would perform eclipse-free-time analysis
an in-house computer program that
Point-mass gravity of the Moon.
Point-mass gravity of the Sun, and
Atmospheric drag,
Non-spherical Earth gravity,
characteristics of IRIS mission orbits:
on the long-term evolution and shadow
the following types of orbit perturbations
IRIS_EFT software models the effects of
integrator within Brent’s method for find-
tions are predicted by embedding this in-
computationally integrate Cowell’s form of the system
perturbation of orbital motion to numeri-
program IRIS_EFT implements a special
spacecraft is not in the Earth’s shadow.
1 day during which the IRIS
defined to be those time intervals longer
Time (EFT) assessment of IRIS (Infrared
An update has been performed to soft-
substrates by rocket exhaust on liftoff.
ware designed to do very rapid automated
software designed to do very rapid automated
AutoArt Rocket Crater Measurement Software
An update has been performed to soft-
nonlinear equations of motion, MASCOT
then calculates vehicle trim and static
shadow conditions. Past applications include
lunar shadow requirements for Chan-
drag, perigee decay of geosynchronous
transfer orbits due to third-body point-
mass perturbations, and prediction of or-
bital lifetime and decay of Earth satellites.
This work was done by David Eagle of a.i.
solutions Inc., for Kennedy Space Center. For
additional information, contact David Eagle at
18 NASA Tech Briefs, January 2012

**Data Distribution System (DDS) and Solar Dynamic Observatory Ground Station (SDOGS) Integration Manager**

The DDS SDOGS Integration Manager (DSIM) provides translation between native control and status formats for systems within DDS and SDOGS, and the ASIST (Advanced Spacecraft Integration and System Test) control environment in the SDO MOC (Solar Dynamics Observatory Mission Operations Center).

This system was created in response for
a need to centralize remote monitor and
control of SDO Ground Station equip-
ments using ASIST control environment
in SDO MOC, and to have configurable
table definition for equipment. It pro-
vides translation of status and monitoring
information from the native systems into
ASIST-readable format to display on
pages in the MOC.

The manager is lightweight, user
friendly, and efficient. It allows data trend-
ing, correlation, and storing. It allows
using ASIST as common interface for re-
 mote monitor and control of heteroge-
 neous equipments. It also provides fail-
over capability to back up machines.

*This work was done by Kim Pham and
Thomas Bialas of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16020-1*

**Eclipse-Free-Time Assessment Tool for IRIS**

IRIS_EFT is a scientific simulation that
can be used to perform an Eclipse-Free-
Time (EFT) assessment of IRIS (Infrared
Imaging Surveyor) mission orbits. EFT is
defined to be those time intervals longer
than one day during which the IRIS
spacecraft is not in the Earth’s shadow.
Program IRIS_EFT implements a special
perturbation of orbital motion to numeri-
cally integrate Cowell’s form of the system
differential equations. Shadow condi-
tions are predicted by embedding this in-
tegrator within Brent’s method for find-
ing the root of a nonlinear equation. The
IRIS_EFT software models the effects of
the following types of orbit perturbations
on the long-term evolution and shadow
characteristics of IRIS mission orbits:

- Non-spherical Earth gravity,
- Atmospheric drag,
- Point-mass gravity of the Sun, and
- Point-mass gravity of the Moon.

The objective of this effort was to create
an in-house computer program that
would perform eclipse-free-time analysis
of candidate IRIS spacecraft mission or-
bits in an accurate and timely fashion.
The software is a suite of Fortran subrou-
tines and data files organized as a “com-
putational” engine that is used to accu-
rately predict the long-term orbit
evolution of IRIS mission orbits while
searching for Earth shadow conditions.

The core algorithms of this software
product have been used to solve a variety
of unique orbital mechanics and target-
ing problems. Past applications include
lunar shadow requirements for Chan-
dra, perigee decay of geosynchronous
transfer orbits due to third-body point-
mass perturbations, and prediction of or-
bital lifetime and decay of Earth satellites.

*This work was done by David Eagle of a.i.
solutions Inc., for Kennedy Space Center. For
additional information, contact David Eagle at
18 NASA Tech Briefs, January 2012

**Automated and Manual Rocket Crater Measurement Software**

An update has been performed to soft-
ware designed to do very rapid automated
measurements of craters created in sandy
substrates by rocket exhaust on liftoff.
The previous software was optimized for
pristine lab geometry and lighting condi-
tions. This software has been enhanced to
include a section for manual measure-
ments of crater parameters; namely,
crater depth, crater full width at half max,
and estimated crater volume. The tools
provide a very rapid method to measure
these manual parameters to ease the bur-
den of analyzing large data sets.

