Data Table Plot View enables visualization of the data table created by Parametric Studies or by another data source: this module quickly generates a display of the data in the form of a rotatable three-dimensional-appearing plot, making it unnecessary to load the SOAP output data into a separate plotting program. The rotatable three-dimensional-appearing plot makes it easy to determine which points in the parameter space are most desirable. Both modules provide intuitive user interfaces for ease of use.

This work was done by Robert Carnright, Adam Loverro, and Robert Oberto of Caltech and David Stodden and John Coggi of The Aerospace Corporation for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

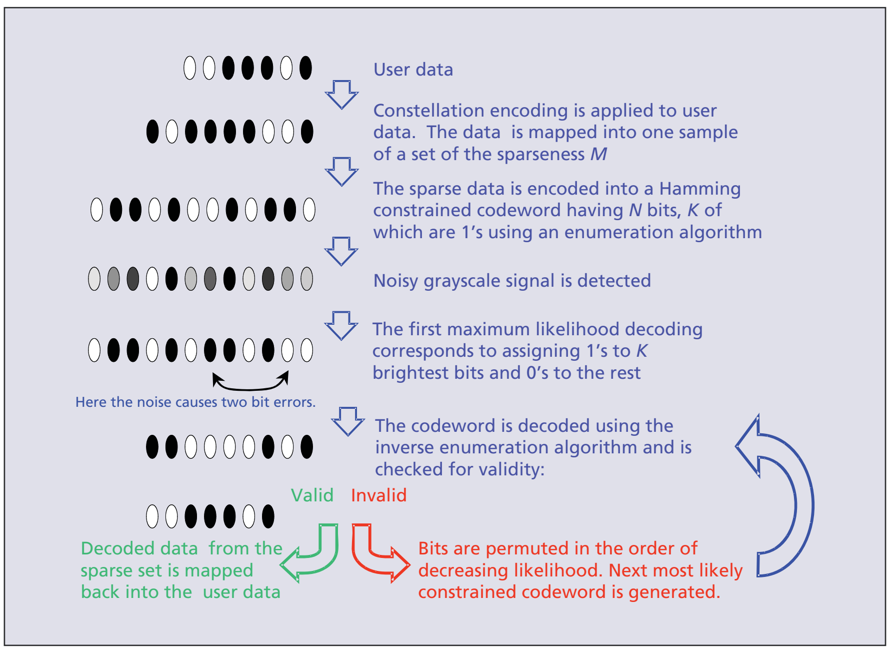
This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-45059.

Testing of Error-Correcting Sparse Permutation Channel Codes

NASA's Jet Propulsion Laboratory, Pasadena, California

A computer program performs Monte Carlo direct numerical simulations for testing sparse permutation channel codes, which offer strong error-correction capabilities at high code rates and are considered especially suitable for storage of digital data in holographic and volume memories. A word in a code of this type is characterized by, among other things, a sparseness parameter (M) and a fixed number (K) of 1 or "on" bits in a channel block length of N (see figure).

In a test, random user data words are generated and mapped into code words. Transmission of the words through a noisy channel is simulated by adding simulated white Gaussian noise whose amplitude is determined by the signal-to-noise ratio. Detection of each word is performed via strict Maximum Likelihood detection algorithm starting with the initially detected codeword, which is produced by sorting the resulting bit values and assigning a value of 1 to the highest K of them and 0 to the rest. A newly developed permutation sorting algorithm is further applied to determine the maximum weight valid code word. The maximum likelihood valid sparse codeword is decoded, by means of an inverse of an enumerative scheme used in generating code words, to obtain the original use data. From the results of this simulation, block error rates (BERs) and other statistics that characterize the performance of the code are calculated. Sparse permutation channel codes satisfy the balanced channel coding constraint and, as determined from the direct numerical simulation, also simultaneously provide high error correction with use of BER as low as 10^{-10} and less even for fairly large raw bit error rates. Channel codes of sufficiently large block size ($N > 100$) asymptotically approach the information theoretic limits for communications channel capacity.



An **Outline of the Code** used for numerical simulation of the error-correction performance.

This program was written by Kirill V. Shcheglov and Sergei S. Orlov of Stanford and was tested numerically by Hongtao Liu and Snezhana I. Abarzhi of Illinois Institute of Technology for NASA's Jet Propulsion Laboratory.

