Software

SynGenics Optimization System (SynOptSys)

The SynGenics Optimization System (SynOptSys) software application optimizes a product with respect to multiple, competing criteria using statistical Design of Experiments, Response-Surface Methodology, and the Desirability Optimization Methodology. The user is not required to be skilled in the underlying math; thus, SynOptSys can help designers and product developers overcome the barriers that prevent them from using powerful techniques to develop better products in a less costly manner. SynOptSys is applicable to the design of any product or process with multiple criteria to meet, and at least two factors that influence achievement of those criteria.

The user begins with a selected solution principle or system concept and a set of criteria that needs to be satisfied. The criteria may be expressed in terms of documented desirements or defined responses that the future system needs to achieve. Documented desirements can be imported into SynOptSys or created and documented directly within SynOptSys. Subsequent steps include identifying factors, specifying model order for each response, designing the experiment, running the experiment and gathering the data, analyzing the results, and determining the specifications for the optimized system. The user may also enter textual information as the project progresses. Data is easily edited within SynOptSys, and the software design enables full traceability within any step in the process, and facilitates reporting as needed.

SynOptSys is unique in the way responses are defined and the nuances of the goodness associated with changes in response values for each of the responses of interest. The Desirability Optimization Methodology provides the basis of this novel feature. Moreover, this is a complete, guided design and optimization process tool with embedded math that can remain invisible to the user. It is not a standalone statistical program; it is a design and optimization system.

This work was done by Carol Ventresca, Michelle L McMillan, and Stephanie Globus of SynGenics Corporation for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18924-1.

CFD Script for Rapid TPS Damage Assessment

This grid generation script creates unstructured CFD grids for rapid thermal protection system (TPS) damage aeroheating assessments. The existing manual solution is cumbersome, open to errors, and slow.

The invention takes a large-scale geometry grid and its large-scale CFD solution, and creates a unstructured "patch" grid that models the TPS damage. The flow field boundary condition for the "patch" grid is then interpolated from the large-scale CFD solution. It speeds up the generation of CFD grids and solutions in the modeling of TPS damages and their aeroheating assessment. This process was successfully utilized during STS-134.

This work was done by Peter McCloud of The Boeing Company for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-24865-1

radEq Add-On Module for CFD Solver Loci-CHEM

The radEq software module allows Loci-CHEM to be applied to flow velocities where surface radiation due to heating from compression and friction becomes significant. The module adds a radiation equilibrium boundary condition to the computational fluid dynamics (CFD) code to produce accurate results. The module expanded the upper limit for accurate CFD solutions of Loci-CHEM from Mach 4 to Mach 10 based on Space Shuttle Orbiter Re-Entry trajectories.

Loci-CHEM already has a very promising architecture and performance, but absence of radiation equilibrium boundary condition limited the application of Loci-CHEM to below Mach 4. The immediate advantage of the add-on module is that it allows Loci-CHEM to work with supersonic flows up to Mach 10. This transformed Loci-CHEM from a rocket engine-heritage CFD code with general subsonic and low-supersonic applications, to an aeroheating code with hypersonic applications. The follow-on advantage of the module is that it is a building block for additional add-on modules that will solve for the heating generated at Mach numbers higher than 10.

This work was done by Peter McCloud of The Boeing Company. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)} to The Boeing Company. Inquiries concerning licenses for its commercial development should be addressed to:

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Refer to MSC-24848-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Science Opportunity Analyzer (SOA) Version 8

SOA allows scientists to plan spacecraft observations. It facilitates the identification of geometrically interesting times in a spacecraft's orbit that a user can use to plan observations or instrument-driven spacecraft maneuvers. These observations can then be visualized multiple ways in both two- and three-dimensional views. When observations have been optimized within a spacecraft's flight rules, the resulting plans can be output for use by other JPL uplink tools. Now in its eighth major version, SOA improves on these capabilities in a modern and integrated fashion.

SOA consists of five major functions: Opportunity Search, Visualization, Observation Design, Constraint Checking, and Data Output. Opportunity Search is a GUI-driven interface to existing search engines that can be used to identify times when a spacecraft is in a specific geometrical relationship with other bodies in the solar system. This function can be used for advanced mission planning as well as for making last-minute adjustments to mission sequences in response to trajectory modifications. Visualization is a key aspect of SOA. The user can view observation opportunities in either a 3D representation or as a 2D map projection.

Observation Design allows the user to orient the spacecraft and visualize the projection of the instrument field of view for that orientation using the same views as Opportunity Search. Constraint Checking is provided to validate various geometrical and physical aspects of an observation design. The user has the ability to easily create custom rules or to use official project-generated flight rules. This capability may also allow scientists to easily assess the cost to science if flight rule changes occur. Data Output allows the user to compute ancillary data related to an observation or to a given position of the spacecraft along its trajectory. The data can be saved as a tab-delimited text file or viewed as a graph.

SOA combines science planning functionality unique to both JPL and the sponsoring spacecraft. SOA is able to ingest JPL SPICE Kernels that are used to drive the tool and its computations. A Percy search engine is then included that identifies interesting time periods for the user to build observations. When observations are then built, flight-like orientation algorithms replicate spacecraft dynamics to closely simulate the flight spacecraft's dynamics.

SOA v8 represents large steps forward from SOA v7 in terms of quality, reliability, maintainability, efficiency, and user experience. A tailored agile development environment has been built around SOA that provides automated unit testing, continuous build and integration, a con-solidated Web-based code and documentation storage environment, modern Java enhancements, and a focus on usability.

This work was done by Robert J. Witoff, Carol A. Polanskey, Anna Marie A. Aguinaldo, Ning Liu, and Mark D. Hofstadter of Caltech; and Steven P. Joy of UCLA for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This software is available for commercial licensing. Please contact Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-48529.

Autonomous Byte Stream Randomizer

Net-centric networking environments are often faced with limited resources and must utilize bandwidth as efficiently as possible. In networking environments that span wide areas, the data transmission has to be efficient without any redundant or exuberant metadata.

The Autonomous Byte Stream Randomizer software provides an extra level of security on top of existing data encryption methods. Randomizing the data's byte stream adds an extra layer to existing data protection methods, thus making it harder for an attacker to decrypt protected data. Based on a generated cryptographically secure random seed, a random sequence of numbers is used to intelligently and efficiently swap the organization of bytes in data using the unbiased and memory-efficient in-place Fisher-Yates shuffle method.

Swapping bytes and reorganizing the crucial structure of the byte data renders the data file unreadable and leaves the data in a deconstructed state. This deconstruction adds an extra level of security requiring the byte stream to be reconstructed with the random seed in order to be readable. Once the data byte stream has been randomized, the software enables the data to be distributed to N nodes in an environment. Each piece of the data in randomized and distributed form is a separate entity unreadable on its own right, but when combined with all N pieces, is able to be reconstructed back to one.

Reconstruction requires possession of the key used for randomizing the bytes, leading to the generation of the same cryptographically secure random sequence of numbers used to randomize the data. This software is a cornerstone capability possessing the ability to generate the same cryptographically secure sequence on different machines and time intervals, thus allowing this software to be used more heavily in net-centric environments where data transfer bandwidth is limited.

This work was done by George K. Paoulian, Simon S. Woo, and Edward T. Chow 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 Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-48495.