This software allows for rapid quantiza-
tion of the rocket crater parameters where
automated methods may not work. The
progress of spreadsheet data is continuously
saved so that data is never lost, and data
can be copied to clipboards and pasted to other
software for analysis. The volume estimation
of a crater is based on the central max depth
axis line, and the polygonal shape of the
 crater is integrated around that axis.

*This work was done by Philip Metzger of
Kennedy Space Center and Christopher Immer
of ASRC Aerospace Corp. Further information is
contained in a TSP (see page 1). KSC-13386*

**Patched Conic Trajectory Code**

PatCon code was developed to help
mission designers run trade studies on
launch and arrival times for any given
planet. Initially developed in Fortran, the
required inputs included launch date, ar-
ival date, and other orbital parameters
of the launch planet and arrival planets
at the given dates. These parameters in-
clude the position of the planets, the ec-
centricity, semi-major axes, argument of
periapsis, ascending node, and inclina-
tion of the planets. With these inputs, a
patched conic approximation is used to
determine the trajectory.

The patched conic approximation di-
vides the planetary mission into three
parts: (1) the departure phase, in which
the two relevant bodies are Earth and the
spacecraft, and where the trajectory is a
departure hyperbola with Earth at the
focus; (2) the cruise phase, in which the
two bodies are the Sun and the spacecraft,
and where the trajectory is a transfer el-

**MATLAB Stability and Control Toolbox Trim and Static Stability Module**

MATLAB Stability and Control Toolbox (MASCOT) utilizes geometric,
aerodynamic, and inertial inputs to cal-
culate air vehicle stability in a variety of
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ellipse with the Sun at the focus; and (3) the arrival phase, in which the two bodies are the target planet and the spacecraft, where the trajectory is an arrival hyperbola with the planet as the focus.

This work was done by Brooke Anderson Park and Henry Wright of Langley Research Center. Further information is contained in a TSP (see page 1). LAR-17446-1

#### Ring Image Analyzer

Ring Image Analyzer software analyzes images to recognize elliptical patterns. It determines the ellipse parameters (axes ratio, centroid coordinate, tilt angle). The program attempts to recognize elliptical fringes (e.g., Newton Rings) on a photograph and determine their centroid position, the short-to-long-axis ratio, and the angle of rotation of the long axis relative to the horizontal direction on the photograph. These capabilities are important in interferometric imaging and control of surfaces. In particular, this program has been developed and applied for determining the rim shape of precision-machined optical whispering gallery mode resonators.

The program relies on a unique image recognition algorithm aimed at recognizing elliptical shapes, but can be easily adapted to other geometric shapes. It is robust against non-elliptical details of the image and against noise.

Interferometric analysis of precision-machined surfaces remains an important technological instrument in hardware development and quality analysis. This software automates and increases the accuracy of this technique. The software has been developed for the needs of an R&T-funded project and has become an important asset for the future research proposal to NASA as well as other agencies.

This work was done by Dmitry V. Strekalov 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-47579.

#### SureTrak Probability of Impact Display

The SureTrak Probability of Impact Display software was developed for use during rocket launch operations. The software displays probability of impact information for each ship near the hazardous area during the time immediately preceding the launch of an unguided vehicle.

Wallops range safety officers need to be sure that the risk to humans is below a certain threshold during each use of the Wallops Flight Facility Launch Range. Under the variable conditions that can exist at launch time, the decision to launch must be made in a timely manner to ensure a successful mission while not exceeding those risk criteria. Range safety officers need a tool that can give them the needed probability of impact information quickly, and in a format that is clearly understandable. This application is meant to fill that need.

The software is a reuse of part of software developed for an earlier project: Ship Surveillance Software System (S4). The S4 project was written in C++ using Microsoft Visual Studio 6. The data structures and dialog templates from it were copied into a new application that calls the implementation of the algorithms from S4 and displays the results as needed. In the S4 software, the list of ships in the area was received from one local radar interface and from operators who entered the ship information manually. The SureTrak Probability of Impact Display application receives ship data from two local radars as well as the SureTrak system, eliminating the need for manual data entry.

This work was done by John Elliott of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16064-1