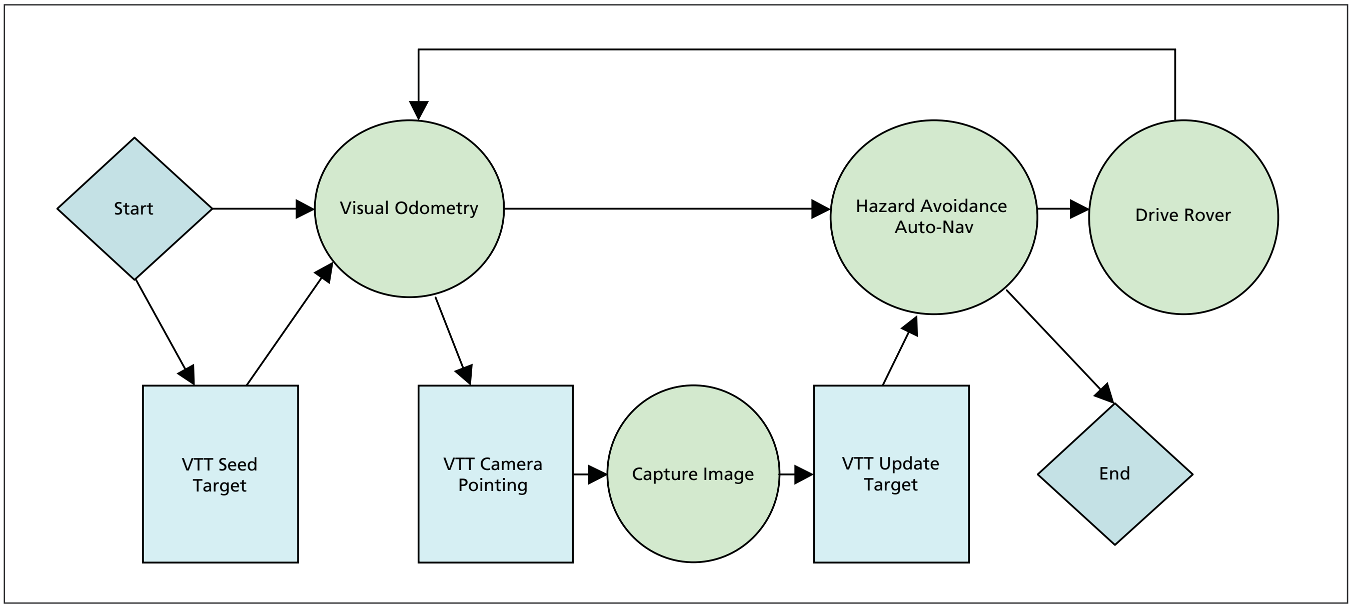
This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-45196.

Visual Target Tracking on the Mars Exploration Rovers

NASA's Jet Propulsion Laboratory, Pasadena, California

Visual target tracking (VTT) software has been incorporated into Release 9.2 of the Mars Exploration Rover (MER) flight software, now running aboard the rovers Spirit and Opportunity. In the VTT operation (see figure), the rover is driven in short steps between stops and, at each stop, still images are acquired by actively aimed navigation cameras (navcams) on a mast on the rover (see artistic rendition). The VTT software processes the digitized navcam images so as to track a target reliably and to make it possible to approach the target accurately to within a few centimeters over a 10-m traverse.

The operations on the digitized images include a normalized cross-correlation algorithm along with template-image-magnification and template-image-roll-compensation algorithms.



Functional Flow of VTT integrated into MER flight software. VTT module functions (square boxes) are additions to the existing MER flight software (circles).

Artistic Rendition of MER.

Each VTT update takes about 50 seconds. VTT has helped to make it possible to approach a target over a 10-m traverse and place an instrument on the target during a single sol, whereas previously, such approach and placement took 3 sols. Alternatively, VTT can be used to simply image a target as the rover passes it. VTT can be used in conjunction with any combination of blind driving, autonomous navigation with hazard avoidance, and/or visual odometry.

This program was written by Won Kim, Jeffrey Biesiadecki, and Khaled Ali of Caltech for NASA's Jet Propulsion Laboratory.

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-45019.

SPICE Module for the Satellite Orbit Analysis Program (SOAP)

NASA's Jet Propulsion Laboratory, Pasadena, California

A SPICE module for the Satellite Orbit Analysis Program (SOAP) precisely represents complex motion and maneuvers in an interactive, 3D animated environment with support for user-defined quantitative outputs. ("SPICE" stands for Spacecraft, Planet, Instrument, Camera-matrix, and Events). This module enables the SOAP software to exploit NASA mission ephemeris represented in the JPL Ancillary Information Facility (NAIF) SPICE formats. Ephemeris types supported include position, velocity, and orientation for spacecraft and planetary bodies including the Sun, planets, natural satellites, comets, and asteroids. Entire missions can now be imported into SOAP for 3D visualization, playback, and analysis.

The SOAP analysis and display features can now leverage detailed mission files to offer the analyst both a numerically correct and aesthetically pleasing combination of results that can be varied to study many hypothetical scenarios. The software provides a modeling and simulation environment that can encompass a broad variety of problems using orbital prediction. For example, ground coverage analysis, communications analysis, power and thermal analysis, and 3D visualization that provide the user with insight into complex geometric relations are included.

The SOAP SPICE module allows distributed science and engineering teams to share common mission models of