

Avionics System Architecture Tool

Avionics System Architecture Tool (ASAT) is a computer program intended for use during the avionics-system-architecture-design phase of the process of designing a spacecraft for a specific mission. ASAT enables simulation of the dynamics of the command-and-data-handling functions of the spacecraft avionics in the scenarios in which the spacecraft is expected to operate. ASAT is built upon I-Logix Statemate MAGNUM, providing a complement of dynamic system modeling tools, including a graphical user interface (GUI), modeling checking capabilities, and a simulation engine. ASAT augments this with a library of predefined avionics components and additional software to support building and analyzing avionics hardware architectures using these components.

This program was written by Savio Chau, Ronald Hall, and Marcus Traylor of Caltech, and Adrian Whitfield of I-Logix for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-30629.

Updated Chemical Kinetics and Sensitivity Analysis Code

An updated version of the General Chemical Kinetics and Sensitivity Analysis (LSENS) computer code has become available. A prior version of LSENS was described in "Program Helps to Determine Chemical-Reaction Mechanisms" (LEW-15758), *NASA Tech Briefs*, Vol. 19, No. 5 (May 1995), page 66. To recapitulate: LSENS solves complex, homogeneous, gas-phase, chemical-kinetics problems (e.g., combustion of fuels) that are represented by sets of many coupled, nonlinear, first-order ordinary differential equations. LSENS has been designed for flexibility, convenience, and computational efficiency. The present version of LSENS incorporates mathematical models for (1) a static system; (2) steady, one-dimensional inviscid flow; (3) reaction behind an incident shock wave, including boundary-layer correction; (4) a perfectly stirred reactor; and (5) a perfectly stirred reactor followed by a plug-flow reactor. In addition,

LSENS can compute equilibrium properties for the following assigned states: enthalpy and pressure, temperature and pressure, internal energy and volume, and temperature and volume. For static and one-dimensional-flow problems, including those behind an incident shock wave and following a perfectly stirred reactor calculation, LSENS can compute sensitivity coefficients of dependent variables and their derivatives, with respect to the initial values of dependent variables and/or the rate-coefficient parameters of the chemical reactions.

This program was written by Krishnan Radhakrishnan of the Institute for Computational Mechanics in Propulsion for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17519-1.

Predicting Flutter and Forced Response in Turbomachinery

TURBO-AE is a computer code that enables detailed, high-fidelity modeling of aeroelastic and unsteady aerodynamic characteristics for prediction of flutter, forced response, and blade-row interaction effects in turbomachinery. Flow regimes that can be modeled include subsonic, transonic, and supersonic, with attached and/or separated flow fields. The three-dimensional Reynolds-averaged Navier-Stokes equations are solved numerically to obtain extremely accurate descriptions of unsteady flow fields in multistage turbomachinery configurations. Blade vibration is simulated by use of a dynamic-grid-deformation technique to calculate the energy exchange for determining the aerodynamic damping of vibrations of blades. The aerodynamic damping can be used to assess the stability of a blade row. TURBO-AE also calculates the unsteady blade loading attributable to such external sources of excitation as incoming gusts and blade-row interactions. These blade loadings, along with aerodynamic damping, are used to calculate the forced responses of blades to predict their fatigue lives. Phase-lagged boundary conditions based on the direct-store

method are used to calculate nonzero interblade phase-angle oscillations; this practice eliminates the need to model multiple blade passages, and, hence, enables large savings in computational resources.

This program was written by Dale E. VanZante and John J. Adamczyk of Glenn Research Center; Rakesh Srivastava, Milind A. Bakhle, and Aamir Shabbir of the University of Toledo; Jen-Ping Chen and J. Mark Janus of Mississippi State University; Wai-Ming To of AP Solutions, Inc.; and John Barter of GE Aircraft Engines. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17514-1.

Upgrades of Two Computer Codes for Analysis of Turbomachinery

Major upgrades have been made in two of the programs reported in "Five Computer Codes for Analysis of Turbomachinery" (LEW-16851), *NASA Tech Briefs*, Vol. 23, No. 11 (November 1999), page 28. The affected programs are:

- Swift — a code for three-dimensional (3D) multiblock analysis; and
- TCGRID, which generates a 3D grid used with Swift.

Originally utilizing only a central-differencing scheme for numerical solution, Swift was augmented by addition of two upwind schemes that give greater accuracy but take more computing time. Other improvements in Swift include addition of a shear-stress-transport turbulence model for better prediction of adverse pressure gradients, addition of an H-grid capability for flexibility in modeling flows in pumps and ducts, and modification to enable simultaneous modeling of hub and tip clearances. Improvements in TCGRID include modifications to enable generation of grids for more complicated flow paths and addition of an option to generate grids compatible with the ADPAC code used at NASA and in industry. For both codes, new test cases were developed and documentation was updated. Both codes were converted to Fortran 90, with dynamic memory allocation. Both codes were also modified for ease of use in

both UNIX and Windows operating systems.

