National Aeronautics and Space Administration

Computational Scaling for an Unstructured-Grid CFD Solver

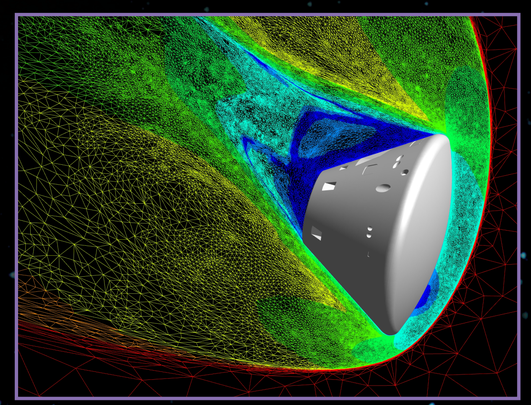
FUN3D is a suite of unstructured-grid computational fluid dynamics (CFD) codes that utilizes an adjoint-based technique to perform design optimization, error estimation, and mesh adaptation for complex flowfields. To enable these computationally intensive analyses, this project seeks to improve application performance and scalability for FUN3D simulations running in massively parallel computing environments. Key accomplishments and efforts include:

- Demonstrating that complex FUN3D simulations can be run effectively on large numbers of processors
- Investigating whether a single set of Message Passing Interface (MPI) constructs can be used over multiple supercomputers with different underlying MPI implementations
- Examining limitations of underlying MPI implementations—such as scalability, memory used by message passing libraries, and synchronization—in conjunction with the MPI constructs used by FUN3D

By enabling the software to run more reliably and efficiently on the world's largest supercomputers, analysis and design cycle times can be dramatically lessened, ultimately reducing cost and turnaround times for a myriad of NASA projects.

Eric Nielsen, NASA Langley Research Center

Simulation of an armed IA-407 helicopter. *Tin-Chee Wong, US Army*



Adjoint-based mesh adaptation for the Orion reentry vehicle. *Bil Kleb, NASA/Langley*

AERONAUTICS

www.nasa.gov

AERONAUTICS RESEARCH MISSION DIRECTORATE