



## Remote Asynchronous Message Service Gateway

The Remote Asynchronous Message Service (RAMS) gateway is a special-purpose AMS application node that enables exchange of AMS messages between nodes residing in different AMS “continua,” notionally in different geographical locations. JPL’s implementation of RAMS gateway functionality is integrated with the ION (Interplanetary Overlay Network) implementation of the DTN (Delay-Tolerant Networking) bundle protocol, and with JPL’s implementation of AMS itself. RAMS protocol data units are encapsulated in ION bundles and are forwarded to the neighboring RAMS gateways identified in the source gateway’s AMS management information base.

Each RAMS gateway has interfaces in two communication environments: the AMS message space it serves, and the RAMS network — the grid or tree of mutually aware RAMS gateways — that enables AMS messages produced in one message space to be forwarded to other message spaces of the same venture. Each gateway opens persistent, private RAMS network communication channels to the RAMS gateways of other message spaces for the same venture, in other continua. The interconnected RAMS gateways use these communication channels to forward message petition assertions and cancellations among themselves. Each RAMS gateway subscribes locally to all subjects that are of interest in any of the linked message spaces. On receiving its copy of a message on any of these subjects, the RAMS gateway node uses the RAMS network to forward the message to every other RAMS gateway whose message space contains at least one node that has subscribed to messages on that subject. On receiving a message via the RAMS network from some other RAMS gateway, the RAMS gateway node forwards the message to all subscribers in its own message space.

In this way, the RAMS protocol enables the free flow of published application messages across arbitrarily long, deep space links while protecting efficient use of those links: only a single copy of any message is ever transmitted on any RAMS network communication channel,

no matter how many subscribers will receive copies when the message reaches its destination message space.

Note that the nature of the RAMS network communication channels depends on the implementation of the RAMS network. In order to communicate over the RAMS network for a given venture, each RAMS gateway must know the RAMS network location — an endpoint in the protocol used to implement the RAMS network (e.g., the DTN bundle protocol) — at which every other RAMS gateway for that venture receives RAMS network traffic. Again, this extension of the publish/subscribe model to interplanetary communications is invisible to application nodes. Application functionality is unaffected by these details of network configuration, and the only effects on behavior are those that are intrinsic to variability in message propagation latency.

*This work was done by Shin-Ywan Wang of Caltech and Scott C. Burleigh of SBAR 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](mailto:danielb@caltech.edu). Refer to NPO-44048.*

## Automatic Tie Pointer for In-Situ Pointing Correction

The MARSAUTOTIE program generates tie points for use with the Mars pointing correction software “In-Situ Pointing Correction and Rover Microlocalization,” (NPO-46696) *Software Tech Briefs*, Vol. 34, No. 9 (September 2010), page 18, in a completely automated manner, with no operator intervention. It takes the place of MARSTIE, although MARSTIE can be used to interactively edit the tie points afterwards. These tie points are used to create a mosaic whose seams (boundaries of input images) have been geometrically corrected to reduce or eliminate errors and mis-registrations. The methods used to find appropriate tie points for use in creating a mosaic are unique, having been designed to work in concert with the “MARSNAV” program to be most effective in reducing or eliminating geometric seams in a mosaic.

The program takes the input images and finds overlaps according to the

nominal pointing. It then finds the most interesting areas using a scene activity metric. Points with higher scene activity are more likely to correlate successfully in the next step. It then uses correlation techniques to find matching points in the overlapped image. Finally, it performs a series of steps to reduce the number of tie points to a manageable level. These steps incorporate a number of heuristics that have been devised using experience gathered by tie pointing mosaics manually during MER operations. The software makes use of the PIG library as described in “Planetary Image Geometry Library” (NPO-46658), *NASA Tech Briefs*, Vol. 34, No. 12 (December 2010), page 30, so it is multi-mission, applicable without change to any *in-situ* mission supported by PIG.

The MARSAUTOTIE algorithm is automated, so it requires no user intervention. Although at the time of this reporting it has not been done, this program should be suitable for integration into a fully automated mosaic production pipeline.

