Improvement in Visual Target Tracking for a Mobile Robot

*NASA's Jet Propulsion Laboratory, Pasadena, California*

In an improvement of the visual-target-tracking software used aboard a mobile robot (rover) of the type used to explore the Martian surface, an affine-matching algorithm has been replaced by a combination of a normalized-cross-correlation (NCC) algorithm and a template-image-magnification algorithm. Although neither NCC nor template-image magnification is new, the use of both of them to increase the degree of reliability with which features can be matched is new. In operation, a template image of a target is obtained from a previous rover position, then the magnification of the template image is based on the estimated change in the target distance from the previous rover position to the current rover position (see figure). For this purpose, the target distance at the previous rover position is determined by stereoscopy, while the target distance at the current rover position is calculated from an estimate of the current pose of the rover. The template image is then magnified by an amount corresponding to the estimated target distance to obtain a best template image to match with the image acquired at the current rover position.

This program was written by Won Kim, Adnan Ansar, and Richard Madison of Caltech 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 Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42682.
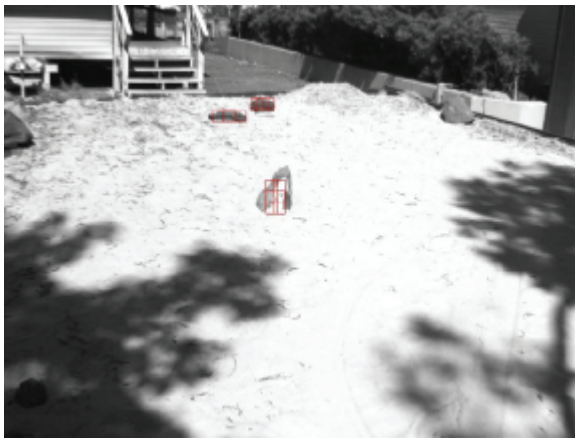
Turn-in-Place Experiments show beginning image (left) and end image (right) after 80° rover rotation. As the rover turns, the mast camera turns in the opposite direction to point to the target.

Software for Simulating Air Traffic

Ames Research Center, Moffett Field, California

Future Air Traffic Management Concepts Evaluation Tool (FACET) is a system of software for performing computational simulations for evaluating advanced concepts of advanced air-traffic management. FACET includes a program that generates a graphical user interface plus programs and databases that implement computational models of weather, airspace, airports, navigation aids, aircraft performance, and aircraft trajectories. Examples of concepts studied by use of FACET include aircraft self-separation for free flight; prediction of air-traffic-controller workload; decision support for direct routing; integration of spacecraft-launch operations into the U.S. national airspace system; and traffic-flow-management using rerouting, metering, and ground delays. Aircraft can be modeled as flying along either flight-plan routes or great-circle routes as they climb, cruise, and descend according to their individual performance models. The FACET software is modular and is written in the Java and C programming languages. The architecture of FACET strikes a balance between flexibility and fidelity; as a consequence, FACET can be used to model system-wide airspace operations over the contiguous U.S., involving as many as 10,000 aircraft, all on a single desktop or laptop computer running any of a variety of operating systems. Two notable applications of FACET include: (1) reroute conformance monitoring algorithms that have been implemented in one of the Federal Aviation Administration's nationally deployed, real-time, operational systems; and (2) the licensing and integration of FACET with the commercially available Flight Explorer, which is an Internet-based, real-time flight-tracking system.

This program was written by Banavar Sridhar, Karl Bilimoria, and Shon Grabbe of **Ames Research Center** *and Gano Chatterji, Kapil Sheth, and Daniel Mulfinger of Raytheon Co. Further information is contained in a TSP (see page 1).*

This invention is owned by NASA and a patent application has been filed. 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-14653-1.