

the satellite, provides command processing and interface to the spacecraft communications and data bus, and provides watchdog functions for error detection.

The Special Test Equipment (STE) software was designed to operate specific test equipment used to support the LIS hardware through development, calibration, qualification, and integration with the TRMM spacecraft. The STE software provides the capability to control instrument activation, commanding (including both data formatting and user interfacing), data collection, decompression,

and display and image simulation.

The LIS STE code was developed for the DOS operating system in the C programming language. Because of the many unique data formats implemented by the flight instrument, the STE software was required to comprehend the same formats, and translate them for the test operator. The hardware interfaces to the LIS instrument using both commercial and custom computer boards, requiring that the STE code integrate this variety into a working system. In addition, the requirement to provide RTEP test capa-

bility dictated the need to provide simulations of background image data with short-duration lightning transients superimposed. This led to the development of unique code used to control the location, intensity, and variation above background for simulated lightning strikes at user-selected locations.

This program was written by Kathleen Freestone, Louis Simeone, Bryan Robertson, Maytha Frankford, David Trice, Kevin Wallace, and DeLisa Wilkerson of Marshall Space Flight Center. Further information is contained in a TSP (see page 1). MFS-32339-1

Processing AIRS Scientific Data Through Level 2

NASA's Jet Propulsion Laboratory, Pasadena, California

The Atmospheric Infrared Spectrometer (AIRS) Science Processing System (SPS) is a collection of computer programs, denoted product generation executives (PGEs), for processing the readings of the AIRS suite of infrared and microwave instruments orbiting the Earth aboard NASA's Aqua spacecraft. AIRS SPS at an earlier stage of development was described in "Initial Processing of Infrared Spectral Data" (NPO-35243), *NASA Tech Briefs*, Vol. 28, No. 11 (November 2004), page 39. To recapitulate: Starting from level 0 (representing raw AIRS data), the PGEs and their data products are denoted by alphanumeric labels (1A, 1B, and 2) that signify the

successive stages of processing. The cited prior article described processing through level 1B (the level-2 PGEs were not yet operational).

The level-2 PGEs, which are now operational, receive packages of level-1B geolocated radiance data products and produce such geolocated geophysical atmospheric data products such as temperature and humidity profiles. The process of computing these geophysical data products is denoted "retrieval" and is quite complex. The main steps of the process are denoted microwave-only retrieval, cloud detection and cloud clearing, regression, full retrieval, and rapid transmittance algorithm.

This program was written by Robert Oliphant, Sung-Yung Lee, Moustafa Chahine of Caltech; Joel Susskind of Goddard Space Flight Center; Christopher Barnett, Larry McMillin, and Mitchell Goldberg of the National Oceanic and Atmospheric Administration; John Blaisdell of Science Applications International Corp; Philip Rosenkranz of Massachusetts Institute of Technology; and Larrabee Strow of the University of Maryland, Baltimore County, 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-40459.

Triaxial Probe Magnetic Data Analysis

NASA's Jet Propulsion Laboratory, Pasadena, California

The Triaxial Magnetic Moment Analysis software uses measured magnetic field test data to compute dipole and quadrupole moment information from a hardware element. It is used to support JPL projects needing magnetic control and an understanding of the spacecraft-generated magnetic fields.

Evaluation of the magnetic moment of an object consists of three steps: acquisition, conditioning, and analysis. This version of existing software was extensively rewritten for easier data acquisition, data analysis, and report presentation, including immediate feedback to the test operator during data acquisi-

tion.

While prior JPL computer codes provided the same data content, this program has a better graphic display including original data overlaid with reconstructed results to show "goodness of fit" accuracy and better appearance of the report graphic page. Data are acquired using three magnetometers and two rotations of the device under test. A clean acquisition user interface presents required numeric data and graphic summaries, and the analysis module yields the best fit (least squares) for the magnetic dipole and/or quadrupole moment of a device.

