



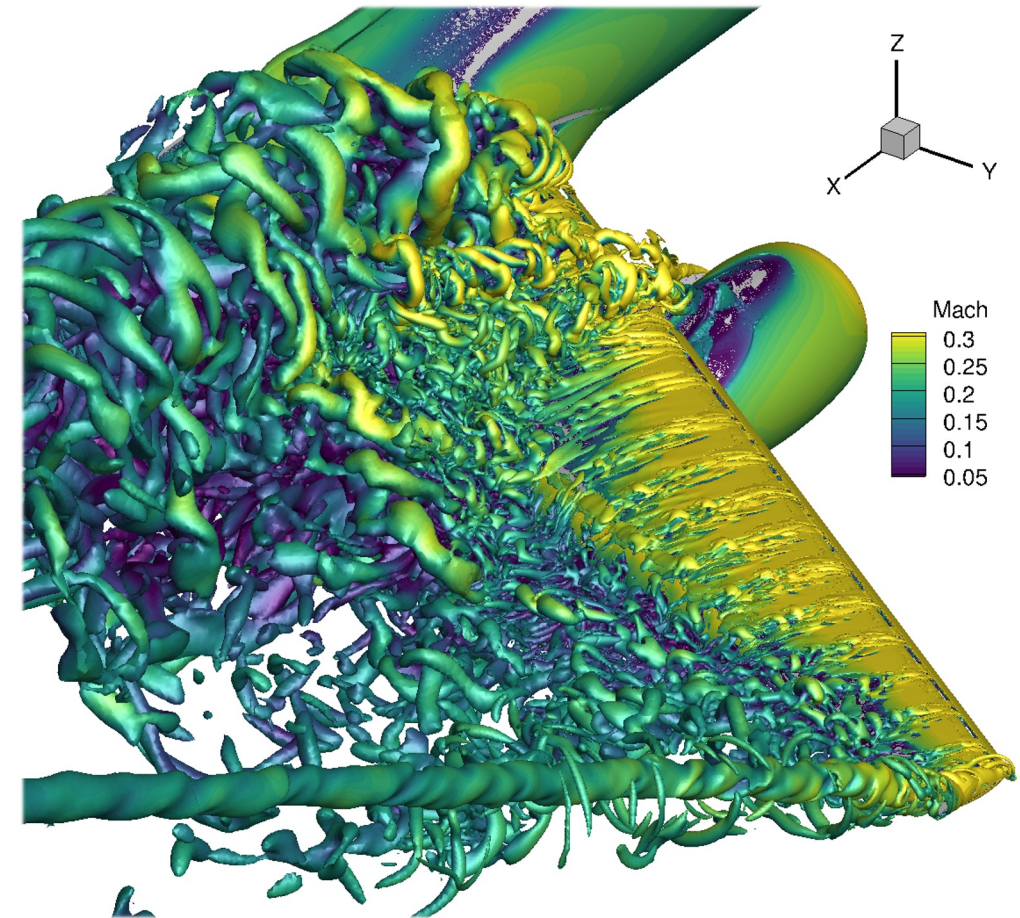
CFD Simulation Methods for High-Lift Aircraft Configurations (Part 2) – RANS vs DES

Based on the paper presented at AIAA Aviation 2022

T. Fitzgibbon, P. Spalart, J. Bungener and Q. Wang., “An Analysis of Modeling Sensitivity Effects for High Lift Predictions Using the Flow360 CFD solver”, Chicago, IL, 2022, AIAA Aviation Forum and Exposition

