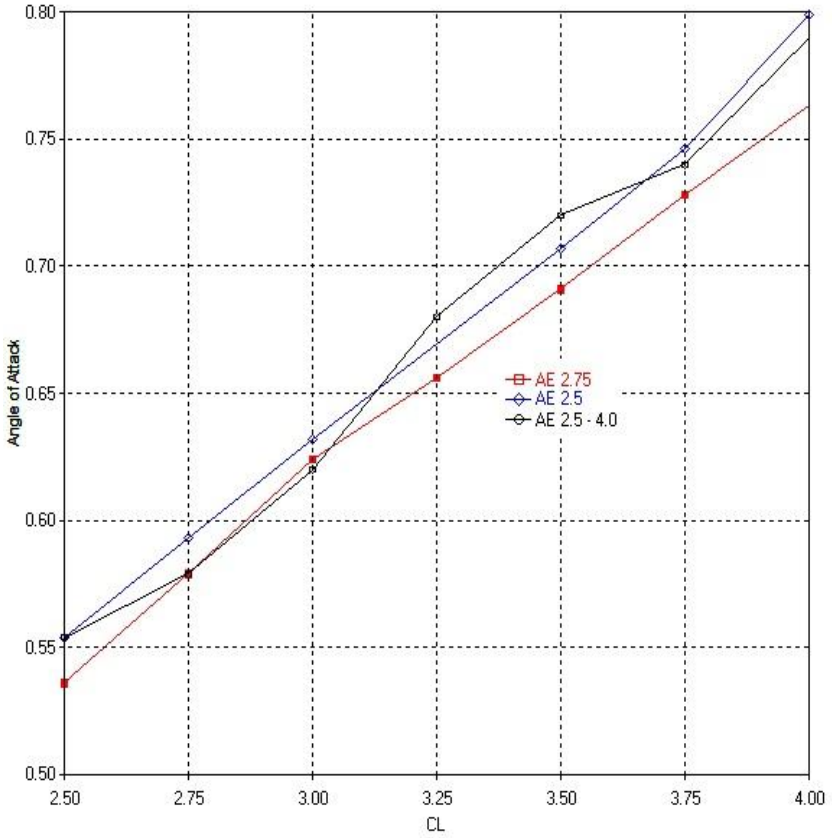


WBNP Grid Study (Grid1; Grid2)

- CL: 0.504; 0.502
- CD_tot: 0.0306; 0.0312
- CD_pr: 0.0209 ; 0.0218
- CD_v : 0.00969; 0.00946
- CD - …: 0.0216; 0.01223
- CM: 0.0297 0.0313 ?

Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Case 3: Grid Study

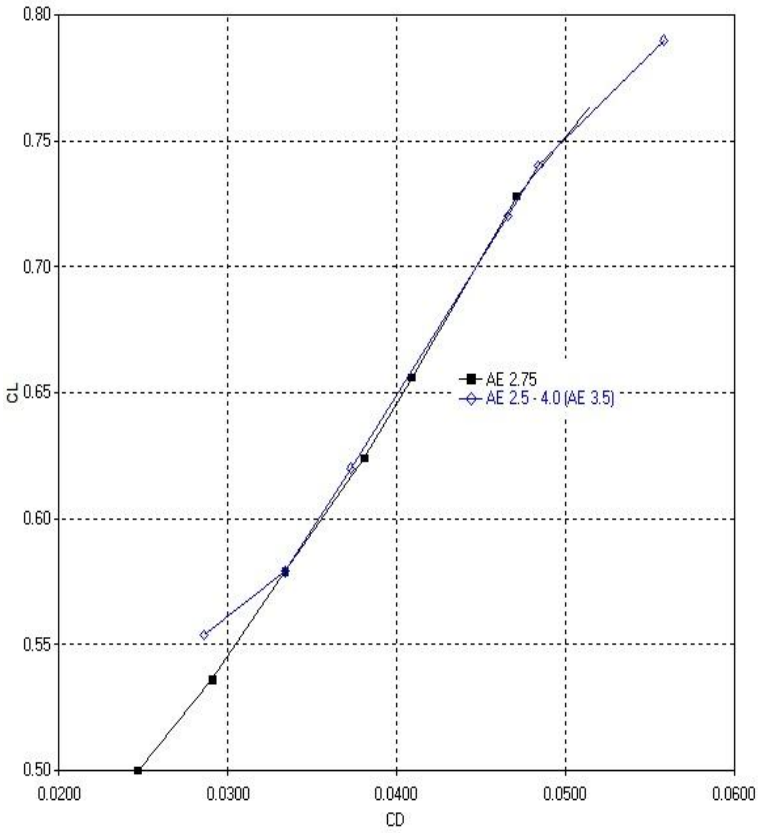


What I Did Not Expect:

- Variations in STL Exports for Each AE model.
- STL surfaces were not uniformly smooth.

Presented by Patrick Hanley, Ph.D.
www.hanleyinnovations.com, (352) 240-3658

Case 3: Grid Study



CL vs. CD AE 2.75 and (AE 2.5 - AE 4.0) Geometries.

Conclusions

- Linear Cl vs. Angle of Attack (AoA between 2.5 and 4.0 degrees)
- Positive CM?
- Need Higher Cell Count Near the Wall for Re = 5,000,000
- Good results for wing pressure coefficients and drag for CL=0.50
- Thanks to DPW Committee for emails and clarifications.