Advanced Strategic and Tactical Relay Request Management for the Mars Relay Operations Service

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This software provides a new set of capabilities for the Mars Relay Operations Service (MaROS) in support of Strategic and Tactical relay, including a highly interactive relay request Web user interface, mission control over relay planning time periods, and mission management of allowed strategic vs. tactical request parameters. Together, these new capabilities expand the scope of the system to include all elements critical for Tactical relay operations.

Planning of replay activities spans a time period that is split into two distinct phases. The first phase is called Strategic, which begins at the time that relay opportunities are identified, and concludes at the point that the orbiter generates the flight sequences for onboard execution. Any relay request changes from this point on are called Tactical.

Tactical requests, otherwise called Orbiter Relay State Changes (ORSC), are highly restricted in terms of what types of changes can be made, and the types of parameters that can be changed may differ from one orbiter to the next. For example, one orbiter may be able to delay the start of a relay request, while another may not. The legacy approach to ORSC management involves exchanges of e-mail with "requests for change" and "acknowledgement of approval," with no other tracking of changes outside of e-mail folders.

MaROS Phases 1 and 2 provided the infrastructure for strategic relay for all supported missions. This new version, 3.0, introduces several capabilities that fully expand the scope of the system to include tactical relay. One new feature allows orbiter users to manage and "lock" Planning Periods, which allows the orbiter team to formalize the changeover from Strategic to Tactical operations. Another major feature allows users to interactively submit tactical request changes via a Web user interface. A third new feature allows orbiter missions to specify allowed tactical updates, which are automatically incorporated into the tactical change process. This software update is significant in that it provides the only centralized service for tactical request management available for relay missions.

This work was done by Daniel A. Allard, Michael N. Wallick, Roy E. Gladden, Paul Wang, and Franklin H. Hy of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This software is available for commercial licensing. Please contact Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-48337.

Software for Generating Troposphere Corrections for InSAR Using GPS and Weather Model Data

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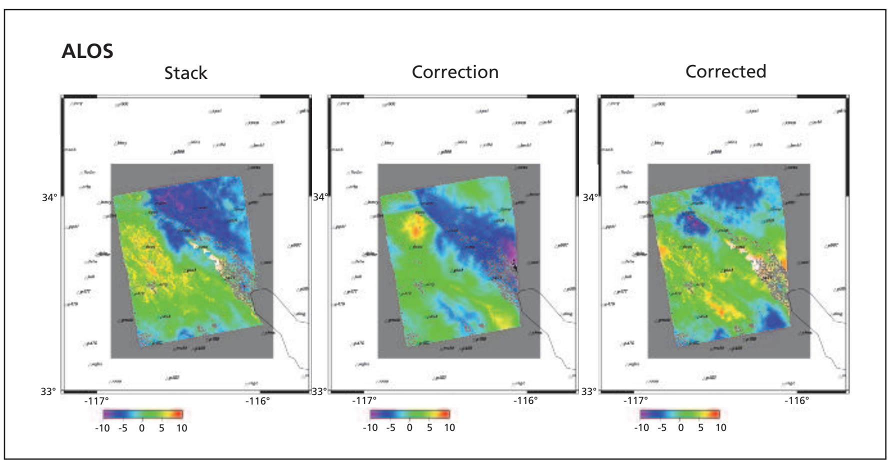
Atmospheric errors due to the troposphere are a limiting error source for spaceborne interferometric synthetic aperture radar (InSAR) imaging. This software generates tropospheric delay maps that can be used to correct atmospheric artifacts in InSAR data. The software automatically acquires all needed GPS (Global Positioning System), weather, and Digital Elevation Map data, and generates a tropospheric correction map using a novel algorithm for combining GPS and weather information while accounting for terrain.

Existing JPL software was prototypical in nature, required a MATLAB license, required additional steps to acquire and ingest needed GPS and weather data, and did not account for topography in interpolation. Previous software did not achieve a level of automation suitable for integration in a Web portal. This software overcomes these issues.