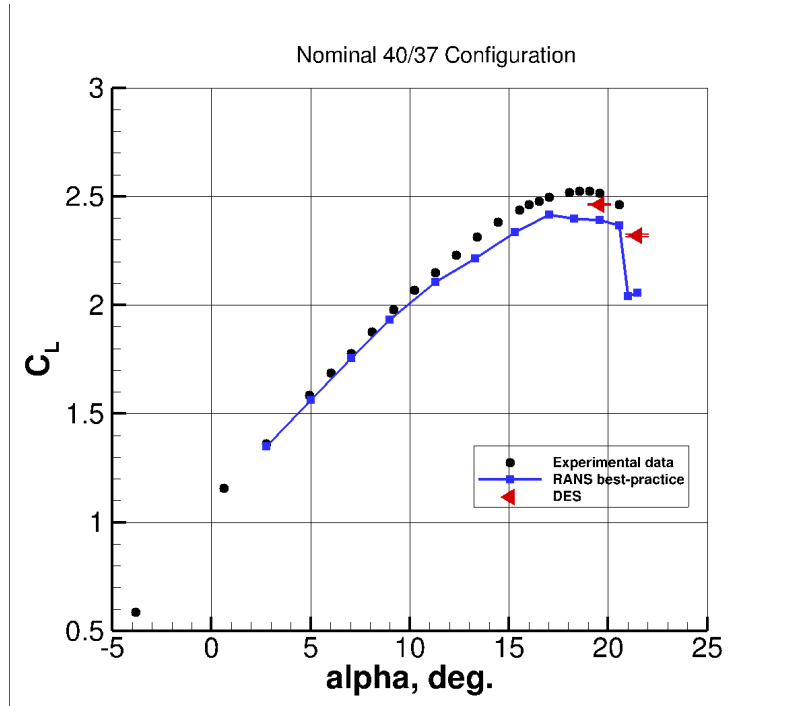
DES Results and Assessment of RANS

- RANS solutions exhibit significant modeling sensitivities.
- Compare RANS results with DES simulations
- DES simulations performed at two key angles of attack, $\alpha = 19.57^\circ$ and $\alpha = 21.47^\circ$ with solutions averaged over 20 CTU's and 40 CTU's respectively. Time step of $0.00388 \Delta t * U_{\text{ref}} / c_{\text{MAC}}$

