Software

1. 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 desirments or defined responses that the future system needs to achieve. Documented desirments 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 and documented directly within SynOptSys. The invention takes a large-scale geometry grid and its large-scale CFD solution, and constructs a “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 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).

2. 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 radEq Add-On Module for CFD Solver Loci-CHEM

The radEq software module allows users to add the capability to their CFD solver Loci-CHEM to work with surfaces at high temperatures. The module expands the upper limit of accurate results by adding 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 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:
The Boeing Company
2201 Seal Beach Boulevard
P.O. Box 2515
Seal Beach, CA 90740-1515
Refer to MSC-24848-1, volume and number of this NASA Tech Briefs issue, and the page number.


SOA allows scientists to plan spacecraft observations. It facilitates the identification of geographically 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. In the 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.