ARNIE library but is not necessary for the execution of the software.

This program was written by Nathalie Mathé and James Chen of **Ames 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 the Patent Counsel, Ames Research Center, (650) 604-5104. Refer to ARC-14136.

Software for Simulating a Complex Robot

RoboSim (Robot Simulation) is a computer program that simulates the poses and motions of the Robonaut — a developmental anthropomorphic robot that has a complex system of joints with 43 degrees of freedom and multiple modes of operation and control. RoboSim performs a full kinematic simulation of all degrees of freedom. It also includes interface components that duplicate the functionality of the real Robonaut interface with control software and human operators. Basically, users see no difference between the real Robonaut and the simulation. Consequently, new control algorithms can be tested by computational simulation, without risk to the Robonaut hardware, and without using excessive Robonaut-hardware experimental time, which is always at a premium. Previously developed software incorporated into RoboSim includes Enigma (for graphical displays), OSCAR (for kinematical computations), and NDDS (for communication between the Robonaut and external software). In addition, RoboSim incorporates unique inverse-kinematical algorithms for chains of joints that have fewer than six degrees of freedom (e.g., finger joints). In comparison with the algorithms of OSCAR, these algorithms are more readily adaptable and provide better results when using equivalent sets of data.

This program was written by S. Michael Goza of **Johnson Space Center**. *Further information is contained in a TSP (see page 1).*
MSC-23602

Software for Planning Scientific Activities on Mars

Mixed-Initiative Activity Plan Generator (MAPGEN) is a ground-based computer program for planning and scheduling the scientific activities of instrumented exploratory robotic vehicles, within the limitations of available resources onboard the vehicle. MAPGEN is a combination of two prior software systems: (1) an activity-planning program, APGEN, developed at NASA's Jet Propulsion Laboratory and (2) the Europa planner/scheduler from NASA Ames Research Center. MAPGEN performs all of the following functions:

- Automatic generation of plans and schedules for scientific and engineering activities;
- Testing of hypotheses (or "what-if" analyses of various scenarios);
- Editing of plans;
- Computation and analysis of resources; and
- Enforcement and maintenance of constraints, including resolution of temporal and resource conflicts among planned activities.

MAPGEN can be used in either of two modes: one in which the planner/scheduler is turned off and only the basic APGEN functionality is utilized, or one in which both component programs are used to obtain the full planning, scheduling, and constraint-maintenance functionality.

This program was written by Mitchell Ai-Chang, John Bresina, Ari Jonsson, Jennifer Hsu, Bob Kanefsky, Paul Morris, Kanna Rajan, and Jeffrey Yglesias of **Ames Research Center** *and Len Charest and Pierre Maldague of NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Ames Research Center, (650) 604-5104. Refer to ARC-15053.

Software for Training in Pre-College Mathematics

The Intelligent Math Tutor (IMT) is a computer program for training students in pre-college and college-level mathematics courses, including fundamentals, intermediate algebra, college algebra, and trigonometry. The IMT can be executed on a server computer for access by students via the Internet; alternatively, it can be executed on students' computers equipped with compact-disk/read-only-memory (CD-ROM) drives. The IMT provides interactive exercises, assessment, tracking, and an on-line graphing calculator with algebraic-manipulation capabilities. The IMT provides an innovative combination of content, delivery mechanism, and artificial intelligence. Careful organization and presentation of the content make it possible to provide intelligent feedback to the student based on performance on exercises and tests. The tracking and feedback mechanisms are implemented within the capabilities of a commercial off-the-shelf development software tool and are written in the Unified Modeling Language to maximize reuse and minimize development cost. The graphical calculator is a standard feature of most college and pre-college algebra and trigonometry courses. Placing this functionality in a Java applet decreases the cost, provides greater capabilities, and provides an opportunity to integrate the calculator with the lessons.

This program was written by Robert O. Shelton of **Johnson Space Center** *and Travis A. Moebes and Scot Van Alstine of Science Applications International Corp. For further information, contact the Johnson Commercial Technology Office at (281) 483-3809.*
MSC-23150