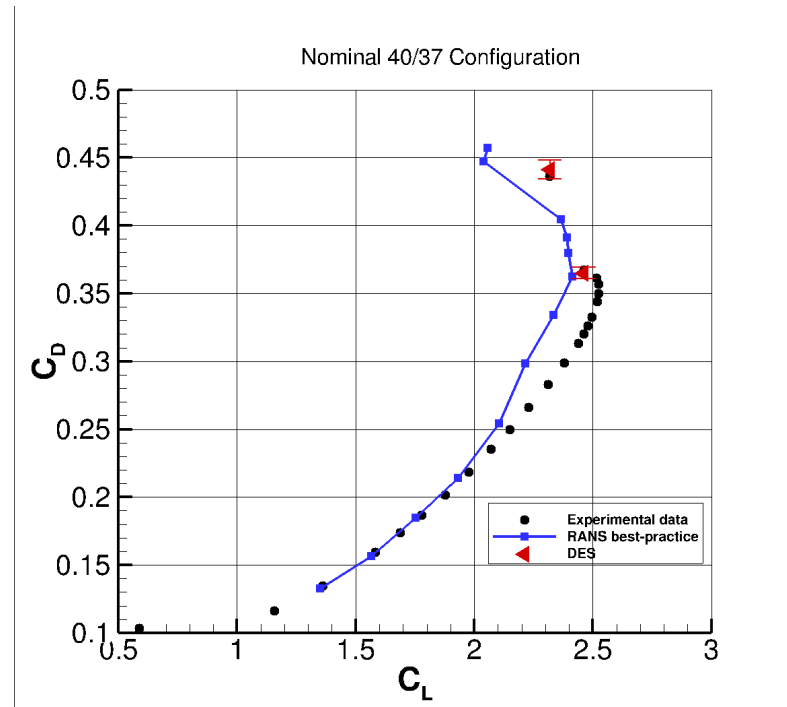


**Isosurface of Q-criterion for a DES solution
at $\alpha = 21.47$**

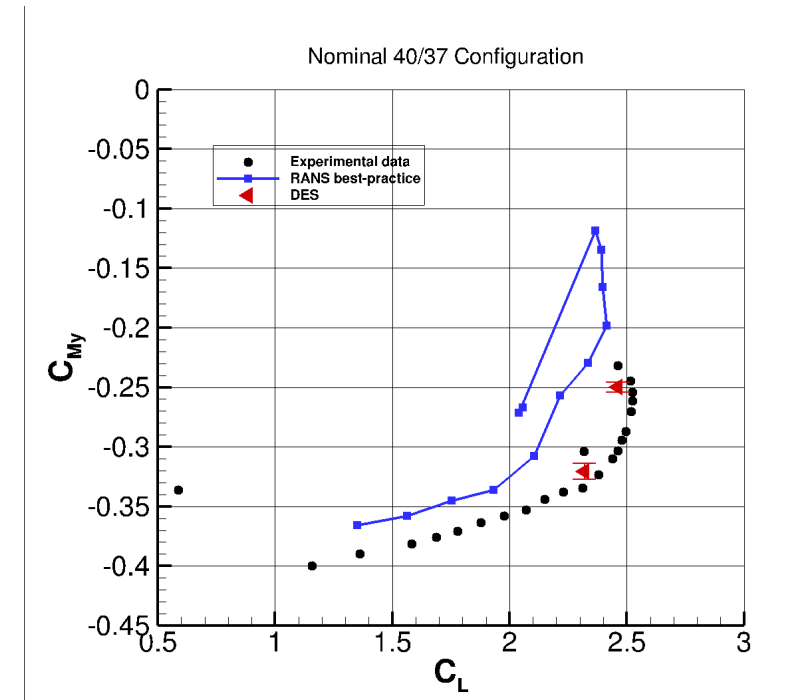
- DES results, ANSA C Level grid, Cold-started



