Software

Algorithm-Based Fault Tolerance for Numerical Subroutines

A software library implements a new methodology of detecting faults in numerical subroutines, thus enabling application programs that contain the subroutines to recover transparently from single-event upsets. The software library in question is fault-detecting middleware that is wrapped around the numerical-subroutines. Conventional serial versions (based on LAPACK and FFTW) and a parallel version (based on ScaLAPACK) exist. The source code of the application program that contains the numerical subroutines is not modified, and the middleware is transparent to the user.

The methodology used is a type of algorithm-based fault tolerance (ABFT). In ABFT, a checksum is computed before a computation and compared with the checksum of the computational result; an error is declared if the difference between the checksums exceeds some threshold. Novel normalization methods are used in the checksum comparison to ensure correct fault detections independent of algorithm inputs. In tests of this software reported in the peer-reviewed literature, this library was shown to enable detection of 99.9 percent of significant faults while generating no false alarms.

This program was written by Michael Turmon, Robert Granat, and John Lou of Caltech for NASA's Jet Propulsion Laboratory.

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42193.

Computational Support for Technology-Investment Decisions

Strategic Assessment of Risk and Technology (START) is a user-friendly computer program that assists human managers in making decisions regarding research-and-development investment portfolios in the presence of uncertainties and of non-technological constraints that include budgetary and time limits, restrictions related to infrastructure, and programmatic and institutional priorities. START facilitates quantitative analysis of technologies, capabilities, missions, scenarios and programs, and thereby enables the selection and scheduling of value-optimal development efforts. START incorporates features that, variously, perform or support a unique combination of functions, most of which are not systematically performed or supported by prior decision-support software. These functions include the following:

• Optimal portfolio selection using an expected-utility-based assessment of capabilities and technologies;
• Temporal investment recommendations;
• Distinctions between enhancing and enabling capabilities;
• Analysis of partial funding for enhancing capabilities; and
• Sensitivity and uncertainty analysis.

START can run on almost any computing hardware, within Linux and related operating systems that include Mac OS X versions 10.3 and later, and can run in Windows under the Cygwin environment. START can be distributed in binary code form. START calls, as external libraries, several open-source software packages. Output is in Excel (.xls) file format.

This program was written by Virgil Adumitroaie, Hook Hua, William Lincoln, Gary Block, Joseph Mrozinski, Kacie Shelton, Charles Weisbin, Alberto Elfes, and Jeffrey Smith 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-44800.

DSN Resource Scheduling

TIGRAS is client-side software, which provides tracking-station equipment planning, allocation, and scheduling services to the DSMS (Deep Space Mission System). TIGRAS provides functions for schedulers to coordinate the DSN (Deep Space Network) antenna usage time and to resolve the resource usage conflicts among tracking passes, antenna calibrations, maintenance, and system testing activities. TIGRAS provides a fully integrated multi-pane graphical user interface for all scheduling operations. This is a great improvement over the legacy VAX VMS command line user interface.

TIGRAS has the capability to handle all DSN resource scheduling aspects from long-range to real time. TIGRAS assists NASA mission operations for DSN tracking of station equipment resource request processes from long-range load forecasts (ten years or longer), to mid-range, short-range, and real-time (less than one week) emergency tracking plan changes. TIGRAS can be operated by NASA mission operations worldwide to make schedule requests for the DSN station equipment.

This program was written by Yeou-Fang Wang and John Baldwin of Caltech for NASAs Jet Propulsion Laboratory.

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-43771.

Distributed Operations Planning

Maestro software provides a secure and distributed mission planning system for long-term missions in general, and the Mars Exploration Rover Mission (MER) specifically. Maestro, the successor to the Science Activity Planner, has a heavy emphasis on portability and distributed operations, and requires no data replication or expensive hardware, instead relying on a set of services functioning on JPL institutional servers.

Maestro works on most current computers with network connections, including laptops. When browsing down-link data from a spacecraft, Maestro functions similarly to being on a Web browser. After authenticating the user, it connects to a database server to query an index of data products. It then contacts a Web server to download and display the actual data products. The software also includes collaboration support based upon a highly reliable messaging system. Modifications made to targets in one instance are quickly and securely transmitted to other instances of Maestro.

The back end that has been developed for Maestro could benefit many future missions by reducing the cost of centralized operations system architecture.

This program was written by Jason Fox, Jeffrey Norris, Mark Powell, Kenneth Rabe, and Khawaja Shams of Caltech for NASA's Jet Propulsion Laboratory.

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-43278.