Software

2D/3D Visual Tracker for Rover Mast

A visual-tracker computer program controls an articulated mast on a Mars rover to keep a designated feature (a target) in view while the rover drives toward the target, avoiding obstacles. Several prior visual-tracker programs have been tested on rover platforms; most require very small and well-estimated motion between consecutive image frames — a requirement that is not realistic for a rover on rough terrain. The present visual-tracker program is designed to handle large image motions that lead to significant changes in feature geometry and photometry between frames. When a point is selected in one of the images acquired from stereoscopic cameras on the mast, a stereo triangulation algorithm computes a three-dimensional (3D) location for the target. As the rover moves, its body-mounted cameras feed images to a visual-odometry algorithm, which tracks two-dimensional (2D) corner features and computes their old and new 3D locations. The algorithm rejects points, the 3D motions of which are inconsistent with a rigid-world constraint, and then computes the apparent change in the rover pose (i.e., translation and rotation). The mast pan and tilt angles needed to keep the target centered in the field-of-view of the cameras (thereby minimizing the area over which the 2D-tracking algorithm must operate) are computed from the estimated change in the rover pose, the 3D position of the target feature, and a model of kinematics of the mast. If the motion between the consecutive frames is still large (i.e., 3D tracking was unsuccessful), an adaptive view-based matching technique is applied to the new image. This technique uses correlation-based template matching, in which a feature template is scaled by the ratio between the depth in the original template and the depth of pixels in the new image. This is repeated over the entire search window and the best correlation results indicate the appropriate match. The program could be a core for building application programs for systems that require coordination of vision and robotic motion.

This program was written by Max Bajracharya, Richard W. Madison, and Issa A. Nesnas of Caltech for **NASA's Jet Propulsion Laboratory**, *and Esfandiar Bandari, Clayton Kunz, Matt Deans, and Maria Bualat of Ames Research Center. Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-40696.

Adding Hierarchical Objects to Relational Database General-Purpose XML-Based Information Managements

NETMARK is a flexible, high-throughput software system for managing, storing, and rapid searching of unstructured and semi-structured documents. NETMARK transforms such documents from their original highly complex, constantly changing, heterogeneous data formats into well-structured, common data formats in using Hypertext Markup Language (HTML) and/or Extensible Markup Language (XML). The software implements an object-relational database system that combines the best practices of the relational model utilizing Structured Query Language (SQL) with those of the object-oriented, semantic database model for creating complex data. In particular, NETMARK takes advantage of the Oracle 8i object-relational database model using physical-address data types for very efficient keyword searches of records across both context and content. NETMARK also supports multiple international standards such as WEBDAV for drag-and-drop file management and SOAP for integrated information management using Web services. The document-organization and -searching capabilities afforded by NETMARK are likely to make this software attractive for use in disciplines as diverse as science, auditing, and law enforcement.

This program was written by Shu-Chun Lin and Chris Knight of **Ames Research Center**; *Tracy La of Computer Science Corporation; David Maluf and David Bell of Universities Space Research; Khai Peter Tran of QSS Group, Inc.; and Yuri Gawdiak of NASA Headquarters. Further information is contained in a TSP (see page 1).*

This invention has been patented by NASA (U.S. Patent No. 6,968,338). Inquiries concerning rights for the commercial use of this invention should be addressed to the Ames Technology Partnerships Division at (650) 604-2954. Refer to ARC-14662-1.