C_L vs α



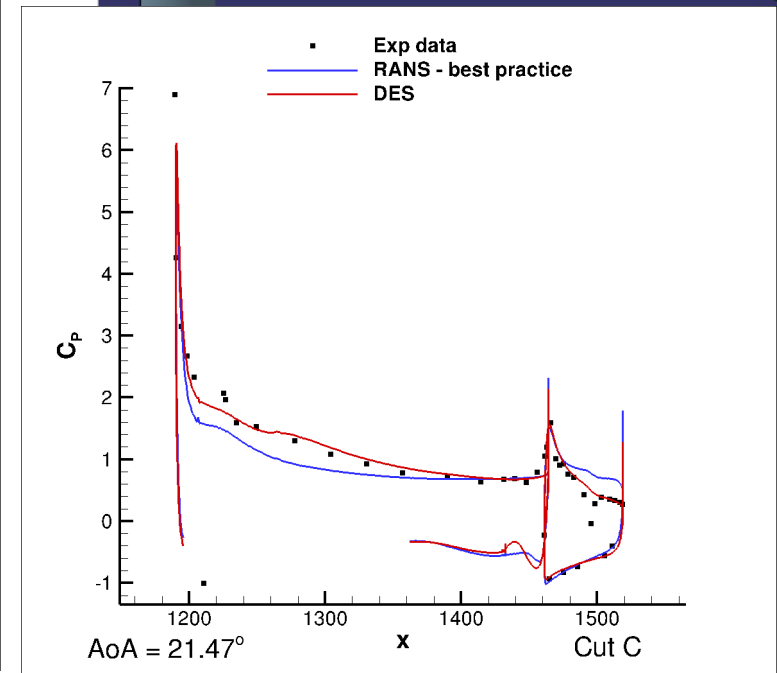
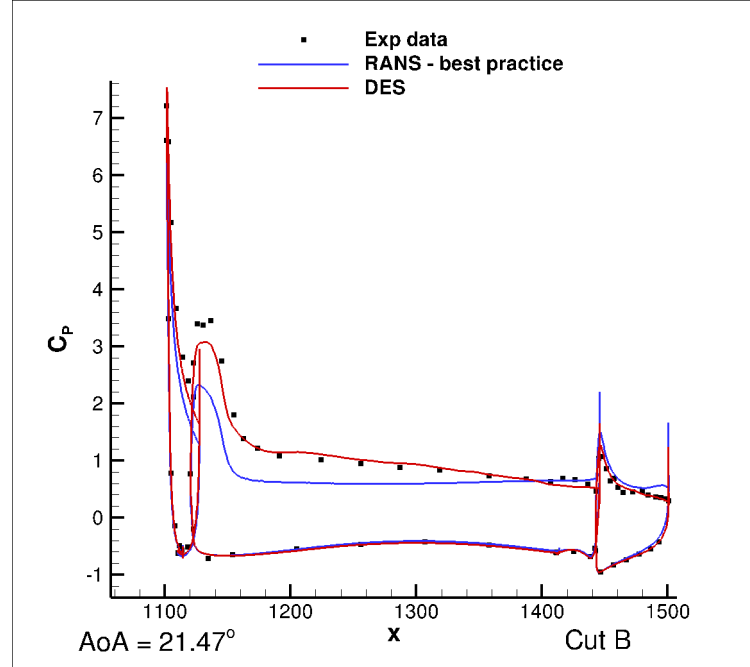
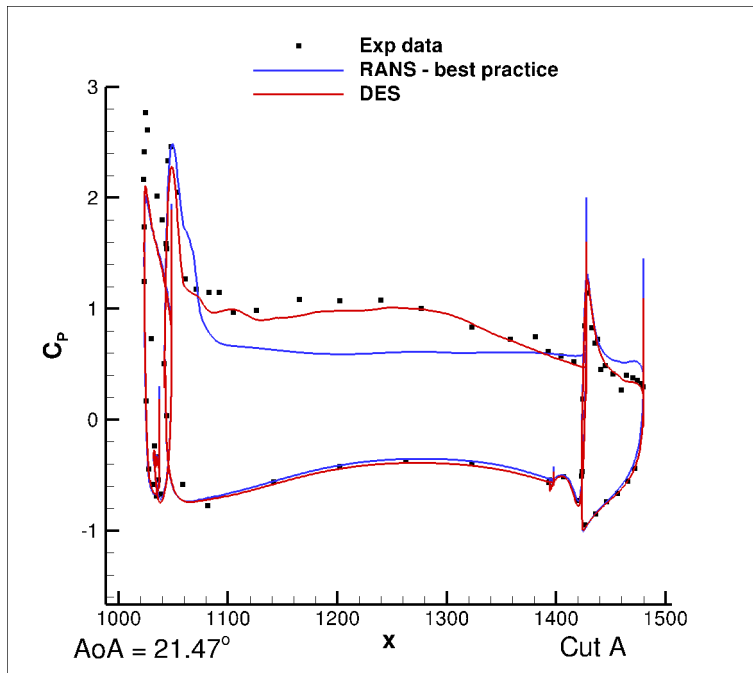
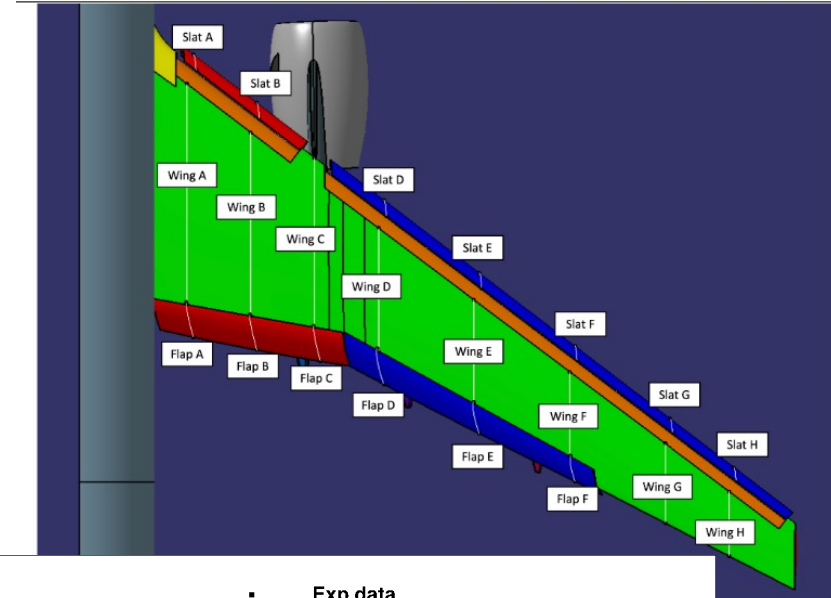
C_D vs C_L



