sparse arrays that is independent of the underlying memory layout representation of the array. A functional interface is defined for implementing sparse arrays in any modern programming language with a particular focus for the Chapel programming language. Examples are provided that show the translation of a loop that computes a matrix vector product into this representation for both the distributed and not-distributed cases. This work is directly applicable to NASA and its High Productivity Computing Systems (HPCS) program that JPL and our current program are engaged in. The goal of this program is to create powerful, scalable, and economically viable high-powered computer systems suitable for use in national security and industry by 2010. This is important to NASA for its computationally intensive requirements for analyzing and understanding the volumes of science data from our returned missions.

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)..*

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42502.

Mission Operations of the Mars Exploration Rovers

A document describes a system of processes involved in planning, commanding, and monitoring operations of the rovers Spirit and Opportunity of the Mars Exploration Rover mission. The system is designed to minimize command turnaround time, given that inherent uncertainties in terrain conditions and in successful completion of planned landed spacecraft motions preclude planning of some spacecraft activities until the results of prior activities are known by the ground-based operations team. The processes are partitioned into those (designated as tactical) that must be tied to the Martian clock and those (designated strategic) that can, without loss, be completed in a more leisurely fashion. The tactical processes include assessment of downlinked data, refinement and validation of activity plans, sequencing of commands, and integration and validation of sequences. Strategic processes include communications planning and generation of long-term activity plans. The primary benefit of this partition is to enable the tactical portion of the team to focus solely on tasks that contribute directly to meeting the deadlines for commanding the rover's each sol (1 sol = 1 Martian day) — achieving a turnaround time of 18 hours or less, while facilitating strategic team interactions with other organizations that do not work on a Mars time schedule.

This work was done by Deborah Bass, Sharon Lauback, Andrew Mishkin, and Daniel Limonadi of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42471.

More About Software for No-Loss Computing

A document presents some additional information on the subject matter of "Integrated Hardware and Software for No-Loss Computing" (NPO-42554), which appears elsewhere in this issue of *NASA Tech Briefs*. To recapitulate: The hardware and software designs of a developmental parallel computing system are integrated to effectuate a concept of no-loss computing (NLC). The system is designed to reconfigure an application program such that it can be monitored in real time and further reconfigured to continue a computation in the event of failure of one of the computers. The design provides for (1) a distributed class of NLC computation agents, denoted introspection agents, that effects hierarchical detection of anomalies; (2) enhancement of the compiler of the parallel computing system to cause generation of state vectors that can be used to continue a computation in the event of a failure; and (3) activation of a recovery component when an anomaly is detected.

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).*

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42511