STANFORD UNIVERSITY

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Drag Prediction of the DLR-F6 Configuration

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2nd AIAA CFD Drag Prediction Workshop, 21-22 June, Orlando, FL

Multi-Block Structured Code FLO107-MB

- Cell-Centered Finite Volume Scheme
- H-CUSP Scheme for Convective Fluxes
- SLIP Construction
- Central Discretization for Viscous Fluxes
- Runge-Kutta Time Stepping
- Multigrid, Implicit Residual Smoothing, Local Time Stepping
- SPMD-Parallel Using MPI

Turbulence Modeling

- Wilcox k - / / Model
- Segregated (Single Grid)
- Same Algorithm as for Laminar Variables (But Only 1st Order Diffusion)
- Point-Implicit Treatment of Source Terms
- Fully Turbulent Flow

Computer Architectures

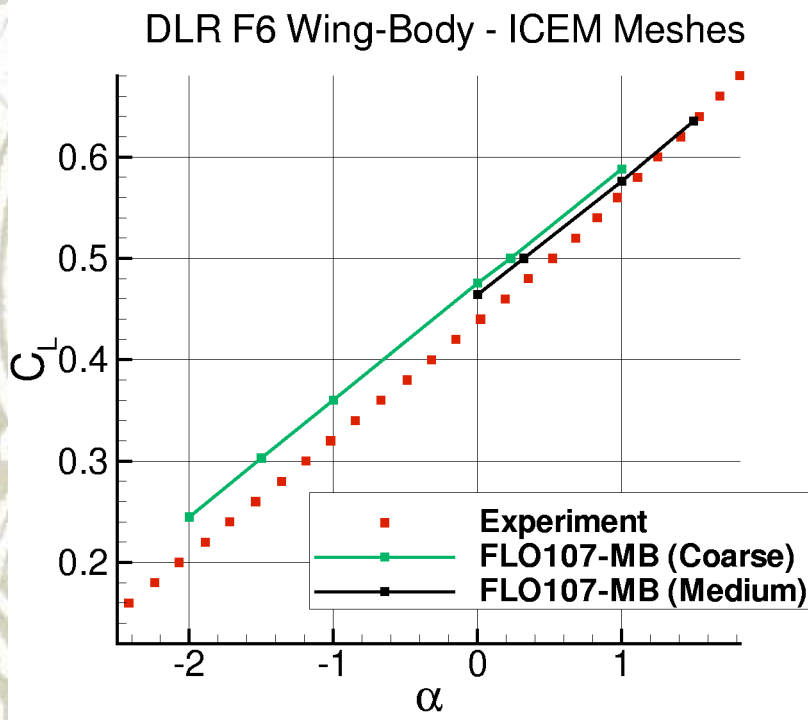
- SGI Origin (IRIX 6.5), 32 Processors, 15GB Memory
- Linux (2.4.18) Beowulf Cluster, 48 Nodes, ~1GB Memory per Node