C_M vs C_L

Do we get the correct answer for the correct reasons?
– Surface pressure coefficient at $\alpha = 21.47^\circ$

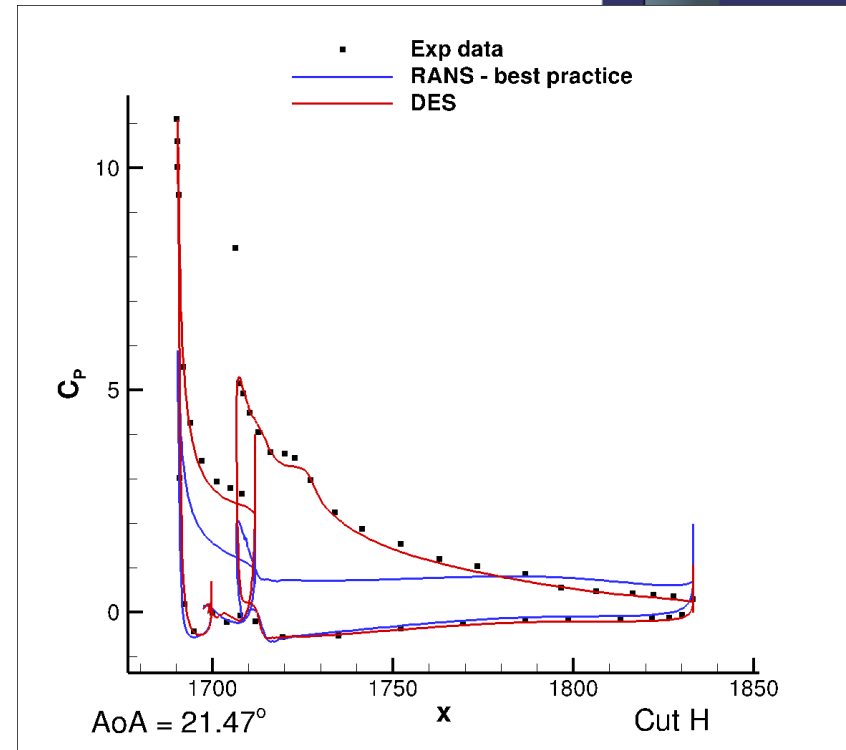
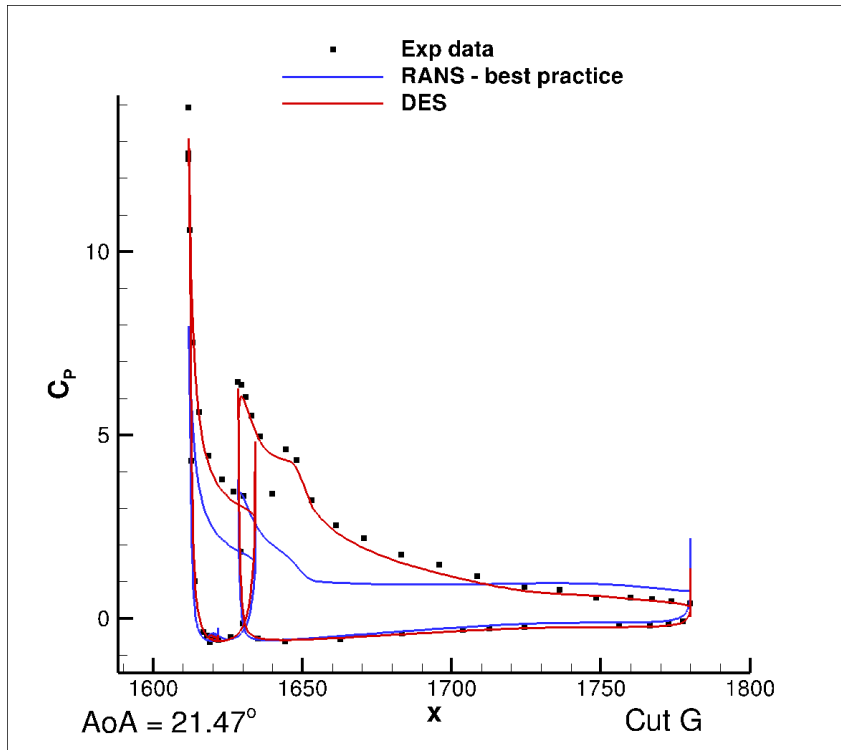
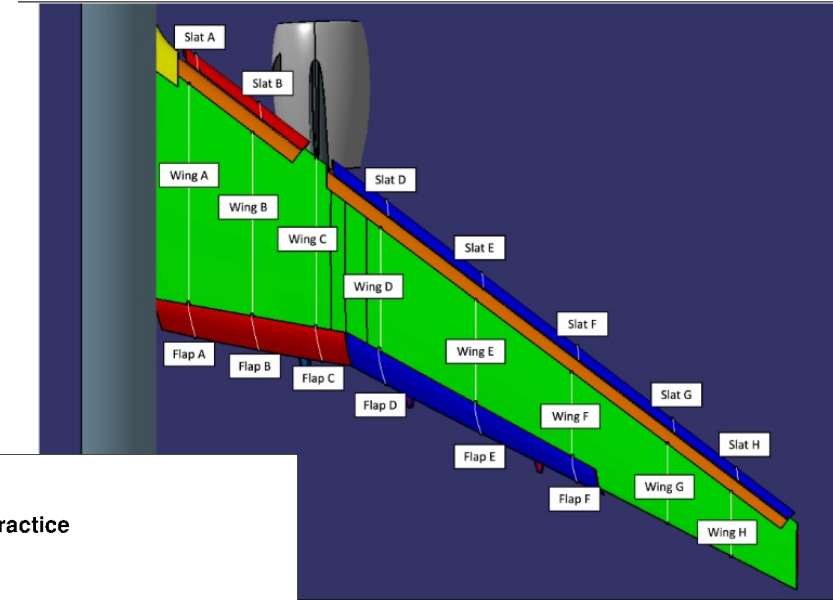
Inboard stations:



