**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 equipments using ASIST control environment in SDO MOC, and to have configurable table definition for equipment. It provides 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 trending, correlation, and storing. It allows using ASIST as common interface for remote monitor and control of heterogeneous 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*

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**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 numerically integrate Cowell’s form of the system of differential equations. Shadow conditions are predicted by embedding this integrator within Brent’s method for finding 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 orbits in an accurate and timely fashion. The software is a suite of Fortran subroutines and data files organized as a “computational” engine that is used to accurately 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 targeting problems. Past applications include lunar shadow requirements for Chandrayaan, perigee decay of geosynchronous transfer orbits due to third-body point-mass perturbations, and prediction of orbital 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 (321) 867-8913, KSC-13519*

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**Automated and Manual Rocket Crater Measurement Software**

An update has been performed to software 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 conditions. This software has been enhanced to include a section for manual measurements 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 burden of analyzing large data sets.

This software allows for rapid quantization 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 Sean P. Kenny of Langley Research Center and Luis Crespo of the National Institute of Aerospace. Further information is contained in a TSP (see page 1), LAR-17483-1*

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**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, arrival date, and other orbital parameters of the launch planet and arrival planets at the given dates. These parameters include the position of the planets, the eccentricity, semi-major axes, argument of periapsis, ascending node, and inclination of the planets. With these inputs, a patched conic approximation is used to determine the trajectory.

The patched conic approximation divides 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-

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

MATLAB Stability and Control Toolbox (MASCOT) utilizes geometric, aerodynamic, and inertial inputs to calculate air vehicle stability in a variety of critical flight conditions. The code is based on fundamental, non-linear equations of motion and is able to translate results into a qualitative, graphical scale useful to the non-expert.

MASCOT was created to provide the conceptual aircraft designer accurate predictions of air vehicle stability and control characteristics. The code takes as input mass property data in the form of an inertia tensor, aerodynamic loading data, and propulsion (i.e. thrust) loading data. Using fundamental nonlinear equations of motion, MASCOT then calculates vehicle trim and static stability data for the desired flight condition(s). Available flight conditions include six horizontal and six landing rotation conditions with varying options for engine out, crosswind, and sideslip, plus three take-off rotation conditions. Results are displayed through a unique graphical interface developed to provide the non-stability and control expert conceptual design engineer a qualitative scale indicating whether the vehicle has acceptable, marginal, or unacceptable static stability characteristics. If desired, the user can also examine the detailed, quantitative results.

*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*
ellipse with the Sun at the focus; and (3) the
deramic phase, in which the two bodies are
the target planet and the spacecraft,
where the trajectory is an arrival hyper-
bola 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 el-
lipical fringes (e.g., Newton Rings) on a
photograph and determine their cen-
troid position, the short-to-long-axis
ratio, and the angle of rotation of the
long axis relative to the horizontal direc-
tion on the photograph. These capabili-
ties are important in interferometric im-
aging and control of surfaces. In
particular, this program has been devel-
oped 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 recogniz-
ing 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-mach-
ined surfaces remains an important
technological instrument in hardware de-
velopment and quality analysis. This soft-
ware 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 impor-
tant 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 com-
mercial licensing. Please contact Daniel Broder-
ick of the California Institute of Technol-
ogy at danielb@caltech.edu. Refer to
NPO-47579.

SureTrak Probability of
Impact Display

The SureTrak Probability of Impact Dis-
play software was developed for use during
rocket launch operations. The software
displays probability of impact information
for each ship near the hazardous area dur-
ing 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 cer-
tain threshold during each use of the Wal-
lops 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 understand-
able. This application is meant to fill that
need.

The software is a reuse of part of soft-
ware 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 algo-
rithms 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 man-
ually. The SureTrak Probability of Im-
 pact 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 God-
dard Space Flight Center. Further information
is contained in a TSP (see page 1). GSC-
16064-1