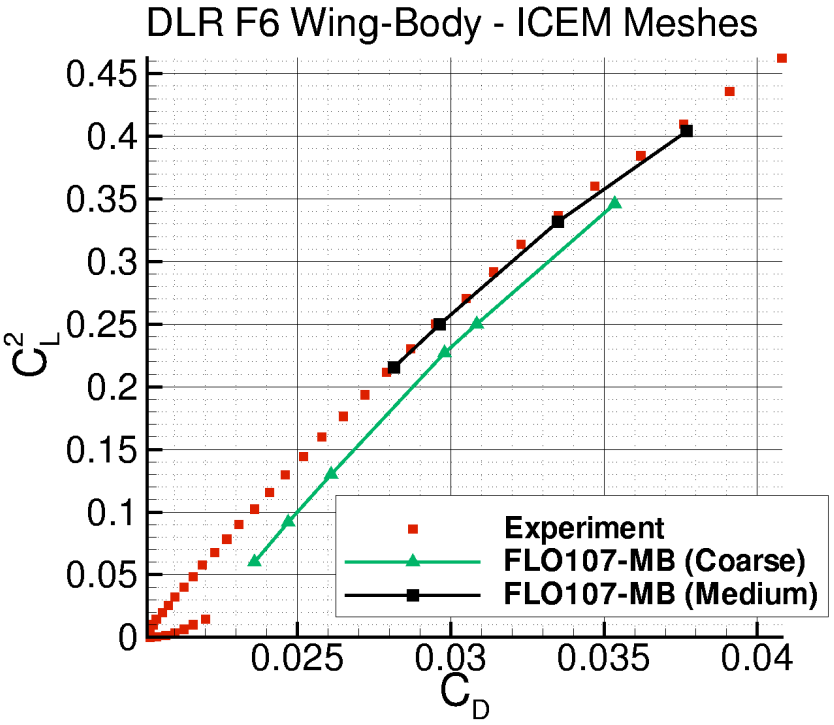
Grids: ICEM Block-Structured

	WB	WBNP
Coarse	3.3	4.6
Medium	5.5	8.5
Fine	10	13.7

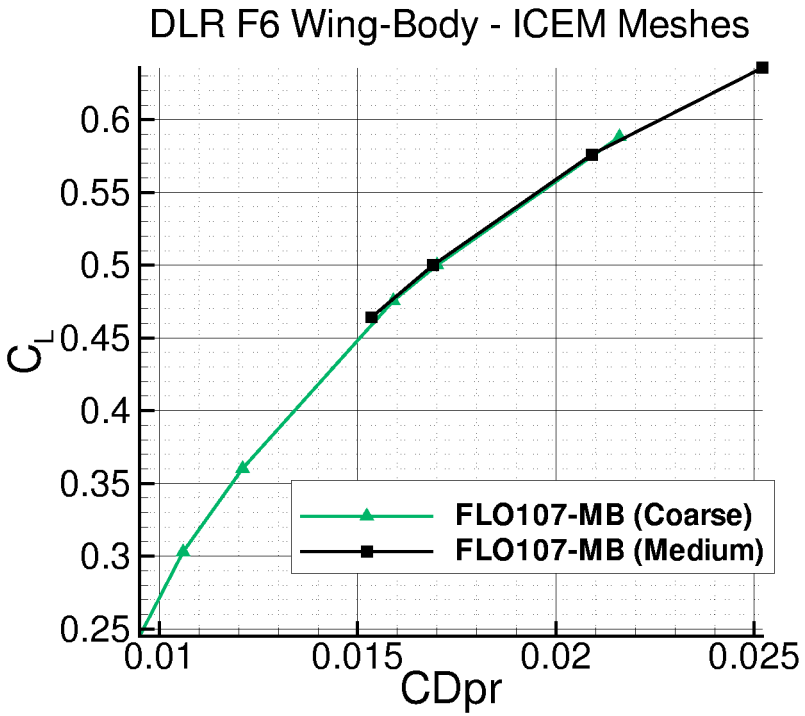
Cells in Million

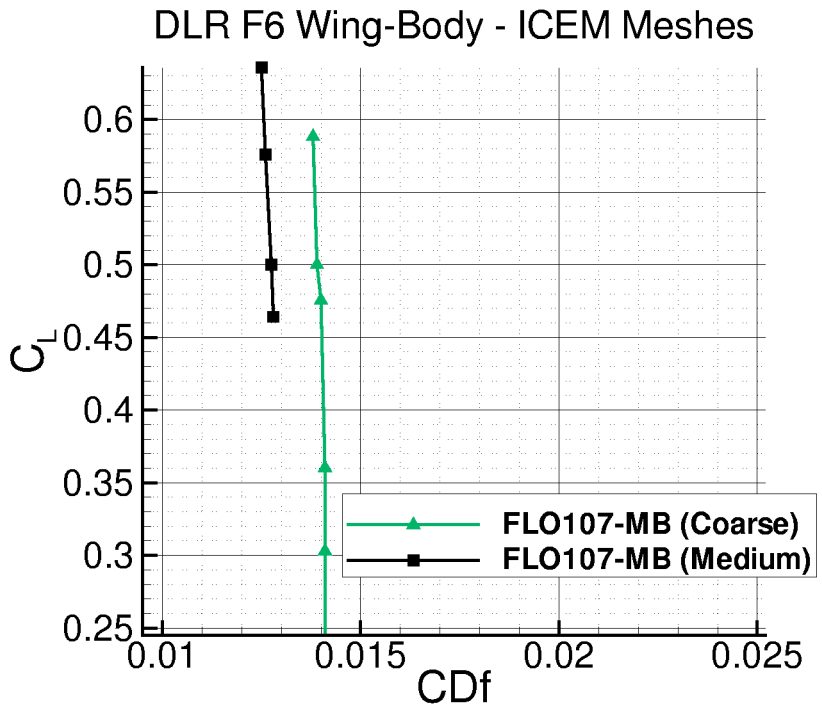
Wing-Body Results (M = 0.75)