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## Jitter Correction

Jitter\_Correct.m is a MATLAB function that automatically measures and corrects inter-frame jitter in an image sequence to a user-specified precision. In addition, the algorithm dynamically adjusts the image sample size to increase the accuracy of the measurement.

The Jitter\_Correct.m function takes an image sequence with unknown frame-to-frame jitter and computes the translations of each frame (column and row, in pixels) relative to a chosen reference frame with sub-pixel accuracy. The translations are measured using a Cross Correlation Fourier transformation method in which the relative phase of the two transformed images is fit to a plane. The measured translations are then used to correct the inter-frame jitter of the image sequence. The function also dynamically expands the image sam-

ple size over which the cross-correlation is measured to increase the accuracy of the measurement. This increases the robustness of the measurement to variable magnitudes of inter-frame jitter.

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*This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at [danielb@caltech.edu](mailto:danielb@caltech.edu). Refer to NPO-47215.*

## MSLICE Sequencing

MSLICE Sequencing is a graphical tool for writing sequences and integrating them into RML files, as well as for producing SCMF files for uplink. When operated in a testbed environment, it also supports uplinking these SCMF files to the testbed via Chill.

This software features a freeform textual sequence editor featuring syntax coloring, automatic content assistance (including command and argument completion proposals), complete with types, value ranges, unites, and descriptions from the command dictionary that appear as they are typed. The sequence editor also has a “field mode” that allows tabbing between arguments and displays type/range/units/description for each argument as it is edited. Color-coded error and warning annotations on problematic tokens are included, as well as indications of problems that are not visible in the current scroll range. “Quick Fix” suggestions are made for resolving problems, and all the features afforded by modern source editors are also included such as copy/cut/paste, undo/redo, and a sophisticated find-and-replace system optionally using regular expressions.

The software offers a full XML editor for RML files, which features syntax coloring, content assistance and problem annotations as above. There is a form-based, “detail view” that allows structured editing of command arguments and sequence parameters when preferred. The “project view” shows the user’s “workspace” as a tree of “resources” (projects, folders, and files) that can subsequently be opened in editors by double-clicking.

Files can be added, deleted, dragged-dropped/copied-pasted between folders or projects, and these operations are undoable and redoable.

A “problems view” contains a tabular list of all problems in the current workspace. Double-clicking on any row in the table opens an editor for the appropriate sequence, scrolling to the specific line with the problem, and highlighting the problematic characters. From there, one can invoke “quick fix” as described above to resolve the issue. Once resolved, saving the file causes the problem to be removed from the problem view.

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## EOS MLS Level 2 Data Processing Software Version 3

This software accepts the EOS MLS calibrated measurements of microwave radiances products and operational meteorological data, and produces a set of estimates of atmospheric temperature and composition. This version has been designed to be as flexible as possible. The software is controlled by a Level 2 Configuration File that controls all aspects of the software: defining the contents of state and measurement vectors, defining the configurations of the various forward models available, reading appropriate *a priori* spectroscopic and calibration data, performing retrievals, post-processing results, computing diagnostics, and outputting results in appropriate files.

In production mode, the software operates in a parallel form, with one instance of the program acting as a master, coordinating the work of multiple slave instances on a cluster of computers, each computing the results for individual chunks of data. In addition, to do conventional retrieval calculations and producing geophysical products, the Level 2 Configuration File can instruct

the software to produce files of simulated radiances based on a state vector formed from a set of geophysical product files taken as input. Combining both the retrieval and simulation tasks in a single piece of software makes it far easier to ensure that identical forward model algorithms and parameters are used in both tasks. This also dramatically reduces the complexity of the code maintenance effort.

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## DspaceOgre 3D Graphics Visualization Tool

This general-purpose 3D graphics visualization C++ tool is designed for visualization of simulation and analysis data for articulated mechanisms. Examples of such systems are vehicles, robotic arms, biomechanics models, and biomolecular structures. DspaceOgre builds upon the open-source Ogre3D graphics visualization library. It provides additional classes to support the management of complex scenes involving multiple viewpoints and different scene groups, and can be used as a remote graphics server.

This software provides improved support for adding programs at the graphics processing unit (GPU) level for improved performance. It also improves upon the messaging interface it exposes for use as a visualization server.

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