Software

Time Analyzer For Time Synchronization and Monitor of the Deep Space Network

A software package has been developed to measure, monitor, and archive the performance of timing signals distributed in the NASA Deep Space Network. Timing signals are generated from a central master clock and distributed to over 100 users at distances up to 30 kilometers. The time offset due to internal distribution delays and time jitter with respect to the central master clock are critical for successful spacecraft navigation, radio science, and very long baseline interferometry (VLBI) applications. The instrument controller and operator interface software is written in LabView and runs on the Linux operating system. The software controls a commercial multiplexer to switch 120 separate timing signals to measure offset and jitter with a time-interval counter referenced to the master clock. The offset of each channel is displayed in histogram form, and "out of specification" alarms are sent to a central complex monitor and control system. At any time, the measurement cycle of 120 signals can be interrupted for diagnostic tests on an individual channel. The instrument also routinely monitors and archives the long-term stability of all frequency standards or any other 1-pps source compared against the master clock. All data is stored and made available for remote access via network connection.

This program was developed by Steven Cole, Jorge Gonzalez, Jr., Malcolm Calhoun, and Robert Tjoelker 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 Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-30483.

Program for Computing Albedo

Simple Thermal Environment Model (STEM) is a FORTRAN-based computer program that provides engineering estimates of top-of-atmosphere albedo and outgoing long-wave radiation (OLR) for use in analyzing thermal loads on spacecraft near Earth. The thermal environment of a spacecraft is represented in STEM as consisting of direct solar radiation; short-wave radiation reflected by the atmosphere of the Earth, as characterized in terms of the albedo of the Earth; and OLR emitted by the atmosphere of the Earth. STEM can also address effects of heat loads internal to a spacecraft. Novel features of STEM include (1) the use of Earth albedo and OLR information based on time series of measurements by Earth Radiation Budget Experiment satellites in orbit; (2) the ability to address thermal time constants of spacecraft systems by use of albedo and OLR values representing averages over a range of averaging times; and (3) the ability to address effects, on albedo and OLR values, of satellite orbital inclination, the angle between the plane of a spacecraft orbit and the line between the centers of the Earth and Sun, the solar zenith angle, and latitude.

This program was written by Carl G. (Jere) Justus of Computer Sciences Corp. for **Marshall Space Flight Center**. *Further information is contained in a TSP (see page 1). MFS-31728*

Integrated Software for Analyzing Designs of Launch Vehicles

Launch Vehicle Analysis Tool (LVA) is a computer program for preliminary design structural analysis of launch vehicles. Before LVA was developed, in order to analyze the structure of a launch vehicle, it was necessary to estimate its weight, feed this estimate into a program to obtain pre-launch and flight loads, then feed these loads into structural and thermal analysis programs to obtain a second weight estimate. If the first and second weight estimates differed, it was necessary to reiterate these analyses until the solution converged. This process generally took six to twelve person-months of effort. LVA incorporates text to structural layout converter, configuration drawing, mass properties generation, pre-launch and flight loads analysis, loads output plotting, direct solution structural analysis, and thermal analysis subprograms. These subprograms are integrated in LVA so that solutions can be iterated automatically. LVA incorporates expert-system software that makes fundamental design decisions without intervention by the user. It also includes unique algorithms based on extensive research. The total integration of analysis modules drastically reduces the need for interaction with the user. A typical solution can be obtained in 30 to 60 minutes. Subsequent runs can be done in less than two minutes.

This program was written by Alan D. Philips of **Marshall Space Flight Center**. *LVA contains code modules previously written by Carl E. Colley while he was a NASA civil servant. For further information, contact the Marshall Commercial Technology Office at (256) 544-2615. MFS-31694*

Abstract-Reasoning Software for Coordinating Multiple Agents

A computer program for scheduling the activities of multiple agents that share limited resources has been incorporated into the Automated Scheduling and Planning Environment (ASPEN) software system, aspects of which have been reported in several previous NASA Tech Briefs articles. In the original intended application, the agents would be multiple spacecraft and/or robotic vehicles engaged in scientific exploration of distant planets. The program could also be used on Earth in such diverse settings as production lines and military maneuvers. This program includes a planning/scheduling subprogram of the iterative repair type that reasons about the activities of multiple agents at abstract levels in order to greatly improve the scheduling of their use of shared resources. The program summarizes the information about the constraints on, and resource requirements of, abstract activities on the basis of the constraints and requirements that pertain to their potential refinements (decomposition into less-abstract and ultimately to primitive activities). The advantage of reasoning about summary information is that time needed to find consistent schedules is exponentially smaller than the time that would be needed for reasoning about the same tasks at the primitive level.

This program was written by Bradley Clement, Anthony Barrett, Gregg Rabideau, and Russell Knight for 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 Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-30340.