The acquisition module allows the user

to record multiple data sets, selecting the best data to analyze, and is repeated three times for each of the z-axial and y-axial rotations. In this update, the y-axial rotation starting position has been changed to an option, allowing either the x- or z-axis to point towards the magnetometer. The code has been rewritten to use three simultaneous axes of magnetic data (three probes), now using two "rotations" of the device under test rather than the previous three rotations, thus reducing handling activities on the device under test. The present version of the software gathers data in one-degree increments, which permits much better accuracy of the fit-

ted data than the coarser data acquisition of the prior software.

The data-conditioning module provides a clean data set for the analysis module. For multiple measurements at a given degree, the first measurement is used. For omitted measurements, the missing field is estimated by linear interpolation between the two nearest measurements.

The analysis module was rewritten for the dual rotation, triaxial probe measurement process and now has better moment estimation accuracy, based on the finer one degree of data acquisition resolution. The magnetic moments thus computed are used as an input to summarize the total spacecraft field.

This program was written by Kimberly Shultz, Albert Whittlesey, and Pablo Narvaez 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-44192.

Analyzing Responses of Chemical Sensor Arrays

NASA's Jet Propulsion Laboratory, Pasadena, California

NASA is developing a third-generation electronic nose (ENose) capable of continuous monitoring of the International Space Station's cabin atmosphere for specific, harmful airborne contaminants. Previous generations of the ENose have been described in prior *NASA Tech Briefs* issues.

Sensor selection is critical in both (pre-fabrication) sensor material selection and (post-fabrication) data analysis of the ENose, which detects several analytes that are difficult to detect, or that are at very low concentration ranges. Existing sensor selection approaches usually include limited statistical measures, where selectivity is more important but reliability and sen-

sitivity are not of concern. When reliability and sensitivity can be major limiting factors in detecting target compounds reliably, the existing approach is not able to provide meaningful selection that will actually improve data analysis results.

The approach and software reported here consider more statistical measures (factors) than existing approaches for a similar purpose. The result is a more balanced and robust sensor selection from a less than ideal sensor array. The software offers quick, flexible, optimal sensor selection and weighting for a variety of purposes without a time-consuming, iterative search by performing sensor calibrations to a known linear or nonlin-

ear model, evaluating the individual sensor's statistics, scoring the individual sensor's overall performance, finding the best sensor array size to maximize class separation, finding optimal weights for the remaining sensor array, estimating limits of detection for the target compounds, evaluating fingerprint distance between group pairs, and finding the best event-detecting sensors.

This program was written by Hanying Zhou 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-43988.

PREDICTS

NASA's Jet Propulsion Laboratory, Pasadena, California

PREDICTS is a computer program that predicts the frequencies, as functions of time, of signals to be received by a radio science receiver — in this case, a special-purpose digital receiver dedicated to analysis of signals received by an antenna in NASA's Deep Space Network (DSN). Unlike other software used in the DSN, PREDICTS does not use interpolation early in the calculations; as a consequence, PREDICTS is more precise and more stable. The precision afforded by

the other DSN software is sufficient for telemetry; the greater precision afforded by PREDICTS is needed for radio-science experiments. In addition to frequencies as a function of time, PREDICTS yields the rates of change and interpolation coefficients for the frequencies and the beginning and ending times of reception, transmission, and occultation.

PREDICTS is applicable to S-, X-, and Ka-band signals and can accommodate the following link configurations: (1)

one-way (spacecraft to ground), (2) two-way (from a ground station to a spacecraft to the same ground station), and (3) three-way (from a ground transmitting station to a spacecraft to a different ground receiving station).

This work was done by Nicole Rappaport 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-40987.

Software Compensates Electronic-Nose Readings for Humidity

NASA's Jet Propulsion Laboratory, Pasadena, California

A computer program corrects for the effects of humidity on the readouts of an array of chemical sensors (an "electronic nose"). To enable the use of this program, the array must incorporate an in-

dependent humidity sensor in addition to sensors designed to detect analytes other than water vapor. The basic principle of the program was described in "Compensating for Effects of Humidity

on Electronic Noses" (NPO-30615), *NASA Tech Briefs*, Vol. 28, No. 6 (June 2004), page 63. To recapitulate: The output of the humidity sensor is used to generate values that are subtracted from