Do we get the correct answer for the correct reasons?

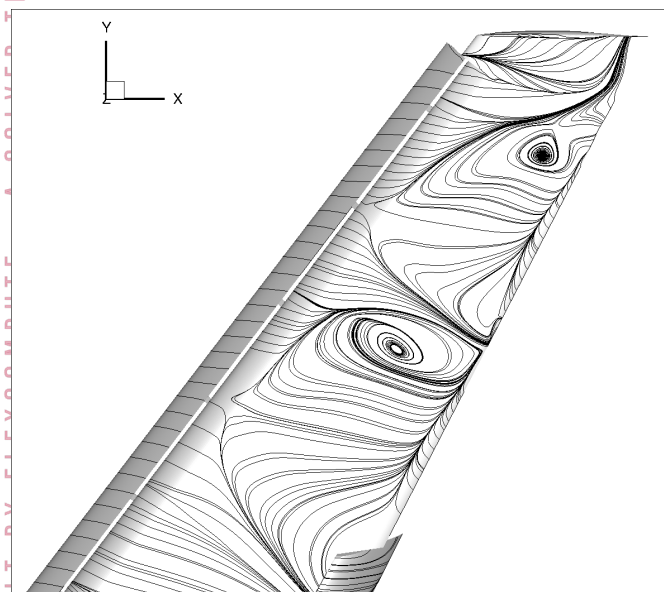
– Surface pressure coefficient at $\alpha = 21.47^\circ$

Outboard stations:

