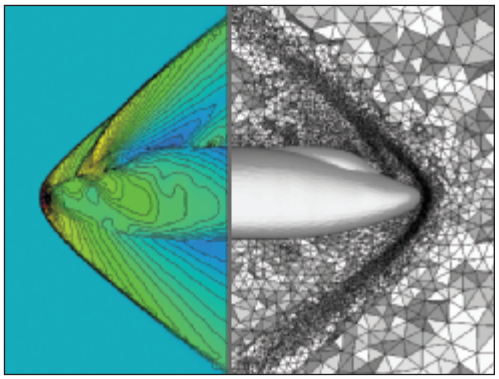
- Autonomous formation of teams through negotiations among the spacecraft,
- Working out details of high-level commands (e.g., shapes and sizes of geometrically complex formations),
- Implementation of a distributed guidance law providing autonomous optimization and assignment of target states, and
- Implementation of a decentralized, fuel-optimal, impulsive control law for planning maneuvers.

This work was done by Joseph B. Mueller of Princeton Satellite Systems, Inc. for **Goddard Space Flight Center**. *Further information is contained in a TSP (see page 1).* *GSC-14779-1*

More About the Tetrahedral Unstructured Software System

Langley Research Center, Hampton, Virginia

TetrUSS is a comprehensive suite of computational fluid dynamics (CFD) programs that won the Software of the Year award in 1996 and has found increasing use in government, academia, and industry for solving realistic flow problems (especially in aerodynamics and aeroelastics of aircraft having complex shapes). TetrUSS includes not only programs for solving basic equations of flow but also programs that afford capabilities for efficient generation and utilization of computational grids and for graphical representation of computed flows (see figure). The 2004 version of the Tetrahedral Unstructured Software System (TetrUSS), which is one of two software systems reported in "NASA's 2004 Software of the Year," *NASA Tech Briefs*, Vol. 28, No. 10 (October 2004), page 18, has been improved greatly since 1996. These improvements include (1) capabilities to simulate viscous flow by solving the Navier-Stokes equations on unstructured grids, (2) portability to personal computers from diverse manufacturers, (3) advanced models of turbulence, (4) a parallel-processing version of one of the unstructured-grid Navier-Stokes-equation-solving programs, and (5) advanced programs for generating unstructured grids.



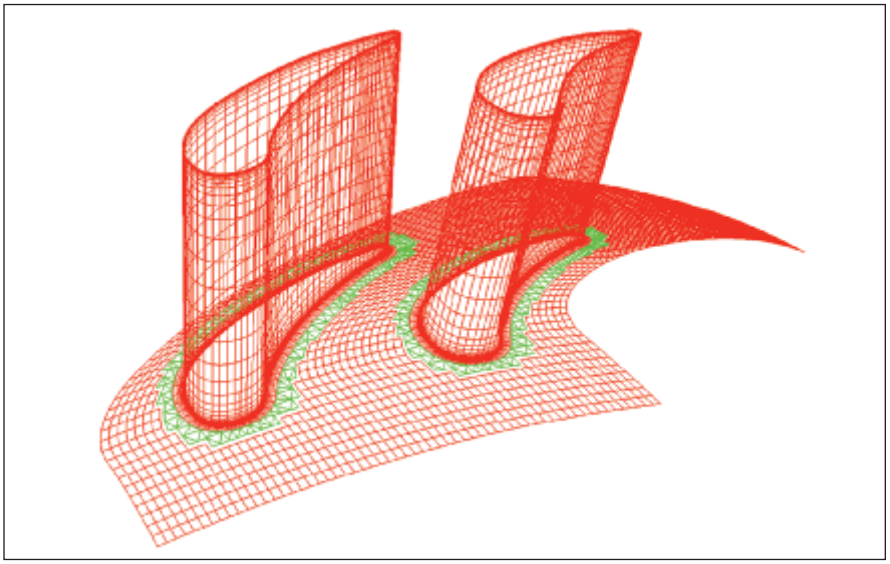
An **Adapted Grid and Flow Solution** are shown on the X-38 vehicle. This is one of the recent features included in TetrUSS.

These programs were written by Khaled S. Abdol-Hamid, Neal T. Frink, Craig A. Hunter, Paresh C. Parikh, Shahyar Z. Pizadeh, and Jamshid A. Samareh of **Langley Research Center**; *Maharaj K. Bhat of EITI; Mohagna J. Pandya of Swales Aerospace; and Matthew J. Grismer of the U.S. Air Force Research Laboratory. Further information is contained in a TSP (see page 1). .*
LAR-16882-1

Computing Flows Using Chimera and Unstructured Grids

John H. Glenn Research Center, Cleveland, Ohio

DRAGONFLOW is a computer program that solves the Navier-Stokes equations of flows in complexly shaped three-dimensional regions discretized by use of a direct replacement of arbitrary grid overlapping by nonstructured (DRAGON) grid. A DRAGON grid (see figure) is a combination of a chimera grid (a composite of structured subgrids) and a collection of unstructured subgrids. DRAGONFLOW incorporates modified versions of two prior Navier-Stokes-equation-solving programs: OVERFLOW, which is designed to solve on chimera grids; and USM3D, which is used to solve on unstructured grids. A master module controls the invocation of individual modules in the libraries. At each time step of a simulated flow, DRAGONFLOW is invoked on the chimera portion of the



This is a **DRAGON Grid** of the annular turbine cascade.