Wing-Body Results (M = 0.75)





Wing-Body Results

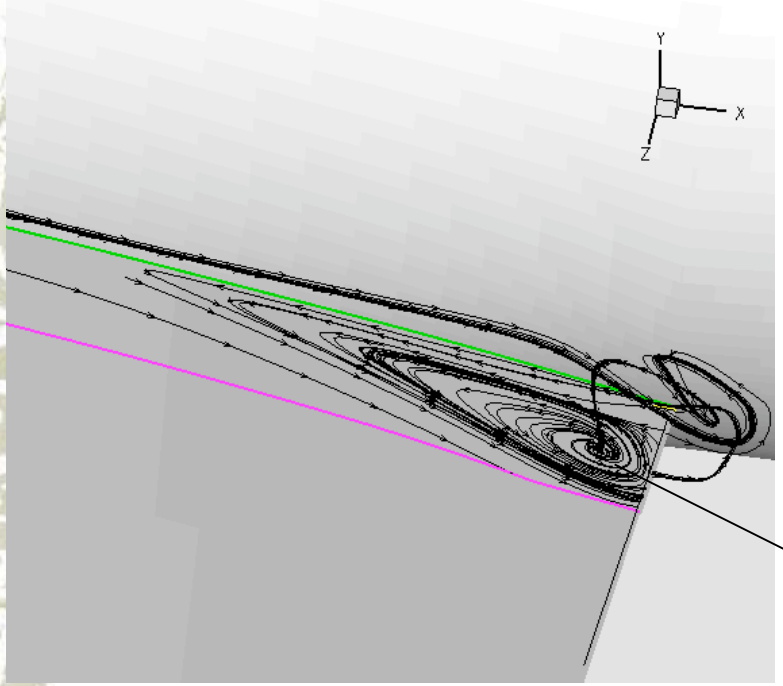
(M = 0.75, CL = 0.5)

	Coarse	Medium	Experiment
Incidence	0.23	0.32	0.52
CD	0.0308	0.0297	0.0295
CDpr	0.0169	0.0169	
CDf	0.0139	0.0128	
CM	-0.136	-0.131	-0.121

Wing-Body Results

(M = 0.75, CL = 0.5)

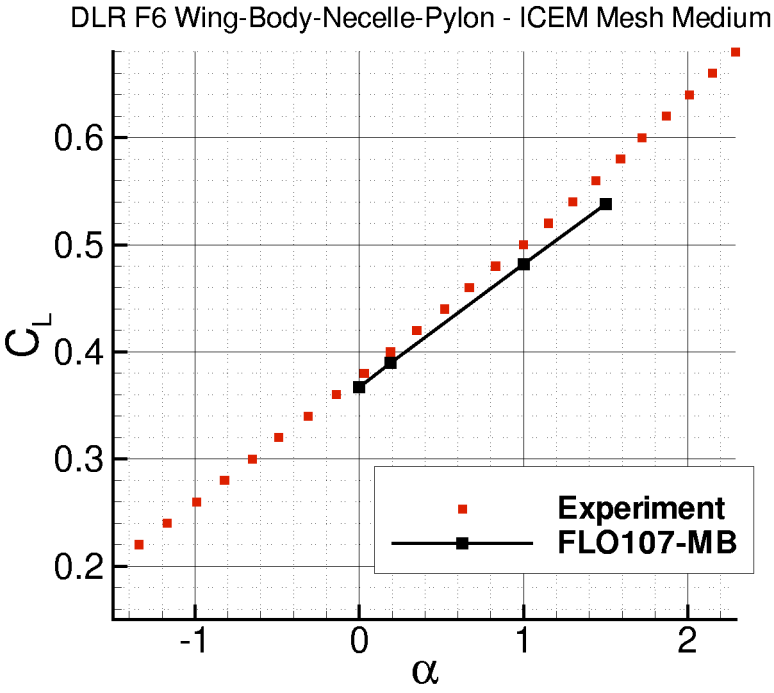
- We Have a Separation Zone Near the Wing Root