GPS estimates of tropospheric delay are a source of corrections that can be used to form correction maps to be applied to InSAR data, but the spacing of GPS stations is insufficient to remove short-wavelength tropospheric artifacts. This software combines interpolated GPS delay with weather model precipitable water vapor (PWV) and a digital elevation model to account for terrain, increasing the spatial resolution of the tropospheric correction maps and thus removing short-wavelength tropospheric artifacts to a greater extent. It will be integrated into a Web portal request system, allowing use in a future L-band SAR Earth radar mission data system. This will be a significant contribution to its technology readiness,



Advanced Land Observing Satellite (ALOS) Data. At left, the original stack of 33 interferograms. Center: The stacked correction maps, showing typical distribution of moisture in the Coachella Valley, CA. At right, the corrected stacked image.

building on existing investments in *in situ* space geodetic networks, and improving timeliness, quality, and science value of the collected data.

This work was done by Angelyn W. Moore, Frank H. Webb, Evan F. Fishbein, Eric J. Fielding, Susan E. Owen, and Stephanie L. Granger of Caltech; Fredrik Björndahl and Johan Löfgren of Chalmers University of Technology; and Peng Fang, James D. Means, Yehuda Bock, and Xiaopeng Tong of UC San Diego's Scripps Institution of Oceanography 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 Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-48556.

Ionospheric Specifications for SAR Interferometry (ISSI)

NASA's Jet Propulsion Laboratory, Pasadena, California

The ISSI software package is designed to image the ionosphere from space by calibrating and processing polarimetric synthetic aperture radar (PolSAR) data collected from low Earth orbit satellites. Signals transmitted and received by a PolSAR are subject to the Faraday rotation effect as they traverse the magnetized ionosphere. The ISSI algorithms combine the horizontally and vertically polarized (with respect to the radar system) SAR signals to estimate Faraday rotation and ionospheric total electron content (TEC) with spatial resolutions of sub-kilometers to kilometers, and to derive radar system calibration parameters. The ISSI software package has been designed and developed to integrate the algorithms, process PolSAR data, and image as well as visualize the ionospheric measurements.

A number of tests have been conducted using ISSI with PolSAR data collected from various latitude regions using the phase array-type L-band synthetic aperture radar (PALSAR) onboard Japan Aerospace Exploration Agency's Advanced Land Observing Satellite mission, and also with Global Positioning System data. These tests have demonstrated and validated SAR-derived ionospheric images and data correction algorithms.

This work was done by Xiaoqing Pi, Bruce D. Chapman, Anthony Freeman, Walter Szeliga, Sean M. Buckley, Paul A. Rosen, and Marco Lavalle of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This software is available for commercial licensing. Please contact Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-48351.

Implementation of a Wavefront-Sensing Algorithm

Goddard Space Flight Center, Greenbelt, Maryland

A computer program has been written as a unique implementation of an image-based wavefront-sensing algorithm reported in "Iterative-Transform Phase Retrieval Using Adaptive Diversity" (GSC-14879-1), *NASA Tech Briefs*, Vol. 31, No. 4 (April 2007), page 32. This software was originally intended for application to the James Webb Space Telescope, but is also applicable to other segmented-mirror telescopes.

The software is capable of determining optical-wavefront information using, as input, a variable number of irradiance measurements collected in defocus planes about the best focal position. The software also uses input of the geometrical definition of the telescope exit pupil (otherwise denoted the pupil mask) to identify the locations of the segments of the primary telescope mirror. From the irradiance data and mask information, the software calculates an estimate of the optical wavefront (a measure of performance) of the telescope generally and across each primary mirror segment specifically. The software is capable of generating irradiance data, wavefront estimates, and basis functions for the full telescope and for each primary-mirror segment. Optionally, each of these pieces of information can be measured or computed outside of the software and incorporated during execution of the software.

This program was written by Jeffrey S. Smith, Bruce Dean, and David Aronstein of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15399-1

Sally Ride EarthKAM — Automated Image Geo-Referencing Using Google Earth Web Plug-In

NASA's Jet Propulsion Laboratory, Pasadena, California

Sally Ride EarthKAM is an educational program funded by NASA that aims to provide the public the ability to picture Earth from the perspective of the International Space Station (ISS). A computer-controlled camera is mounted on the ISS in a nadir-pointing window; however, timing limitations in the system cause inaccurate positional metadata. Manually correcting images within an orbit allows the positional metadata to be improved using mathematical regressions. The manual correction process is time-consuming and thus, unfeasible for a large number of images.

The standard Google Earth program allows for the importing of KML (keyhole markup language) files that previ-