

from the line segments. The images are also processed by a feature-extraction algorithm that performs a wavelet analysis, then performs a pattern-recognition operation in the wavelet-coefficient space to determine matches to a texture feature measure derived from the horizontal, vertical, and diagonal coefficients. The centroids from the ellipse finder and the wavelet feature matcher are then fused to determine co-location. In the event that a match is found, the centroid (or centroids if multiple matches are present) is reported. If no match is found, the process reports the results of the analyses for further examination by human experts.

*This program was written by Terrance Huntsberger, Yang Cheng, Robert Liebersbach, and Ashitey Trebi-Ollenu 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-43470.*

## Implementation of a Point Algorithm for Real-Time Convex Optimization

The primal-dual interior-point algorithm implemented in G-OPT is a relatively new and efficient way of solving convex optimization problems. Given a prescribed level of accuracy, the convergence to the optimal solution is guaranteed in a predetermined, finite number of iterations. G-OPT Version 1.0 is a flight software implementation written in C. On-board application of the software enables autonomous, real-time guidance and control that explicitly incorporates mission constraints such as control authority (e.g. maximum thrust limits), hazard avoidance, and fuel limitations.

This software can be used in planetary landing missions (Mars pinpoint landing and lunar landing), as well as in proximity operations around small celestial bodies (moons, asteroids, and comets). It also can be used in any spacecraft mission for thrust allocation in six-degrees-of-freedom control.

*This program was written by Behçet Açıkmüş, Shui Motaghedi, and John Carson 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-44352.*

## Handling Input and Output for COAMPS

Two suites of software have been developed to handle the input and output of the Coupled Ocean Atmosphere Prediction System (COAMPS), which is a regional atmospheric model developed by the Navy for simulating and predicting weather. Typically, the initial and boundary conditions for COAMPS are provided by a flat-file representation of the Navy's global model. Additional algorithms are needed for running the COAMPS software using global models. One of the present suites satisfies this need for running COAMPS using the Global Forecast System (GFS) model of the National Oceanic and Atmospheric Administration. The first step in running COAMPS — downloading of GFS data from an Internet file-transfer-protocol (FTP) server computer of the National Centers for Environmental Prediction (NCEP) — is performed by one of the programs (SSC-00273) in this suite. The GFS data, which are in gridded binary (GRIB) format, are then changed to a COAMPS-compatible format by another program in the suite (SSC-00278). Once a forecast is complete, still another program in the suite (SSC-00274) sends the output data to a different server computer.

The second suite of software (SSC-00275) addresses the need to ingest up-to-date land-use-and-land-cover (LULC) data into COAMPS for use in specifying typical climatological values of such surface parameters as albedo, aerodynamic roughness, and ground wetness. This suite includes (1) a program to process LULC data derived from observations by the Moderate Resolution Imaging Spectroradiometer (MODIS) instruments aboard NASA's Terra and Aqua satellites, (2) programs to derive new climatological parameters for the 17-land-use-category MODIS data; and (3) a modified version of a FORTRAN subroutine to be used by COAMPS. The MODIS data files are processed to reformat them into a compressed American Standard Code for Information Interchange (ASCII) format used by COAMPS for efficient processing.

*These programs were written by Patrick Fitzpatrick, Nam Tran, Yongzuo Li, and Valentine Anantharaj of Mississippi State University for Stennis Space Center.*

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*Refer to SSC-00273/4/5/8, volume and number of this NASA Tech Briefs issue, and the page number.*

## Modeling and Grid Generation of Iced Airfoils

SmagglIce Version 2.0 is a software toolkit for geometric modeling and grid generation for two-dimensional, single- and multi-element, clean and iced airfoils. A previous version of SmagglIce was described in "Preparing and Analyzing Iced Airfoils," *NASA Tech Briefs*, Vol. 28, No. 8 (August 2004), page 32. To recapitulate: Ice shapes make it difficult to generate quality grids around airfoils, yet these grids are essential for predicting ice-induced complex flow. This software efficiently creates high-quality structured grids with tools that are uniquely tailored for various ice shapes.

SmagglIce Version 2.0 significantly enhances the previous version primarily by adding the capability to generate grids for multi-element airfoils. This version of the software is an important step in streamlining the aeronautical analysis of ice airfoils using computational fluid dynamics (CFD) tools. The user may prepare the ice shape, define the flow domain, decompose it into blocks, generate grids, modify/divide/merge blocks, and control grid density and smoothness. All these steps may be performed efficiently even for the difficult glaze and rime ice shapes. Providing the means to generate highly controlled grids near rough ice, the software includes the creation of a wrap-around block (called the "viscous sublayer block"), which is a thin, C-type block around the wake line and iced airfoil. For multi-element airfoils, the software makes use of grids that wrap around and fill in the areas between the viscous sub-layer blocks for all elements that make up the airfoil. A scripting feature records the history of interactive steps, which can be edited and re-played later to produce other grids.

Using this version of SmagglIce, ice shape handling and grid generation can become a practical engineering process, rather than a laborious research effort.

*This program was written by Mary B. Vickerman, Marivell Baez, Donald C. Braun, Anthony W. Hackenberg, James A. Pennline, and Herbert W. Schilling of Glenn*