



✚ Translator for Optimizing Fluid-Handling Components

A software interface has been devised to facilitate optimization of the shapes of valves, elbows, fittings, and other components used to handle fluids under extreme conditions. This software interface translates data files generated by PLOT3D (a NASA grid-based plotting-and-data-display program) and by computational fluid dynamics (CFD) software into a format in which the files can be read by Sculptor, which is a shape-deformation-and-optimization program. Sculptor enables the user to interactively, smoothly, and arbitrarily deform the surfaces and volumes in two- and three-dimensional CFD models. Sculptor also includes design-optimization algorithms that can be used in conjunction with the arbitrary-shape-deformation components to perform automatic shape optimization. In the optimization process, the output of the CFD software is used as feedback while the optimizer strives to satisfy design criteria that could include, for example, improved values of pressure loss, velocity, flow quality, mass flow, etc.

This program was written by Mark Landon and Ernest Perry of Optimal Solutions Software, LLC for Stennis Space Center.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to SSC-00190, volume and number of this NASA Tech Briefs issue, and the page number.*

🔗 AIRSAR Web-Based Data Processing

The AIRSAR automated, Web-based data processing and distribution system is an integrated, end-to-end synthetic aperture radar (SAR) processing system. Designed to function under limited resources and rigorous demands, AIRSAR eliminates operational errors and provides for paperless archiving. Also, it provides a yearly tune-up of the processor on flight missions, as well as quality

assurance with new radar modes and anomalous data compensation.

The software fully integrates a Web-based SAR data-user request subsystem, a data processing system to automatically generate co-registered multi-frequency images from both polarimetric and interferometric data collection modes in 80/40/20 MHz bandwidth, an automated verification quality assurance subsystem, and an automatic data distribution system for use in the remote-sensor community. Features include Survey Automation Processing in which the software can automatically generate a quick-look image from an entire 90-GB SAR raw data 32-MB/s tape overnight without operator intervention. Also, the software allows product ordering and distribution via a Web-based user request system.

To make AIRSAR more user friendly, it has been designed to let users search by entering the desired mission flight line (Missions Searching), or to search for any mission flight line by entering the desired latitude and longitude (Map Searching). For precision image automation processing, the software generates the products according to each data processing request stored in the database via a Queue management system. Users are able to have automatic generation of co-registered multi-frequency images as the software generates polarimetric and/or interferometric SAR data processing in ground and/or slant projection according to user processing requests for one of the 12 radar modes.

This program was written by Anhua Chu, Jakob Van Zyl, Yunjin Kim, Scott Hensley, Yunling Lou, Soren Madsen, Bruce Chapman, David Imel, and Stephen Durdan of Caltech, and Wayne Tung of Columbus Technologies and Services, Inc. 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-40998.

🔗 Pattern Matcher for Trees Constructed From Lists

A software library has been developed that takes a high-level description of a pattern to be satisfied and applies it to a target. If the two match, it returns success; otherwise, it indicates a failure.

The target is semantically a tree that is constructed from elements of terminal and non-terminal nodes represented through lists and symbols. Additionally, functionality is provided for finding the element in a set that satisfies a given pattern and doing a tree search, finding all occurrences of leaf nodes that match a given pattern. This process is valuable because it is a new algorithmic approach that significantly improves the productivity of the programmers and has the potential of making their resulting code more efficient by the introduction of a novel semantic representation language. This software has been used in many applications delivered to NASA and private industry, and the cost savings that have resulted from it are significant.

This program was written by Mark James 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-42732.

🔗 Reducing a Knowledge-Base Search Space When Data Are Missing

This software addresses the problem of how to efficiently execute a knowledge base in the presence of missing data. Computationally, this is an exponentially expensive operation that without heuristics generates a search space of $1 + 2^n$ possible scenarios, where n is the number of rules in the knowledge base. Even for a knowledge base of the most modest size, say 16 rules, it would produce 65,537 possible scenarios. The purpose of this software is to reduce the complexity of this operation to a more manageable size. The problem that this system solves is to develop an automated approach that can reason in the presence of missing data. This is a meta-reasoning capability that repeatedly calls a diagnostic engine/model to provide prognoses and prognosis tracking. In the big picture, the scenario generator takes as its input the current state of a system, including probabilistic information from Data Forecasting. Using model-based reasoning techniques, it returns an ordered list of fault scenarios that could be

generated from the current state, i.e., the plausible future failure modes of the system as it presently stands. The scenario generator models a Potential Fault Scenario (PFS) as a black box, the input of which is a set of states tagged with priorities and the output of which is one or more potential fault scenarios tagged by a confidence factor. The results from the system are used by a model-based diagnostician to predict the future health of the monitored system.