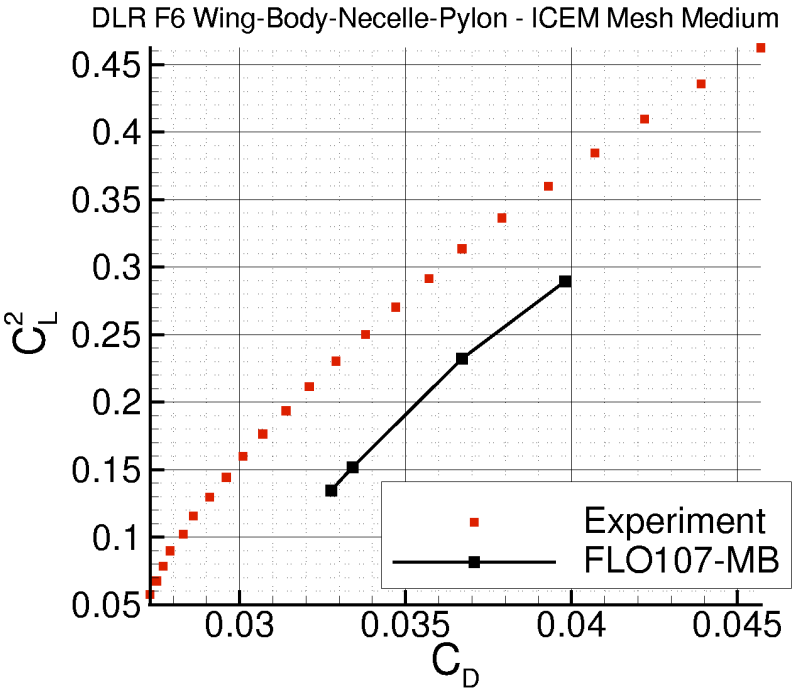


Size: ~ 73mm upstream of TE (at Wing Root)
~ 22 mm maximum extension of separating Streamline

Eye ~ 7mm/15mm from TE and WF Intersection, respectively

Wing-Body-Nacelle-Pylon Results (M = 0.75)



