# Software

## Oxidation Behavior of Carbon Fiber-Reinforced Composites

OXIMAP is a numerical (FEA-based) solution tool capable of calculating the carbon fiber and fiber coating oxidation patterns within any arbitrarily shaped carbon silicon carbide composite structure as a function of time, temperature, and the environmental oxygen partial pressure. The mathematical formulation is derived from the mechanics of the flow of ideal gases through a chemically reacting, porous solid. The result of the formulation is a set of two coupled, non-linear differential equations written in terms of the oxidant and oxide partial pressures. The differential equations are solved simultaneously to obtain the partial vapor pressures of the oxidant and oxides as a function of the spatial location and time. The local rate of carbon oxidation is determined at each time step using the map of the local oxidant partial vapor pressure along with the Arrhenius rate equation. The non-linear differential equations are cast into matrix equations by applying the Bubnov-Galerkin weighted residual finite-element method, allowing for the solution of the differential equations numerically.

The mathematical formulation and the numerical solution allow for two types of diffusion: a pressure gradient-driven diffusion (Darcy) and a mass concentration gradient-driven diffusion (Fick). The Darcian flow is governed by the material permeability, and the Fickian flow is governed by the areal porosity and gas diffusivity. OXIMAP allows for orthotropic transport properties, so that the permeability and areal porosity in the two perpendicular directions can have different values. The input into OXIMAP includes: the temperature history, the finite-element nodal coordinates and element connectivity, the material permeability and areal porosity in the principal material directions, the gas viscosity, the volumetric porosity, the initial carbon fiber volume fraction and the initial carbon fiber coating volume fraction, the carbon fiber and carbon fiber coating area fractions, the stoichiometric constants and the Arrhenius constants for the oxidation reaction, and the oxygen and oxide vapor-pressure boundary conditions.

*This program was written by Roy M. Sullivan of 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: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18212-1.*

## GIDEP Batching Tool

This software provides internal, automated search mechanics of GIDEP (Government-Industry Data Exchange Program) Alert data imported from the GIDEP government Web site. The batching tool allows the import of a single parts list in tab-delimited text format into the local JPL GIDEP database. Delimiters from every part number are removed. The original part numbers with delimiters are compared, as well as the newly generated list without the delimiters. The two lists run against the GIDEP imports, and output any matches. This feature only works with Netscape 2.0 or greater, or Internet Explorer 4.0 or greater.

The user selects the browser button to choose a text file to import. When the submit button is pressed, this script will import alerts from the text file into the local JPL GIDEP database. This batch tool provides complete in-house control over exported material and data for automated batch match abilities. The batching tool has the ability to match capabilities of the parts list to tables, and yields results that aid further research and analysis. This provides more control over GIDEP information for metrics and reports information not provided by the government site.

This software yields results quickly and gives more control over external data from the government site in order to generate other reports not available from the external source. There is enough space to store years of data. The program relates to risk identification and management with regard to projects and GIDEP alert information encompassing flight parts for space exploration.

*This program was written by Danny Fong, Dorice Odell, and Peter Barry of Caltech and Tomik Abrahamian of SRS Technologies 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-43661.*

## Generic Spacecraft Model for Real-Time Simulation

"Generic Spacecraft" is the name of an evolving library of software that provides for simulation of a generic spacecraft that can orbit the Earth and land on the Moon (and, eventually, on Mars). This library is incorporated into the Langley Standard Realtime Simulation in C++ (LaSRS++) software framework. The generic-spacecraft simulation serves as a test bed for modeling spacecraft dynamics, propulsion, control systems, guidance, and displays.

The Generic Spacecraft library supplements the LaSRS++ framework with an interface that facilitates the connection of new models into the LaSRS++ simulation by eliminating what would otherwise be the necessity of writing additional C++ classes to record data from the models and code to display values on graphical user interfaces (GUIs): The library includes routines for integrating new models into the LaSRS++ framework, identifying model inputs and outputs with full descriptions and units identified, recording data, and automatically generating graphical user interfaces (GUIs). The library is designed to be used in a manner similar to that of LaSRS++ software components for simulating vehicles other than the generic spacecraft. The user specifies (1) a spacecraft and individual models to be constructed and (2) connections between individual model inputs and outputs.

*This program was written by Patrick S. Kenney of Langley Research Center and William Ragsdale and Jason R. Neuhaus of Unisys Corp. Further information is contained in a TSP (see page 1). LAR-17534*

## Parallel-Processing Software for Creating Mosaic Images

A computer program implements parallel processing for nearly real-time creation of panoramic mosaics of images of terrain acquired by video cameras on an exploratory robotic vehicle (e.g., a Mars rover). Because the original images are typically acquired at various camera positions and orientations, it is necessary to