as affine invariant parameter space (AIPS), the technique can be applied to many image-processing and computer-vision problems, including image registration, template matching, and object tracking from image sequence.

The AIPS is formed by the parameters in an affine combination of a set of feature points in the image plane. In cases where the entire image can be assumed to have undergone a single affine transformation, the new AIPS match metric and matching framework becomes very effective (compared with the state-of-the-art methods at the time of this reporting). No knowledge about scaling or any other transformation parameters need to be known *a priori* to apply the AIPS framework.

An automated suite of software tools has been created to provide accurate image segmentation (for data cleaning) and high-quality 2D image and 3D surface registration (for fusing multi-resolution terrain, image, and map data). These tools are capable of supporting existing GIS toolkits already in the marketplace, and will also be usable in a standalone fashion. The toolkit applies novel algorithmic approaches for image segmentation, feature extraction, and registration of 2D imagery and 3D surface data, which supports first-pass, batched, fully automatic feature extraction (for segmentation), and registration.

A hierarchical and adaptive approach is taken for achieving automatic feature extraction, segmentation, and registration. Surface registration is the process of aligning two (or more) data sets to a common coordinate system, during which the transformation between their different coordinate systems is determined.

Also developed here are a novel, volumetric surface modeling and compression technique that provide both quality-guaranteed mesh surface approximations and compaction of the model sizes by efficiently coding the geometry and connectivity/topology components of the generated models. The highly efficient triangular mesh compression compacts the connectivity information at the rate of 1.5–4 bits per vertex (on average for triangle meshes), while reducing the 3D geometry by 40–50 percent.

Finally, taking into consideration the characteristics of 3D terrain data, and using the innovative, regularized binary decomposition mesh modeling, a multistage, pattern-drive modeling, and compression technique has been developed to provide an effective framework for compressing digital elevation model (DEM) surfaces, high-resolution aerial imagery, and other types of NASA data.

This work was done by Jacob Yadegar, Hai Wei, Joseph Yadegar, Nilanjan Ray, and Sakina Zabuawala of UtopiaCompression Corp. for Stennis Space Center.

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Σ Image Calibration

Calibrate_Image calibrates images obtained from focal plane arrays so that the output image more accurately represents the observed scene. The function takes as input a degraded image along with a flat field image and a dark frame image produced by the focal plane array and outputs a corrected image. The three most prominent sources of image degradation are corrected for: dark current accumulation, gain non-uniformity across the focal plane array, and hot and/or dead pixels in the array. In the corrected output image the dark current is subtracted, the gain variation is equalized, and values for hot and dead pixels are estimated, using bicubic interpolation techniques.

This work was done by Christopher S. Peay and David M. Palacios of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

The software used in this innovation is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47191.

⊚ Rapid ISS Power Availability Simulator

The ISS (International Space Station) Power Resource Officers (PROs) needed a tool to automate the calculation of thousands of ISS power availability simulations used to generate power constraint matrices. Each matrix contains 864 cells, and each cell represents a single power simulation that must be run. The tools available to the flight controllers were very operator intensive and not conducive to rapidly running the thousands of simulations necessary to generate the power constraint data.

SOLAR is a Java-based tool that leverages commercial-off-the-shelf software (Satellite Toolkit) and an existing in-house ISS EPS model (SPEED) to rapidly perform thousands of power availability simulations. SOLAR has a very modular architecture and consists of a series of plug-ins that are loosely coupled. The modular architecture of the software allows for the easy replacement of the ISS power system model simulator, re-use of the Satellite Toolkit integration code, and separation of the user interface from the core logic.

Satellite Toolkit (STK) is used to generate ISS eclipse and insulation times, solar beta angle, position of the solar arrays over time, and the amount of shadowing on the solar arrays, which is then provided to SPEED to calculate power generation forecasts.

The power planning turn-around time is reduced from three months to two weeks (83-percent decrease) using SOLAR, and the amount of PRO power planning support effort is reduced by an estimated 30 percent.

This work was done by Nicholas Downing of United Space Alliance for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-24623-1