Software

⟫ 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. 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.

This work was done by Robert G. Deen 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47083.

◎ 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-