Software

Scheduling With Automatic Resolution of Conflicts

DSN Requirement Scheduler is a computer program that automatically schedules, reschedules, and resolves conflicts for allocations of resources of NASA's Deep Space Network (DSN) on the basis of ever-changing project requirements for DSN services. As used here, "resources" signifies, primarily, DSN antennas, ancillary equipment, and times during which they are available. Examples of project-required DSN services include arraying, segmentation, very-long-baseline interferometry, and multiple spacecraft per aperture. Requirements can include periodic reservations of specific or optional resources during specific time intervals or within ranges specified in terms of starting times and durations. This program is built on the Automated Scheduling and Planning Environment (ASPEN) software system (aspects of which have been described in previous *NASA Tech Briefs* articles), with customization to reflect requirements and constraints involved in allocation of DSN resources. Unlike prior DSN-resource-scheduling programs that make single passes through the requirements and require human intervention to resolve conflicts, this program makes repeated passes in a continuing search for all possible allocations, provides a best-effort solution at any time, and presents alternative solutions among which users can choose.

This program was written by Bradley Clement and Steve 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 (626) 395-2322. Refer to NPO-41313.

Symbolic Constraint Maintenance Grid

Version 3.1 of Symbolic Constraint Maintenance Grid (SCMG) is a software system that provides a general conceptual framework for utilizing pre-existing programming techniques to perform symbolic transformations of data. SCMG also provides a language (and an associated communication method and protocol) for representing constraints on the original non-symbolic data. SCMG provides a facility for exchanging information between numeric and symbolic components without knowing the details of the components themselves. In essence, it integrates symbolic software tools (for diagnosis, prognosis, and planning) with non-artificial-intelligence software. SCMG executes a process of symbolic summarization and monitoring of continuous time series data that are being abstractly represented as symbolic templates of information exchange. This summarization process enables such symbolic-reasoning computing systems as artificial-intelligence planning systems to evaluate the significance and effects of channels of data more efficiently than would otherwise be possible. As a result of the increased efficiency in representation, reasoning software can monitor more channels and is thus able to perform monitoring and control functions more effectively.

This work was done by Mark James 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 (626) 395-2322. Refer to NPO-42001.

Discerning Trends in Performance Across Multiple Events

Mass Data is a computer program that enables rapid, easy discernment of trends in performance data across multiple flights and ground tests. The program can perform Fourier analysis and other functions for the purposes of frequency analysis and trending of all variables. These functions facilitate identification of past use of diagnosed systems and of anomalies in such systems, and enable rapid assessment of related current problems. Many variables, for computation of which it is usually necessary to perform extensive manual manipulation of raw downlist data, are automatically computed and made available to all users, regularly eliminating the need for what would otherwise be an extensive amount of engineering analysis. Data from flight, ground test, and simulation are preprocessed and stored in one central location for instantaneous access and comparison for diagnostic and trending purposes. Rules are created so that an event log is created for every flight, making it easy to locate information on similar maneuvers across many flights. The same rules can be created for test sets and simulations, and are searchable, so that information on like events is easily accessible.

This program was written by Simon Slater, Mike Hiltz, and Craig Rice of MacDonald Dettwiler Space Robotics for **Johnson Space Center**. *For further information, contact the Johnson Technology Transfer Office at (281) 483-3809.*
MSC-23824

Magnetic Field Solver

The Magnetic Field Solver computer program calculates the magnetic field generated by a group of collinear, cylindrical axisymmetric electromagnet coils. Given the current flowing in, and the number of turns, axial position, and axial and radial dimensions of each coil, the program calculates matrix coefficients for a finite-difference system of equations that approximates a two-dimensional partial differential equation for the magnetic potential contributed by the coil. The program iteratively solves these finite-difference equations by use of the modified incomplete Cholesky preconditioned-conjugate-gradient method. The total magnetic potential as a function of axial (z) and radial (r) position is then calculated as a sum of the magnetic potentials of the individual coils, using a high-accuracy interpolation scheme. Then the r and z components of the magnetic field as functions of r and z are calculated from the total magnetic potential by use of a high-accuracy finite-difference scheme. Notably, for the finite-difference calculations, the program generates nonuniform two-dimensional computational meshes from nonuniform one-dimensional meshes. Each mesh is generated in such a way as to minimize the numerical error for a benchmark one-dimensional magnetostatic problem.

This program was written by Andrew V. Ilin of Muniz Engineering, Inc. for **Johnson Space Center**. *For further information, contact the Johnson Technology Transfer Office at (281) 483-3809.*
MSC-23618