

version — Loci-STREAM version 0.9 — includes an interface with the Portable, Extensible Toolkit for Scientific Computation (PETSc) library for access to enhanced linear-equation-solving programs therein that accelerate convergence toward a solution. The name “Loci” reflects the creation of this software within the Loci computational

framework, which was developed at Mississippi State University for the primary purpose of simplifying the writing of complex multidisciplinary application programs to run in distributed-memory computing environments including clusters of personal computers. Loci has been designed to relieve application programmers of the details of

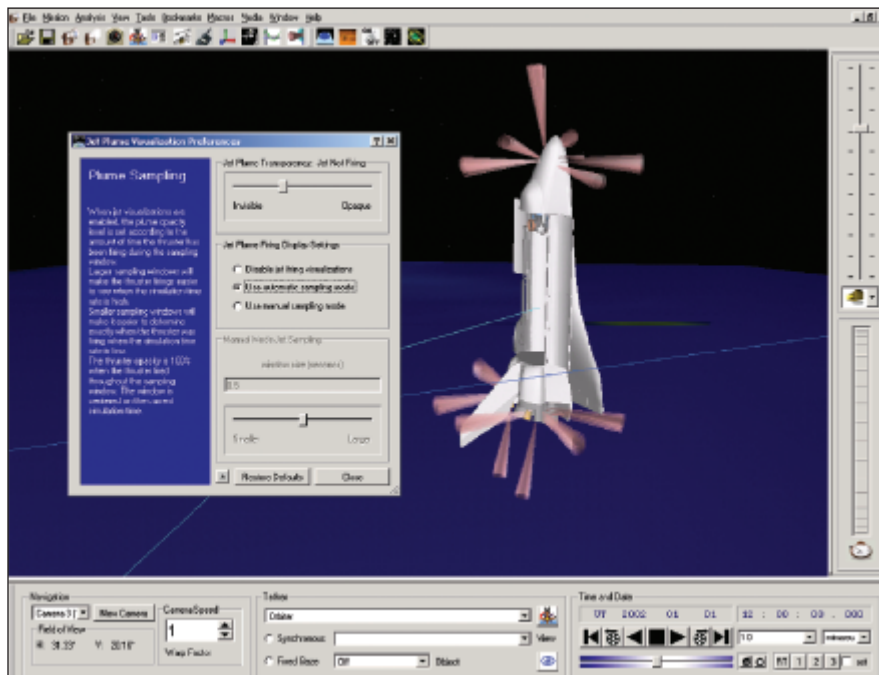
programming for distributed-memory computers.

*This program was written by Jeffrey Wright and Siddharth Thakur of Streamline Numerics, Inc. for Marshall Space Flight Center. Further information is contained in a TSP (see page 1).
MFS-32303-1*

The Synergistic Engineering Environment

Langley Research Center, Hampton, Virginia

The Synergistic Engineering Environment (SEE) is a system of software dedicated to aiding the understanding of space mission operations. The SEE can integrate disparate sets of data with analytical capabilities, geometric models of spacecraft, and a visualization environment (see figure), all contributing to the creation of an interactive simulation of spacecraft. Initially designed to satisfy needs pertaining to the International Space Station, the SEE has been broadened in scope to include spacecraft ranging from those in low orbit around the Earth to those on deep-space missions. The SEE includes analytical capabilities in rigid-body dynamics, kinematics, orbital mechanics, and payload operations. These capabilities enable a user to perform real-time interactive engineering analyses focusing on diverse aspects of operations, including flight attitudes and maneuvers, docking of visiting spacecraft, robotic operations, impingement of spacecraft-engine exhaust plumes, obscuration of instrumentation fields of view, communications, and alternative assembly configurations. The SEE continues to undergo development at Langley Research Center.



Plumes of Jet Firings can be displayed by the SEE. The user can turn off the firing visualization without disabling the visualization of the location.

This program was written by Jonathan Cruz of Langley Research Center and Scott Angster of Analytical Mechanics Associ-

*ates, Inc. Further information is contained in a TSP (see page 1).
LAR-16842-1*

Reconfigurable Software for Controlling Formation Flying

Goddard Space Flight Center, Greenbelt, Maryland

Software for a system to control the trajectories of multiple spacecraft flying in formation is being developed to reflect underlying concepts of (1) a decentralized approach to guidance and control and (2) reconfigurability of the control system, including reconfigurability of the software and of control laws. The software is organized as a modular

network of software tasks. The computational load for both determining relative trajectories and planning maneuvers is shared equally among all spacecraft in a cluster. The flexibility and robustness of the software are apparent in the fact that tasks can be added, removed, or replaced during flight. In a computational simulation of

a representative formation-flying scenario, it was demonstrated that the following are among the services performed by the software:

- Uploading of commands from a ground station and distribution of the commands among the spacecraft,
- Autonomous initiation and reconfiguration of formations,

- 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

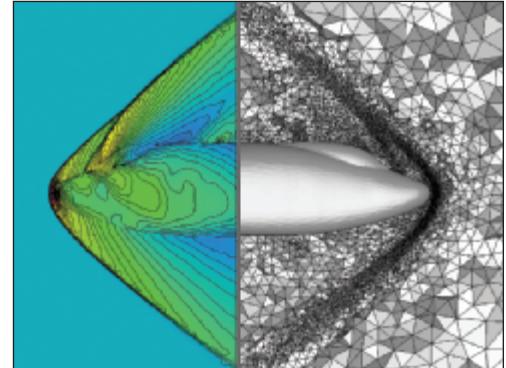
More About the Tetrahedral Unstructured Software System

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 im-

proved 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.

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



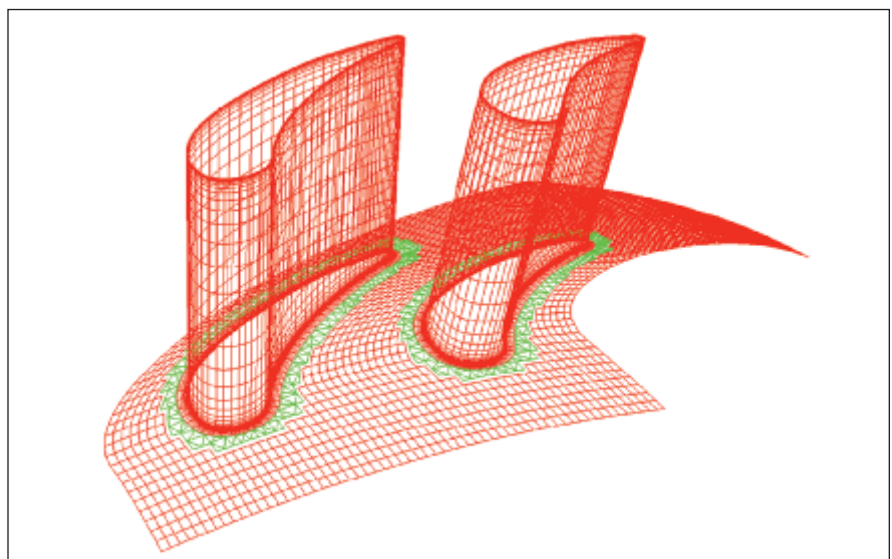
An Adapted Grid and Flow Solution are shown on the X-38 vehicle. This is one of the recent features included in TetrUSS.

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 unstructured (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.