arm, and places the end effector in-}

proach the target, deploys its robotic}

The rover then positions itself to ap-

reaches the vicinity of the target. The}

continuously tracking a target of inter-

form to traverse rocky terrain auton-

There is also a mean orbital ele-

including visual target tracking of a desig-

instrument on the designated target to

within 2–3-cm accuracy of the origi-

serves multiple purposes of measuring

strains and displacements, as well as de-

termining structural bending moment,

shear, and loads for assessing real-time

structural health.

The first step is to install a series of

strain sensors on the structure’s surface

in such a way as to measure bending

strains at desired locations. The next

step is to perform a simple ground test

calibration. For a beam of length l (see

example), discretized into n sections

and subjected to a tip load of P that

places the beam in bending, the flex-

ural rigidity of the beam can be experi-

mentally determined at each measure-

ment location x. The bending moment

at each station can then be determined

for any general set of loads applied dur-

operation.

This work was done by W. Lance Richards

and William L. Ko of Dryden Flight Research

Center. Further information is contained in a

TSP (see page 1). DRC-008-023

Mission Analysis, Operations, and Navigation Toolkit
Environment (Monte) Version 040
NASA’s Jet Propulsion Laboratory, Pasadena, California

Monte is a software set designed for use

in mission design and spacecraft naviga-

tion operations. The system can process

measurement data, design optimal trajec-

tories and maneuvers, and do orbit deter-

mination, all in one application. For the

first time, a single software set can be used

for mission design and navigation opera-

tions. This eliminates problems due to dif-

terent models and fidelities used in legacy

mission design and navigation software.

The unique features of Monte 040 in-

clude a blowdown thruster model for

GRAIL (Gravity Recovery and Interior

Laboratory) with associated pressure

models, as well as an updated, optimal-

search capability (COSMIC) that facili-

tated mission design for ARTEMIS.

Existing legacy software lacked the

capabilities necessary for these two mis-

sions. There is also a mean orbital ele-

ment propagator and an osculating to

mean element converter that allows

long-term orbital stability analysis for the

first time in compiled code.

The optimized trajectory search tool

COSMIC allows users to place constraints

and controls on their searches without

any restrictions. Constraints may be user-
defined and depend on trajectory infor-

mation either forward or backwards in

time. In addition, a long-term orbit stabil-

ity analysis tool (morbiter) existed previ-

ously as a set of scripts on top of Monte.

Monte is becoming the primary tool

for navigation operations, a core compe-
tency at JPL. The mission design capabil-

ities in Monte are becoming mature

enough for use in project proposals as

well as post-phase A mission design.

Monte has three distinct advantages

over existing software. First, it is being

developed in a modern paradigm: ob-

ject-oriented C++ and Python. Second,

the software has been developed as a

toolkit, which allows users to customize

their own applications and allows the de-

development team to implement require-

ments quickly, efficiently, and with mini-

mal bugs. Finally, the software is

managed in accordance with the CMMI

(Capability Maturity Model Integra-

tion), where it has been appraised at ma-

turity level 3.

This work was done by Richard F. Sunseri,

Hsi-Cheng Wu, Scott E. Evans, James R.

Evans, Theodore R. Drain, and Michelle M.

Guevara of Caltech for NASA’s Jet Propulsion

Laboratory.

This software is available for commercial li-

censing. Please contact Daniel Broderick of

the California Institute of Technology at

danielb@caltech.edu. Refer to NPO-48184.

Autonomous Rover Traverse and Precise Arm Placement on
Remoteley Designated Targets
NASA’s Jet Propulsion Laboratory, Pasadena, California

This software controls a rover plat-

form to traverse rocky terrain auton-

omously, plan paths, and avoid obsta-

cles using its stereo hazard and

navigation cameras. It does so while

continuously tracking a target of inter-

est selected from 10–20 m away. The

rover drives and tracks the target until

it reaches the vicinity of the target.

The rover then positions itself to ap-

proach the target, deploys its robotic

arm, and places the end effector in-

structural loads in real time while the

structure is in service.

The amount of structural informa-

tion can be maximized through the use

of highly multiplexed fiber Bragg grat-

ing technology using optical time do-

main reflectometry and optical fre-

quency domain reflectometry, which

provide a local strain measurement

every 10 mm on a single hair-sized opti-

cal fiber. Since local strain is used as

input to the algorithms, this system
Computing Radiative Transfer in a 3D Medium
NASA’s Jet Propulsion Laboratory, Pasadena, California

A package of software computes the time-dependent propagation of a narrow laser beam in an arbitrary three-dimensional (3D) medium with absorption and scattering, using the transient-discrete-ordinates method and a direct integration method. Unlike prior software that utilizes a Monte Carlo method, this software enables simulation at very small signal-to-noise ratios. The ability to simulate propagation of a narrow laser beam in a 3D medium is an improvement over other discrete-ordinate software. Unlike other direct-integration software, this software is not limited to simulation of propagation of thermal radiation with broad angular spread in three dimensions or of a laser pulse with narrow angular spread in two dimensions. Uses for this software include (1) computing scattering of a pulsed laser beam on a material having given elastic scattering and absorption profiles, and (2) evaluating concepts for laser-based instruments for sensing oceanic turbulence and related measurements of oceanic mixed-layer depths. With suitable augmentation, this software could be used to compute radiative transfer in ultrasound imaging in biological tissues, radiative transfer in the upper Earth crust for oil exploration, and propagation of laser pulses in telecommunication applications.

This work was done by Kenneth J. Peters, James P. Lux, Minh Lang, and Courtney B. Duncan 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-48062.

NASA’s Jet Propulsion Laboratory, Pasadena, California

This software demonstrates a working implementation of the NASA STRS (Space Telecommunications Radio System) architecture specification. This is a developing specification of software architecture and required interfaces to provide commonality among future NASA and commercial software-defined radios for space, and allow for easier mixing of software and hardware from different vendors.

It provides required functions, and supports interaction with STRS-compliant simple test plug-ins (“waveforms”). All of it is programmed in “plain C,” except where necessary to interact with C++ plug-ins. It offers a small footprint, suitable for use in JPL radio hardware.

Future NASA work is expected to develop into fully capable software-defined radios for use on the space station, other space vehicles, and interplanetary probes.

This work was done by Kenneth J. Peters, James P. Lux, Minh Lang, and Courtney B. Duncan 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47328.

Journal and Wave Bearing Impedance Calculation Software
John H. Glenn Research Center, Cleveland, Ohio

The wave bearing software suite is a MALTA application that computes bearing properties for user-specified wave bearing conditions, as well as plain journal bearings. Wave bearings are fluid film journal bearings with multi-lobed wave patterns around the circumference of the bearing surface. In this software suite, the dynamic coefficients are outputted in a way for easy implementation in a finite element model used in rotor dynamics analysis. The software has a graphical user interface (GUI) for inputting bearing geometry parameters, and uses MATLAB’s structure interface.