

warp the images into the reference frame of the mosaic before stitching them together to create the mosaic. [Also see "Parallel-Processing Software for Correlating Stereo Images," Software Supplement to *NASA Tech Briefs*, Vol. 31, No. 9 (September 2007) page 26.]

The warping algorithm in this computer program reflects the considerations that (1) for every pixel in the desired final mosaic, a good corresponding point must be found in one or more of the original images and (2) for this purpose, one needs a good mathematical model of the cameras and a good correlation of individual pixels with respect to their positions in three dimensions. The desired mosaic is divided into slices, each of which is assigned to one of a number of central processing units (CPUs) operating simultaneously. The results from the CPUs are gathered and placed into the final mosaic. The time taken to create the mosaic depends upon the number of CPUs, the speed of each CPU, and whether a local or a remote data-staging mechanism is used.

*This program was written by Gerhard Klimeck, Robert Deen, Michael Mcauley, and Eric De Jong 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-30630.*

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## Software for Verifying Image-Correlation Tie Points

A computer program enables assessment of the quality of tie points in the image-cor-

relation processes of the software described in the immediately preceding article. Tie points are computed in mappings between corresponding pixels in the left and right images of a stereoscopic pair. The mappings are sometimes not perfect because image data can be noisy and parallax can cause some points to appear in one image but not the other. The present computer program relies on the availability of a left→right correlation map in addition to the usual right→left correlation map. The additional map must be generated, which doubles the processing time. Such increased time can now be afforded in the data-processing pipeline, since the time for map generation is now reduced from about 60 to 3 minutes by the parallelization discussed in the previous article. Parallel cluster processing time, therefore, enabled this better science result. The first mapping is typically from a point (denoted by coordinates  $x,y$ ) in the left image to a point ( $x',y'$ ) in the right image. The second mapping is from ( $x',y'$ ) in the right image to some point ( $x'',y''$ ) in the left image. If ( $x,y$ ) and ( $x'',y''$ ) are identical, then the mapping is considered perfect. The perfect-match criterion can be relaxed by introducing an error window that admits of round-off error and a small amount of noise. The mapping procedure can be repeated until all points in each image not connected to points in the other image are eliminated, so that what remains are verified correlation data.

*This program was written by Gerhard Klimeck and Gary Yagi 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 Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-30632.*

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## Flexcam Image Capture Viewing and Spot Tracking

Flexcam software was designed to allow continuous monitoring of the mechanical deformation of the telescope structure at Palomar Observatory. Flexcam allows the user to watch the motion of a star with a low-cost astronomical camera, to measure the motion of the star on the image plane, and to feed this data back into the telescope's control system. This automatic interaction between the camera and a user interface facilitates integration and testing.

Flexcam is a CCD image capture and analysis tool for the ST-402 camera from Santa Barbara Instruments Group (SBIG). This program will automatically take a dark exposure and then continuously display corrected images. The image size, bit depth, magnification, exposure time, resolution, and filter are always displayed on the title bar. Flexcam locates the brightest pixel and then computes the centroid position of the pixels falling in a box around that pixel. This tool continuously writes the centroid position to a network file that can be used by other instruments.

Images are auto-scaled by the program to the screen. Flexcam also allows dark frame, or background frame, subtraction. The centroid of a star's image is computed, while data from ghost images is excluded.

*This program was written by Shanti Rao 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-44361.*