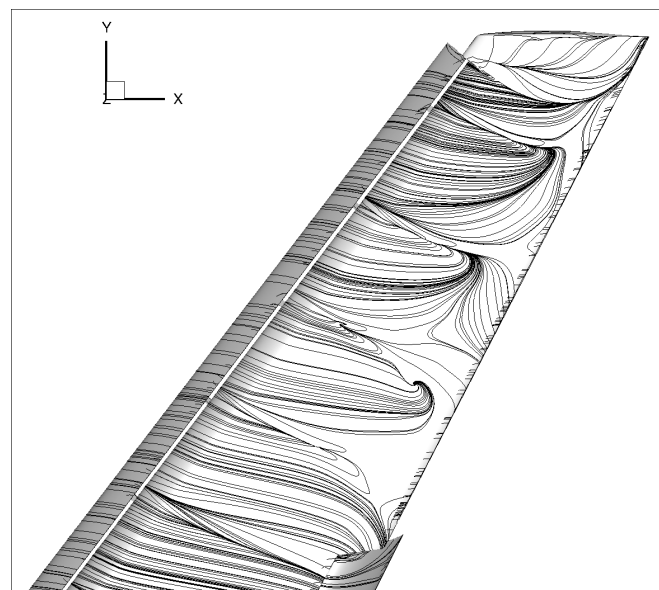


Do we get the correct answer for the correct reasons?

