USM3D-ME Buffet Simulations of the ONERA OAT15A Airfoil for DPW-8/AePW-4

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Contents

Introduction

- **Supports DPW-8/AePW-4 Buffet Working Group**
- **ONERA OAT15A transonic airfoil**
  - Well-studied geometry and results are compared to Jacquin, et al.[1]
  - Buffet Working Group Test Case 1a
  - RANS, range of alphas (1.36 through 3.90 deg)
  - Mach 0.73
  - Re = 3 million
- **Time-resolving technology is in development**

Grids

- **Utilized committee-supplied Cadence and Helden unstructured grids**
- **Differing gridding techniques were employed**
- **Simulated grid levels L1, L2, and L3 for both grid families**

Cadence

Grid Level	Approx Cell Count	Target y^+
L1	47,000	1.000
L2	89,000	0.670
L3	150,000	0.500
L4	235,000	0.400
L5	353,000	0.330
L6	517,000	0.290

Helden Aerospace

Grid Level	Approx Cell Count	Target y^+
L1	10,000	4.000
L2	35,000	2.000
L3	134,000	1.000
L4	528,000	0.500
L5	2,076,000	0.250
L6	8,208,000	0.125

Grids

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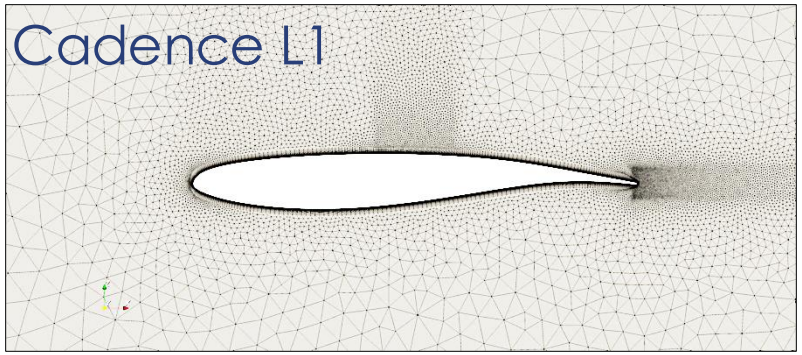
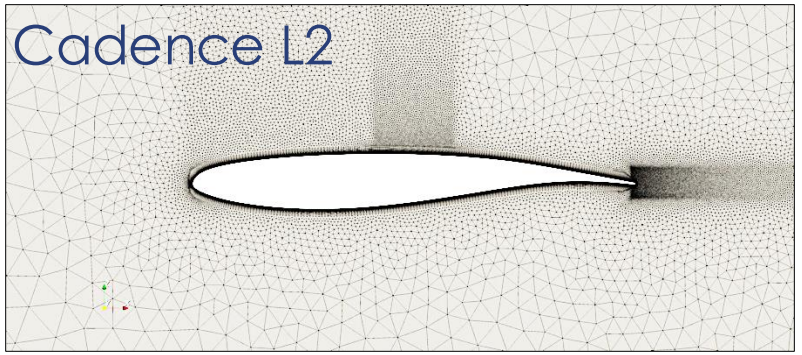
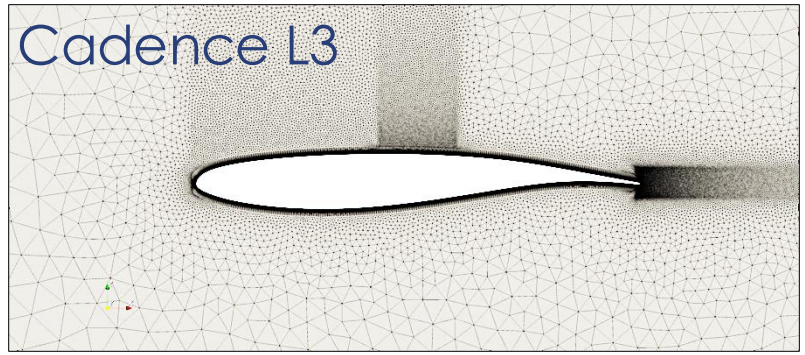
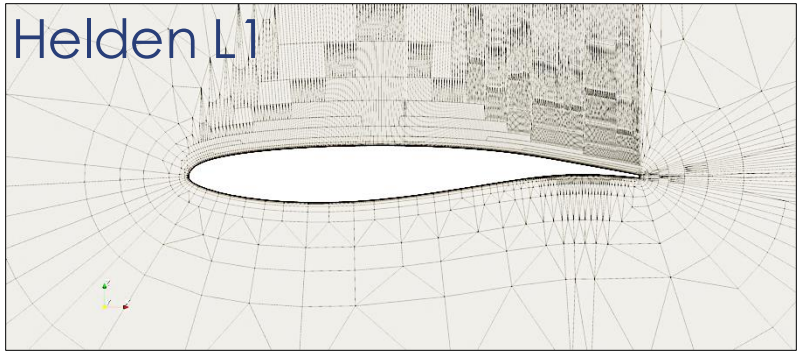
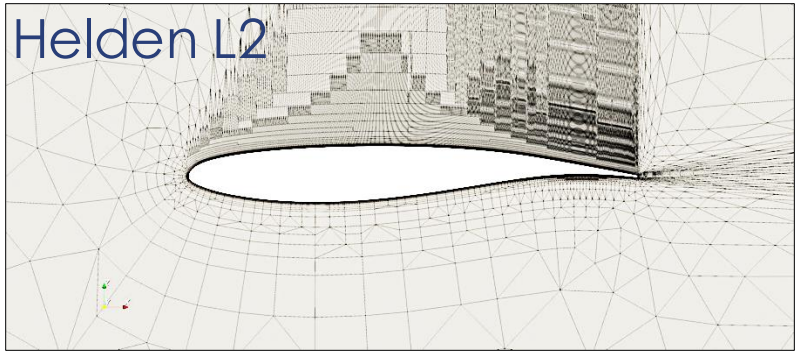
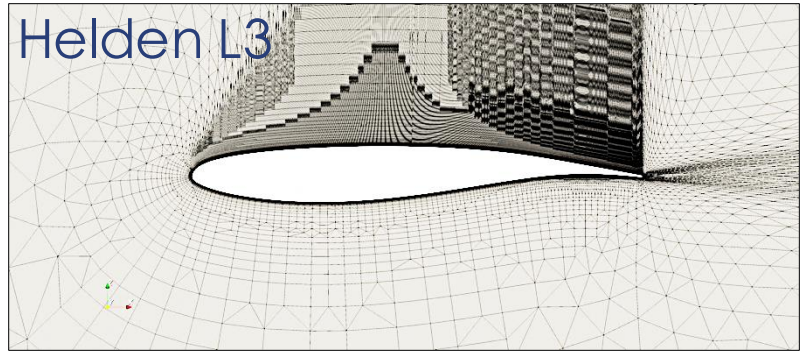






