points. Tiepoints may also be edited.

The tiepoints are then used by the second program, marsnav, to generate pointing corrections. This works by projecting one half of each tiepoint to a surface model and back into the other image. This projected location is then compared to the measured tiepoint and a residual error is determined. A global minimization process adjusts the pointing of each input frame until the optimal pointing is determined. The pointing is typically constrained to match possible physical camera motions, although the pointing model is selectable via the PIG library. The resulting "nav solution" is then input into the mosaic programs, which apply the pointing adjustment in order to make seamless mosaics.

In addition to adjusting the pointing, marsnav can also adjust the surface model (helpful when dealing with an unknown terrain), and the position and/or orientation of the rover itself. The latter results in a "micro-localization" — determining where the rover is and how it is oriented on a very fine scale.

Commercial mosaic-stitching programs exist. However, they typically perform unconstrained warping of the images in order to achieve a match. This results in an unknown geometry and unacceptable distortion. By correcting the seams using this pointing-correction method, the result is constrained to be physically meaningful, and is accurate enough to be acceptable for use by science and ops teams. This method does, however, require *a priori* camera calibration information. The techniques are not limited to mast-mounted cameras; they have been successfully applied to arm cameras as well.

This work was done by Robert G. Deen and Jean J. Lorre of Caltech for NASA's Jet Propulsion Laboratory.

This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-46696.

Operation Program for the Spatially Phase-Shifted Digital Speckle Pattern Interferometer — SPS-DSPI

Goddard Space Flight Center, Greenbelt, Maryland

SPS-DSPI software has been revised so that Goddard optical engineers can operate the instrument, instead of data programmers. The user interface has been improved to view the data collected by the SPS-DSPI, with a real-time mode and a play-back mode. The SPS-DSPI has been developed by NASA/GSFC to measure the temperature distortions of the primary-mirror backplane structure for the James Webb Space Telescope. It requires a team of computer specialists to run successfully, because, at the time of this reporting, it just finished the prototype stage. This software improvement will transition the instrument to become available for use by many programs that measure distortion.

Dead code from earlier versions has been removed. The tighter code has been refactored to improve usability and maintainability. A prototype GUI has been created to run this refactored code. A big improvement is the ability to test the monitors and real-time functions without running the laser, by using a data acquisition simulator.

This work was done by Peter N. Blake, Joycelyn T. Jones, and Carl F. Hostetter of Goddard Space Flight Center and Perry Greenfield and Todd Miller of AURA Space Telescope Science Institute. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15709-1

GOATS - Orbitology Component

NASA's Jet Propulsion Laboratory, Pasadena, California

The GOATS Orbitology Component software was developed to specifically address the concerns presented by orbit analysis tools that are often written as stand-alone applications. These applications do not easily interface with standard JPL first-principles analysis tools, and have a steep learning curve due to their complicated nature. This toolset is written as a series of MATLAB functions, allowing seamless integration into existing JPL optical systems engineering modeling and analysis modules. The functions are completely open, and allow for advanced users to delve into and modify the underlying physics being modeled. Additionally, this software module fills an analysis gap, allowing for quick, high-level mission analysis trades without the need for detailed and complicated orbit analysis using commercial stand-alone tools.

This software consists of a series of MATLAB functions to provide for geometric orbit-related analysis. This includes propagation of orbits to varying levels of generalization. In the simplest case, geosynchronous orbits can be modeled by specifying a subset of three orbit elements. The next case is a circular orbit, which can be specified by a subset of four orbit elements. The most general case is an arbitrary elliptical orbit specified by all six orbit elements. These orbits are all solved geometrically, under the basic problem of an object in circular (or elliptical) orbit around a rotating spheroid. The orbit functions output time series ground tracks, which serve as the basis for more detailed orbit analysis. This software module also includes functions to track the positions of the Sun, Moon, and arbitrary celestial bodies specified by right ascension and declination. Also included are functions to calculate line-of-sight geometries to ground-based targets, angular rotations and decompositions, and other line-of-site calculations.

The toolset allows for the rapid execution of orbit trade studies at the level of detail required for the early stage of mission concept development.