Automatic Rock Detection and Mapping from HiRISE Imagery

NASA's Jet Propulsion Laboratory, Pasadena, California

This system includes a C-code software program and a set of MATLAB software tools for statistical analysis and rock distribution mapping. The major functions include rock detection and rock detection validation. The rock detection code has been evolved into a production tool that can be used by engineers and geologists with minor training.

The software takes as an input an image of a scene containing rocks and produces as output a description of the rock population and associated statistics. Each rock is described in terms of location, dimensions, and confidence of detection. The input parameters are the image resolution (ground sampling distance, or the size of a pixel in centimeters), the Sun incidence and azimuth angles for analysis of the shadows cast by rocks to derive individual rock models, and a parameter than can be adjusted to accommodate variations in image contrast.

The software is able to process very large reconnaissance imagery using a standard desktop computer by automatically processing image blocks and collecting all output in a single rock population description file (RPDF). Processing time is in the order of minutes for nominal HiRISE images covering 6×12 km areas at 30 cm/pixel.

The test option allows small portions of the large images to be selected and processed. Alternatively, a specific image window can be processed by indicating its coordinates and size. In this mode, visual results (detections overlaid on the images) are provided in addition to the rock population file (RPDF). This option is useful to quickly allow verification of parameter settings, and the quality of the detection results.

This work was done by Andres Huertas, Douglas S. Adams, and Yang Cheng 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-45752.

Parallel Computing for the Computed-Tomography Imaging Spectrometer

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This software computes the tomographic reconstruction of spatial-spectral data from raw detector images of the Computed-Tomography Imaging Spectrometer (CTIS), which enables transient-level, multi-spectral imaging by capturing spatial and spectral information in a single snapshot. The CTIS can be used for surveying planetary landscapes through spectral imaging. It can also be used for battlefield surveillance and the spectral imaging of live tissues for disease detection.

A Message Passing Interface Library (MPI) is used to parallelize the original serial version of the code without modifying its initial structure. By parallelizing the code, a speedup of up to 20 is reached by using 32 processors. The software does not use any third-party libraries that require licenses. It is written in Fortran and MPI, and the storage of matrix elements is efficient, thus reducing memory requirements.

This work was done by Seungwon Lee 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-45831.

Rock Segmentation Through Edge Regrouping

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Rockster is an algorithm that automatically identifies the locations and boundaries of rocks imaged by the rover hazard cameras (hazcams), navigation cameras (navcams), or panoramic cameras (pancams). The software uses edge detection and edge regrouping to identify closed contours that separate the rocks from the background (see figure). The algorithm has applications both in ground-based data analysis, for example, to examine large quantities of images returned by the Mars Exploration Rovers, and in onboard (on-rover) opportunistic science applications such as construction of rock maps during traverse, identification of unusual or otherwise high-value science targets that warrant additional investigation, and detection of certain types of geologic contact zones.

The software uses gray-level intensity gradients to identify raw contours; these raw contours are then split into shorter, low-curvature fragments. New fragments are created where necessary to bridge areas of poor gradient information or poor image quality. The algorithm uses a flooding step to regroup the various fragments into closed contours. The algorithm is very fast with the C implementation able to process (768×1024) images containing hundreds to thousands of rocks in approximately one second on a desktop workstation.

The algorithm is particularly efficient at quickly detecting small- to medium-sized rocks with sufficient contrast (positive or negative) relative to the background. Full quantitative performance comparisons are not yet available; however, preliminary tests show that Rockster appears to detect a significantly larger fraction of rocks