This program was written by Mark James 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-42818.

Ground-Based Correction of Remote-Sensing Spectral Imagery

Software has been developed for an improved method of correcting for the atmospheric optical effects (primarily, effects of aerosols and water vapor) in spectral images of the surface of the Earth acquired by airborne and spaceborne remote-sensing instruments. In this method, the variables needed for the corrections are extracted from the readings of a radiometer located on the ground in the vicinity of the scene of interest. The software includes algorithms that analyze measurement data acquired from a shadow-band radiometer. These algorithms are based on a prior radiation transport software model, called MODTRANTM, that has been developed through several versions up to what are now known as MODTRAN4TM and MODTRAN5TM. These components have been integrated with a user-friendly Interactive Data Language (IDL) front end and an advanced version of MODTRAN4TM. Software tools for handling general data formats, performing a Langley-type calibration, and generating an output file of retrieved atmospheric parameters for use in another atmospheric-correction computer program known as "FLAASH" have also been incorporated into the present software. Concomitantly with

the software described thus far, there has been developed a version of FLAASH that utilizes the retrieved atmospheric parameters to process spectral image data.

These programs were written by Steven M. Adler-Golden, Peter Rochford, Michael Matthew, and Alexander Berk of Spectral Sciences, Inc. for Stennis Space Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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Refer to SSC-00226, volume and number of this NASA Tech Briefs issue, and the page number.

State-Chart Autocoder

A computer program translates Unified Modeling Language (UML) representations of state charts into source code in the C, C++, and Python computing languages. ("State charts" signifies graphical descriptions of states and state transitions of a spacecraft or other complex system.) The UML representations constituting the input to this program are generated by using a UML-compliant graphical design program to draw the state charts. The generated source code is consistent with the "quantum programming" approach, which is so named because it involves discrete states and state transitions that have features in common with states and state transitions in quantum mechanics. Quantum programming enables efficient implementation of state charts, suitable for real-time embedded flight software. In addition to source code, the autocoder program generates a graphical-user-interface (GUI) program that, in turn, generates a display of state transitions in response to events triggered by the user. The GUI program is wrapped around, and can be used to exercise the state-chart behavior of, the generated source code. Once the expected state-chart behavior is confirmed, the generated source code can be augmented with a software interface to the rest of the software with which the source code is required to interact.

This program was written by Kenneth Clark, Garth Watney, Alexander Murray, and Edward Benowitz 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-41951.

Pointing History Engine for the Spitzer Space Telescope

The Pointing History Engine (PHE) is a computer program that provides mathematical transformations needed to reconstruct, from downlinked telemetry data, the attitude of the Spitzer Space Telescope (formerly known as the Space Infrared Telescope Facility) as a function of time. The PHE also serves as an example for development of similar pointing reconstruction software for future space telescopes. The transformations implemented in the PHE take account of the unique geometry of the Spitzer telescope-pointing chain, including all data on relative alignments of components, and all information available from attitude-determination instruments. The PHE makes it possible to coordinate attitude data with observational data acquired at the same time, so that any observed astronomical object can be located for future reference and re-observation. The PHE is implemented as a subroutine used in conjunction with telemetry-formatting services of the Mission Image Processing Laboratory of NASA's Jet Propulsion Laboratory to generate the Bore-sight Pointing History File (BPHF). The BPHF is an archival database designed to serve as Spitzer's primary astronomical reference documenting where the telescope was pointed at any time during its mission.

This program was written by David Bayard, Asif Ahmed, and Paul Brugarolas 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-43374.