

mapped landmarks generated per image allow for automatic detection and elimination of bad matches. Attitude and position can be generated from each image; this image-based attitude measurement can be used by the onboard navigation filter to improve the attitude estimate, which will improve the position estimates.

The algorithm uses normalized correlation of grayscale images, producing

precise, sub-pixel images. The algorithm has been broken into two sub-algorithms: (1) FFT Map Matching (see figure), which matches a single large template by correlation in the frequency domain, and (2) Mapped Landmark Refinement, which matches many small templates by correlation in the spatial domain. Each relies on feature selection, the homography transform, and 3D image correlation. The algorithm is implemented in C++ and is

rated at Technology Readiness Level (TRL) 4.

*This work was done by Andrew Johnson, Adnan Ansar, and Larry Matthies of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

*The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-44463.*

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## Σ WMAP C&DH Software

*Goddard Space Flight Center, Greenbelt, Maryland*

The command-and-data-handling (C&DH) software of the Wilkinson Microwave Anisotropy Probe (WMAP) spacecraft functions as the sole interface between (1) the spacecraft and its instrument subsystem and (2) ground operations equipment. This software includes a command-decoding and -distribution system, a telemetry/data-handling system, and a data-storage-and-playback system. This software performs onboard processing of attitude sensor data and generates

commands for attitude-control actuators in a closed-loop fashion. It also processes stored commands and monitors health and safety functions for the spacecraft and its instrument subsystems. The basic functionality of this software is the same of that of the older C&DH software of the Rossi X-Ray Timing Explorer (RXTE) spacecraft, the main difference being the addition of the attitude-control functionality. Previously, the C&DH and attitude-control computations were performed by differ-

ent processors because a single RXTE processor did not have enough processing power. The WMAP spacecraft includes a more-powerful processor capable of performing both computations.

*This program was written by Alan Cudmore, Tim Leath, Art Ferrer, Todd Miller, Mark Walters, Bruce Savadkin, and Ji-Wei Wu of Goddard Space Flight Center; Steve Slegel of Daedalian Systems Corp.; and Emory Stagmer of Litton/PRC. Further information is contained in a TSP (see page 1). GSC-14964-1*

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## Σ Web-Based Environment for Maintaining Legacy Software

*Lyndon B. Johnson Space Center, Houston, Texas*

"Advanced Tool Integration Environment" ("ATIE") is the name of both a software system and a Web-based environment created by the system for maintaining an archive of legacy software and expertise involved in developing the legacy software. ATIE can also be used in modifying legacy software and developing new software. The information that can be encapsulated in ATIE includes experts' documentation, input and output data of tests cases, source code, and compilation scripts. All of this informa-

tion is available within a common environment and retained in a database for ease of access and recovery by use of powerful search engines. ATIE also accommodates the embedment of supporting software that users require for their work, and even enables access to supporting commercial-off-the-shelf (COTS) software within the flow of the experts' work.

The flow of work can be captured by saving the sequence of computer programs that the expert uses. A user gains

access to ATIE via a Web browser. A modern Web-based graphical user interface promotes efficiency in the retrieval, execution, and modification of legacy code. Thus, ATIE saves time and money in the support of new and pre-existing programs.

*This program was written by Michael Tigges of Johnson Space Center; Nelson Thompson, Mark Orr, and Richard Fox of Dynacs, Inc.; and Rick Rohan of Lockheed Martin Corp. Further information is contained in a TSP (see page 1). MSC-23810-1*

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## Σ Information Metacatalog for a Grid

*Ames Research Center, Moffett Field, California*

SWIM is a Software Information Metacatalog that gathers detailed information about the software components and packages installed on a grid resource. Information is currently gathered for Executable and Linking

Format (ELF) executables and shared libraries, Java classes, shell scripts, and Perl and Python modules. SWIM is built on top of the POUR framework, which is described in the preceding article. SWIM consists of a set of Perl

modules for extracting software information from a system, an XML schema defining the format of data that can be added by users, and a POUR XML configuration file that describes how these elements are used to generate pe-