

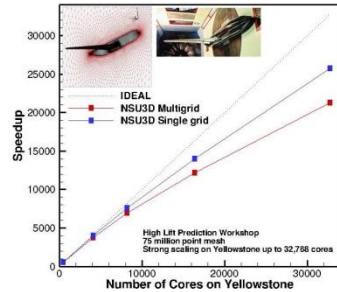


Highly-Scalable Computational-Based Algorithms for Emerging Parallel Machine Architectures

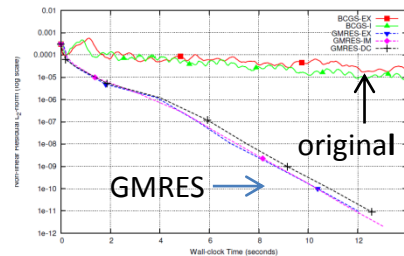
PI: Professor Dimitri Mavriplis, Scientific Simulations LLC STTR with U Wyoming



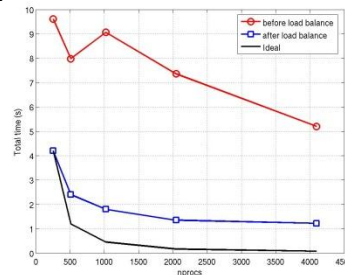
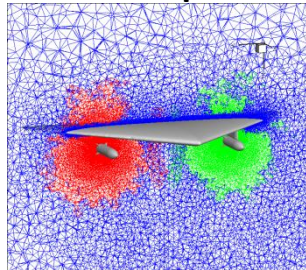
NSU3D Scalability up to 32,768 cores



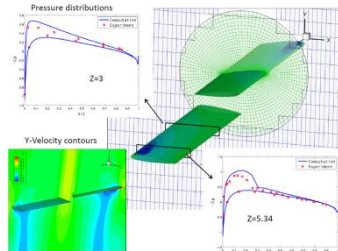
Improved Time-Spectral Solver



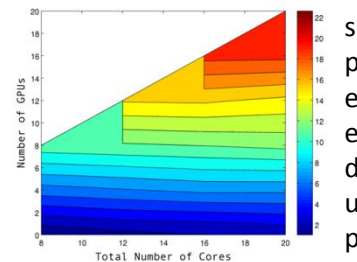
Improved load-balanced overset mesh hole cutting performance up to 4096 cores



Overset mesh problem



Speedup on combined CPU-GPUs



Purpose

Develop and validate novel techniques to enable complex multiphysics codes to scale up to 100,000 computer cores

Approach

- Enhance preprocessing tools to operate on many cores
 - Hierarchical partitioning
 - Parallel mesh refinement
 - Distance function calculation/Parallel multi-grid
- More scalable algorithms (time spectral, implicit Runge-Kutta)
- Improved overset mesh hole cutting (load balancing)
- Combined hybrid GPU-CPU implementations

Highlights

- Parallel partitioning and solution of unstructured mesh solver (NSU3D) demonstrated up to 32,768 cores
- Improved GMRES solution technique for Time-Spectral methods and implicit Runge-Kutta time stepping
- Improved overset hole cutting demonstrated up to 4096 cores
- Combined GPU-CPU overset solver on hybrid hardware

Stakeholders

- AFSEO, HPCMP, 96th TW, 412th TW, AEDC
- AFRL/RW, AFRL/RQ
- NASA