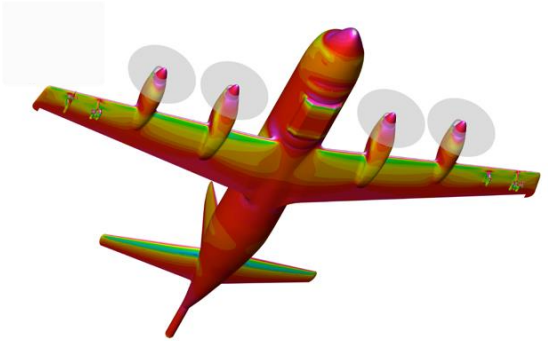


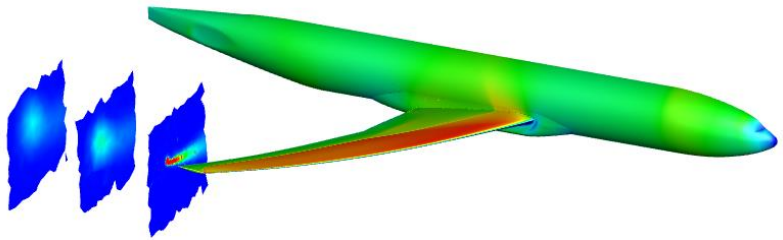




Numerical Method

- **USM3D-ME (mixed element)$_2$**
  - Developed at NASA Langley Research Center
  - Successor to USM3D[3] solver
  - Strong linear solver increases robustness and efficiency[4]
  - Second order in space coupled with Roe's flux-difference-splitting FDS scheme
- **Setup**
  - RANS, local time-stepping
  - Automatic CFL updating
  - Parallelized MPI paradigm
- **Turbulence model**
  - SA-neg[5]
  - SA-neg-R (rotation correction)[6]
  - NA-neg-QCR2000[7]





Grid Convergence

Simulation Convergence

Force and Moment Comparison

Shock Location and Structure

Summary and Conclusions

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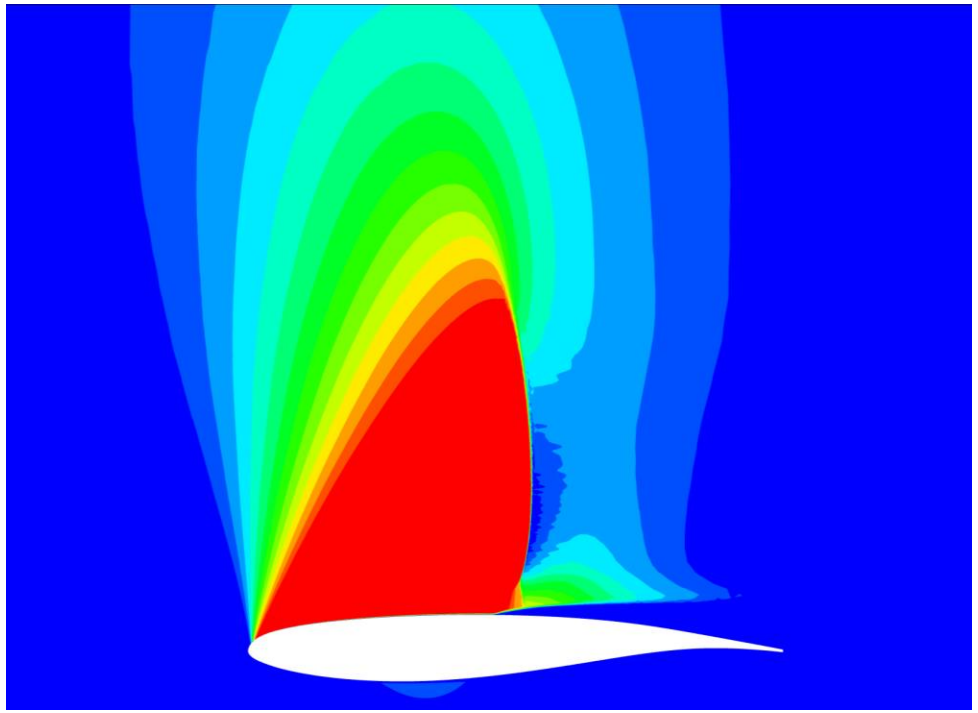
Questions?



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