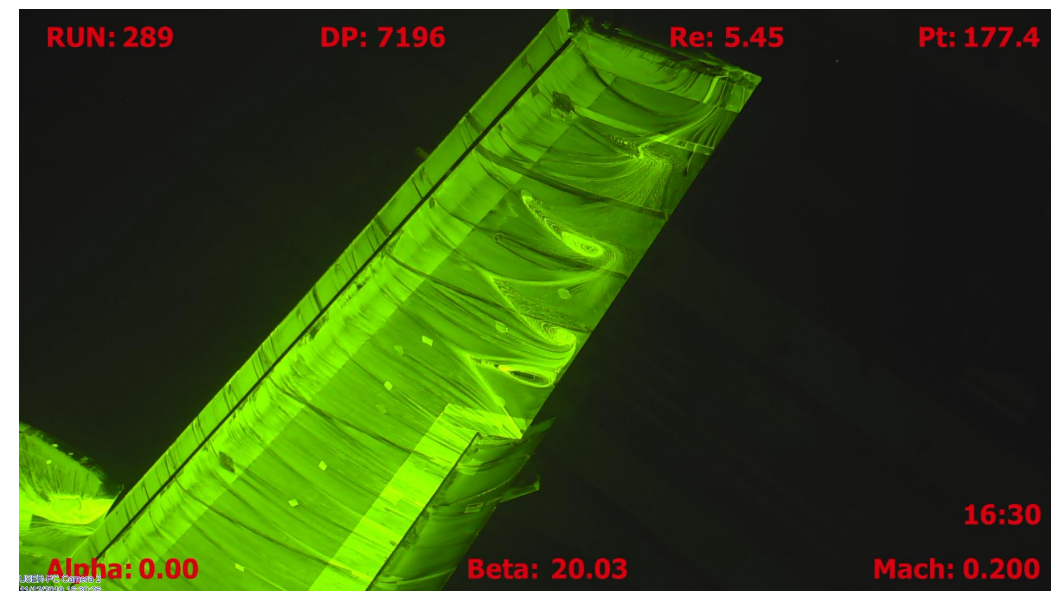
$$\alpha = 21.47^\circ$$



RANS



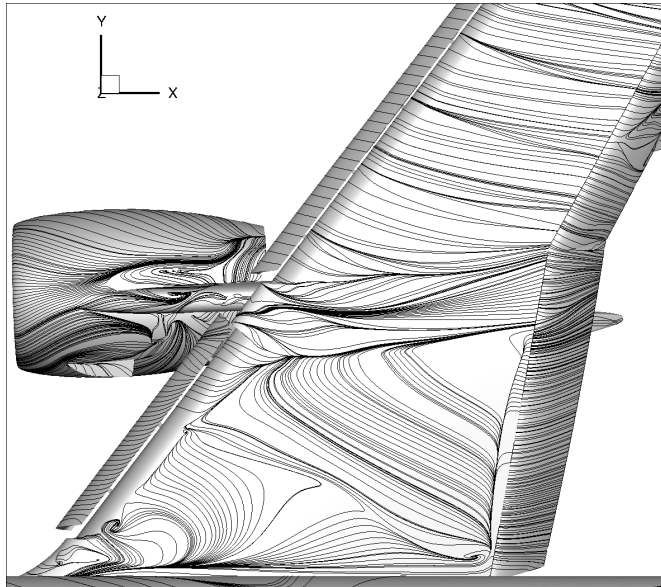
DES



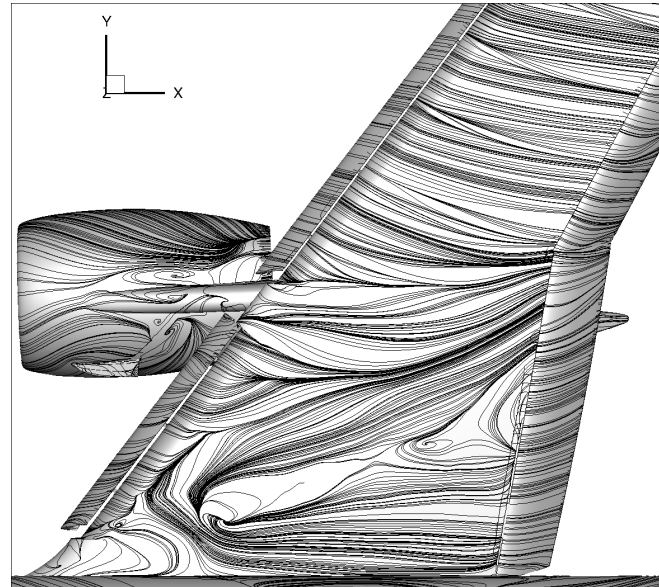
Experiment

Do we get the correct answer for the correct reasons?

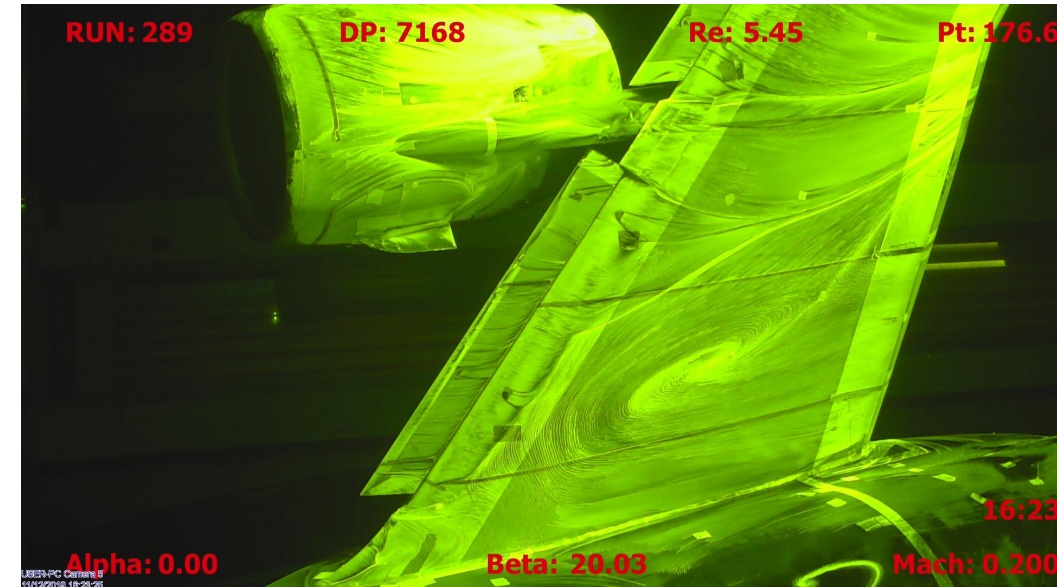
$$\alpha = 21.47^\circ$$



RANS



DES



Experiment

- RANS solutions exhibit significant modeling sensitivities for high-lift predictions.
- The DES results lead to significant improvements in accuracy of the predictions at high lift.

