Information Sciences

Quickly Approximating the Distance Between Two Objects

Lyndon B. Johnson Space Center, Houston, Texas

A method of quickly approximating the distance between two objects (one smaller, regarded as a point; the other larger and complexly shaped) has been devised for use in computationally simulating motions of the objects for the purpose of planning the motions to prevent collisions. The method is needed because computer-based-graphics techniques that have been used heretofore to make such estimates entail amounts of computation that are excessively large for purposes of the simulations.

The method, denoted tree-based model learning, is an integral combination of (1) decision-tree techniques upon which several machine learning techniques have been based and (2) a relatively accurate function-approximation technique. Each node of a decision tree corresponds to a partition of the problem domain — in this case, starting with one node representing a large cubic volume centered on the large object and dividing and subdividing it, at symmetry planes, into successively smaller cubes. Each branch of the tree represents a rule-based decision selecting one of the child nodes of a parent node. The smallest subdivisions (leaf nodes) contain coefficients of a quadric equation that estimates the distance between the objects.

This work was done by David Hammen of LinCom Corp. for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-23264-1

Processing Images of Craters for Spacecraft Navigation

NASA's Jet Propulsion Laboratory, Pasadena, California

A crater-detection algorithm has been conceived to enable automation of what, heretofore, have been manual processes for utilizing images of craters on a celestial body as landmarks for navigating a spacecraft flying near or landing on that body. The images are acquired by an electronic camera aboard the spacecraft, then digitized, then processed by the algorithm, which consists mainly of the following steps:

1. Edges in an image detected and placed in a database.
2. Crater rim edges are selected from the edge database.
3. Edges that belong to the same crater are grouped together.
4. An ellipse is fitted to each group of crater edges.
5. Ellipses are refined directly in the image domain to reduce errors introduced in the detection of edges and fitting of ellipses.
6. The quality of each detected crater is evaluated.

It is planned to utilize this algorithm as the basis of a computer program for automated, real-time, onboard processing of crater-image data. Experimental studies have led to the conclusion that this algorithm is capable of a detection rate >93 percent, a false-alarm rate <5 percent, a geometric error <0.5 pixel, and a position error <0.3 pixel.

This work was done by Yang Cheng, Andrew E. Johnson, and Larry H. Matthies of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-40122

Adaptive Morphological Feature-Based Object Classifier for a Color Imaging System

This technique has potential use in the fields of disease state identification, cancer screening and detection, and wound healing.

John H. Glenn Research Center, Cleveland, Ohio

Utilizing a Compact Color Microscope Imaging System (CCMIS), a unique algorithm has been developed that combines human intelligence along with machine vision techniques to produce an autonomous microscope tool for biomedical, industrial, and space applications. This technique is based on an adaptive, morphological, feature-based mapping function comprising 24 mutually inclusive feature metrics that are used to determine the metrics for complex cell/objects derived from color image analysis. Some of the features include:

- Area (total numbers of non-background pixels inside and including the perimeter),
- Bounding Box (smallest rectangle that bounds and object),
- centerX (x-coordinate of intensity-weighted, center-of-mass of an entire object or multi-object blob),
- centerY (y-coordinate of intensity-weighted, center-of-mass, of an entire object or multi-object blob),
- Circumference (a measure of circumfer-