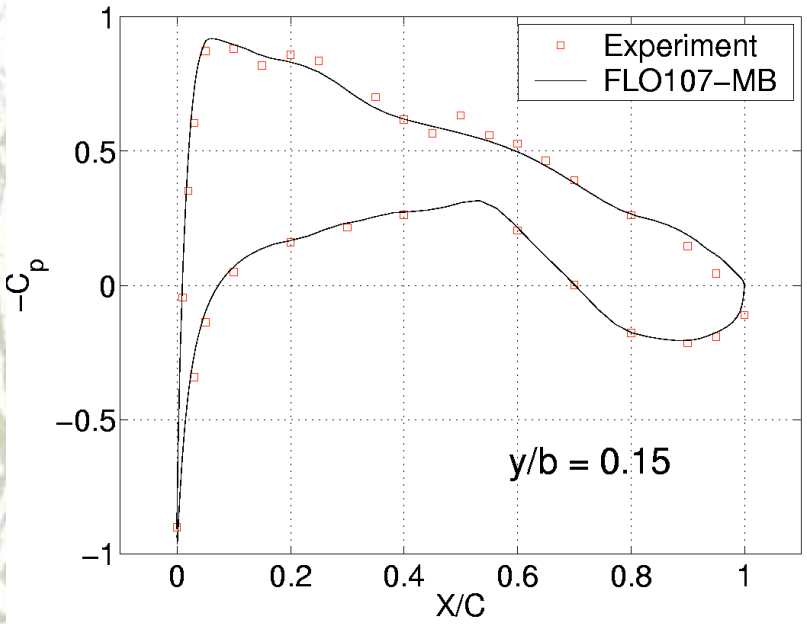


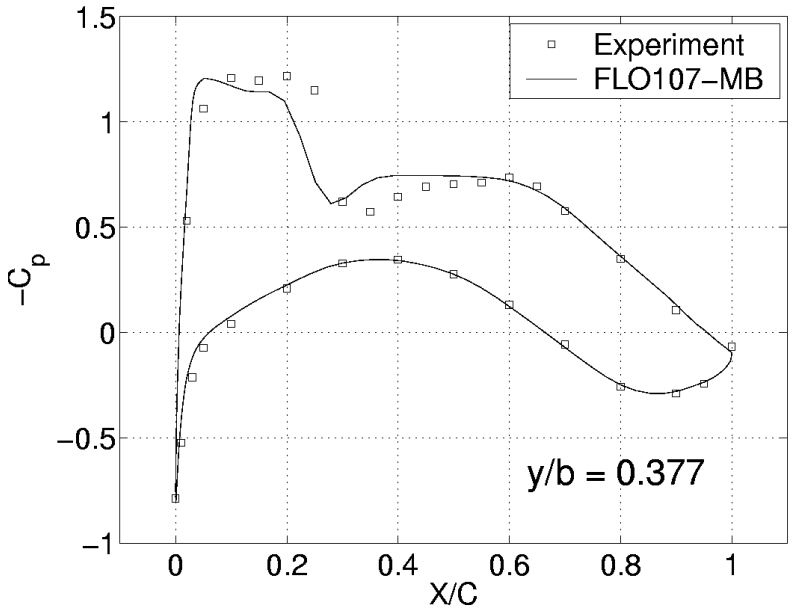
Grid Dependency of Results

Fuselage Skin Friction Drag

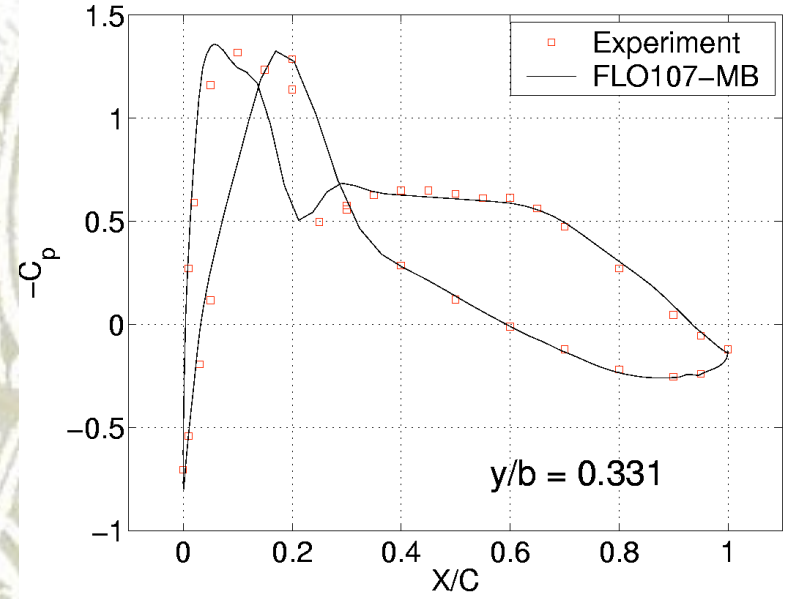
Wing-Body	~72 counts
Wing-Body-Nacelle-Pylon	~77 counts
∏	~ 5 counts

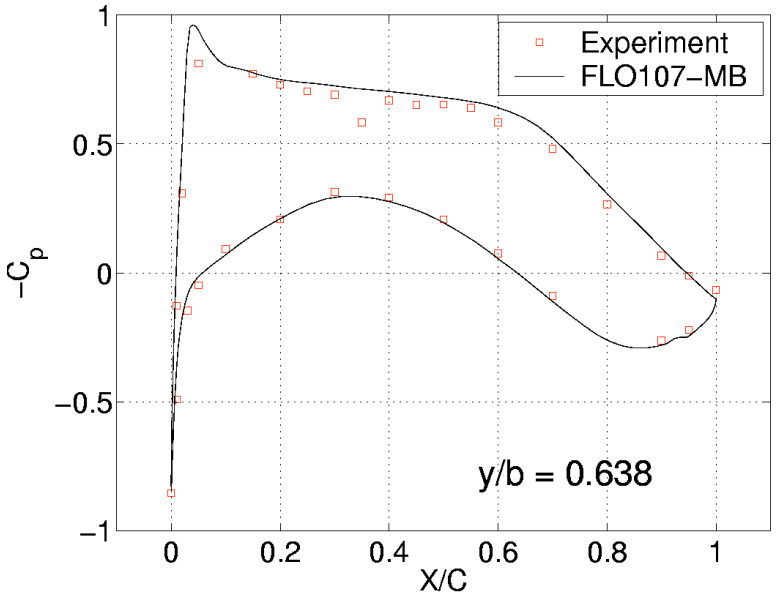
Wing-Body Pressure Distribution (M = 0.75, CL = 0.5)