These programs were written by Rodrick V. Chima and Meng-Sing Liou of Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17635/88-1.

Program Facilitates CMMI Appraisals

A computer program has been written to facilitate appraisals according to the methodology of Capability Maturity Model Integration (CMMI). [CMMI is a government/industry standard, maintained by the Software Engineering Institute at Carnegie Mellon University, for objectively assessing the engineering capability and maturity of an organization (especially, an organization that produces software)]. The program assists in preparation for a CMMI appraisal by providing drop-down lists suggesting required artifacts or evidence. It identifies process areas for which similar evidence is required and includes a copy feature that reduces or eliminates repetitive data entry. It generates reports to show the entire framework for reference, the appraisal artifacts to determine readiness for an appraisal, and lists of interviewees and questions to ask them during the appraisal. During an appraisal, the program provides screens for entering observations and ratings, and reviewing evidence provided thus far. Findings concerning strengths and weaknesses can be exported for use in a report or a graphical presentation. The program generates a chart showing capability level ratings of the organization. A context-sensitive Windows help system enables a novice to use the program and learn about the CMMI appraisal process.

This program was written by Wesley Sweetser of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-14782-1

Grid Visualization Tool

The Grid Visualization Tool (GVT) is a computer program for displaying the path of a mobile robotic explorer (rover) on a terrain map. The GVT reads a map-data file in either portable graymap (PGM) or portable pixmap (PPM) format, representing a gray-scale

or color map image, respectively. The GVT also accepts input from path-planning and activity-planning software. From these inputs, the GVT generates a map overlaid with one or more rover path(s), waypoints, locations of targets to be explored, and/or target-status information (indicating success or failure in exploring each target). The display can also indicate different types of paths or path segments, such as the path actually traveled versus a planned path or the path traveled to the present position versus planned future movement along a path. The program provides for updating of the display in real time to facilitate visualization of progress. The size of the display and the map scale can be changed as desired by the user. The GVT was written in the C++ language using the Open Graphics Library (OpenGL) software. It has been compiled for both Sun Solaris and Linux operating systems.

This program was written by Caroline Chouinard, Forest Fisher, Tara Estlin, Daniel Gaines, and Steven Schaffer of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-40303.

Program Computes Sound Pressures at Rocket Launches

Launch Vehicle External Sound Pressure is a computer program that predicts the ignition overpressure and the acoustic pressure on the surfaces and in the vicinity of a rocket and launch pad during launch. The program generates a graphical user interface (GUI) that gathers input data from the user. These data include the critical dimensions of the rocket and of any launch-pad structures that may act as acoustic reflectors, the size and shape of the exhaust duct or flame deflector, and geometrical and operational parameters of the rocket engine. For the ignition-overpressure calculations, histories of the chamber pressure and mass flow rate also are required. Once the GUI has gathered the input data, it feeds them to ignition-overpressure and launch-acoustics routines, which are based on several approximate mathematical models of distributed sources, transmission, and reflection of acoustic waves. The out-

put of the program includes ignition overpressures and acoustic pressures at specified locations.

This program was written by Gary Ogg, Roy Heyman, Michael White, and Karl Edquist of Applied Research Associates, Inc., for Marshall Space Flight Center. For further information, contact the company at www.ara.com. MFS-31568

Solar-System Ephemeris Toolbox

NASA's Jet Propulsion Laboratory (JPL) generates planetary and lunar ephemeris data and FORTRAN routines that allow users to obtain state data for the Sun, the moon, and the planets. The JPL Solar System Ephemeris Toolbox, developed at Kennedy Space Center, is a set of functions that provides the same functionality in the MATLAB computing environment along with some additional capabilities. The toolbox can be used interactively via a graphical user interface (GUI), or individual functions can be called from the MATLAB command prompt or other MATLAB scripts and functions. The toolbox also includes utility functions to define and perform coordinate transformation (e.g., mean-of-date, true-of-date, J2000) that are common in the use of these ephemerides. An attached README file guides the user through the process of constructing binary ephemeris files, verifying correct installation, and using functions to extract state data. This process also can be performed using the GUI. Help from each toolbox function is available through MATLAB's "help" function. Many of the functions in the toolbox are MATLAB equivalents of the JPL-written FORTRAN programs and sub-routines used for the same purposes. A novice can use the GUI to extract state data, while a more experienced user can use the functions directly, as needed, in his/her applications. The toolbox has been tested using MATLAB Releases 13 and 14.

This program was written by Charles F. Walker of Kennedy Space Center. For further information, access www.openchannelsoftware.org. KSC-12544

Data-Acquisition Software for PSP/TSP Wind-Tunnel Cameras

Wing-Viewer is a computer program for acquisition and reduction of image data acquired by any of five different scientific-grade commercial electronic cameras used at Langley Research center to observe wind-tunnel models coated with pressure-