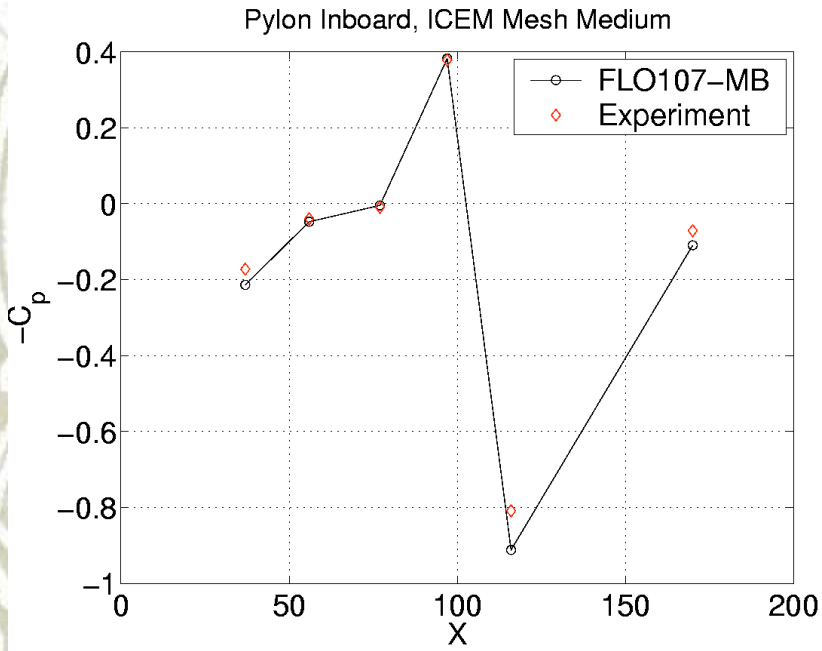


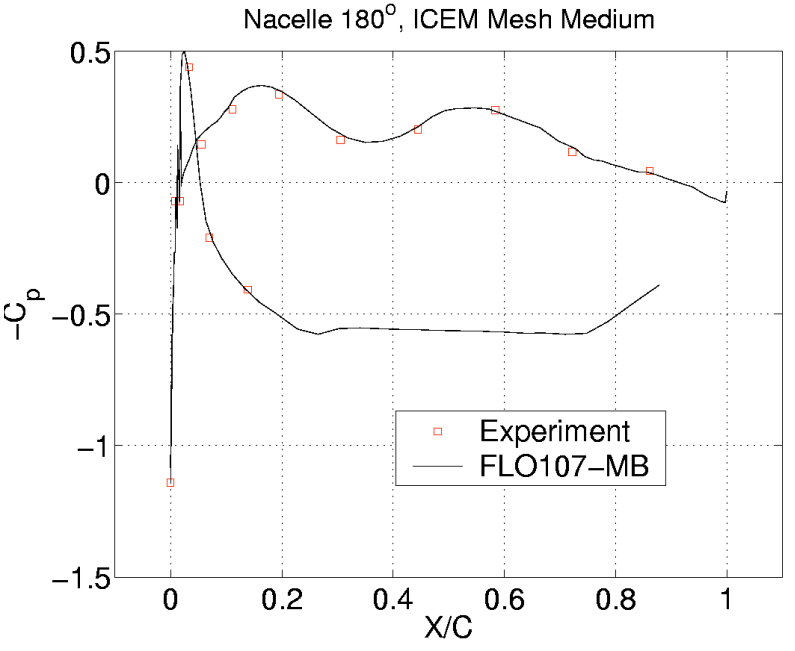
Wing-Body-Nacelle-Pylon Pressure Distribution
(M = 0.75, Incidence = 0.19)





Pylon and Nacelle Pressure Distribution (M = 0.75, Incidence = 0.19)





Summary

- Correct Lift Slope and Polar Shape
- Good Agreement in Total Drag for Wing-Body configuration
- Deviation in Total Drag for Wing-Body-Nacelle-Pylon configuration likely due to Grid Dependency