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 warp the images into the reference frame of the mosaic before stitching them together to create the mosaic. [Also see "Parallel-Processing Software for Correlating Stereo Images," Software Supplement to *NASA Tech Briefs*, Vol. 31, No. 9 (September 2007) page 26.]

The warping algorithm in this computer program reflects the considerations that (1) for every pixel in the desired final mosaic, a good corresponding point must be found in one or more of the original images and (2) for this purpose, one needs a good mathematical model of the cameras and a good correlation of individual pixels with respect to their positions in three dimensions. The desired mosaic is divided into slices, each of which is assigned to one of a number of central processing units (CPUs) operating simultaneously. The results from the CPUs are gathered and placed into the final mosaic. The time taken to create the mosaic depends upon the number of CPUs, the speed of each CPU, and whether a local or a remote data-staging mechanism is used.

This program was written by Gerhard Klimeck, Robert Deen, Michael Mcauley, and Eric De Jong 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-30630.

Software for Verifying Image-Correlation Tie Points

A computer program enables assessment of the quality of tie points in the image-correlation processes of the software described in the immediately preceding article. Tie points are computed in mappings between corresponding pixels in the left and right images of a stereoscopic pair. The mappings are sometimes not perfect because image data can be noisy and parallax can cause some points to appear in one image but not the other. The present computer program relies on the availability of a left→right correlation map in addition to the usual right→left correlation map. The additional map must be generated, which doubles the processing time. Such increased time can now be afforded in the data-processing pipeline, since the time for map generation is now reduced from about 60 to 3 minutes by the parallelization discussed in the previous article. Parallel cluster processing time, therefore, enabled this better science result. The first mapping is typically from a point (denoted by coordinates x,y) in the left image to a point (x',y') in the right image. The second mapping is from (x',y') in the right image to some point (x'',y'') in the left image. If (x,y) and (x'',y'') are identical, then the mapping is considered perfect. The perfect-match criterion can be relaxed by introducing an error window that admits of round-off error and a small amount of noise. The mapping procedure can be repeated until all points in each image not connected to points in the other image are eliminated, so that what remains are verified correlation data.

This program was written by Gerhard Klimeck and Gary Yagi 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 Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-30632.

Flexcam Image Capture Viewing and Spot Tracking

Flexcam software was designed to allow continuous monitoring of the mechanical deformation of the telescope structure at Palomar Observatory. Flexcam allows the user to watch the motion of a star with a low-cost astronomical camera, to measure the motion of the star on the image plane, and to feed this data back into the telescope's control system. This automatic interaction between the camera and a user interface facilitates integration and testing.

Flexcam is a CCD image capture and analysis tool for the ST-402 camera from Santa Barbara Instruments Group (SBIG). This program will automatically take a dark exposure and then continuously display corrected images. The image size, bit depth, magnification, exposure time, resolution, and filter are always displayed on the title bar. Flexcam locates the brightest pixel and then computes the centroid position of the pixels falling in a box around that pixel. This tool continuously writes the centroid position to a network file that can be used by other instruments.

Images are auto-scaled by the program to the screen. Flexcam also allows dark frame, or background frame, subtraction. The centroid of a star's image is computed, while data from ghost images is excluded.

This program was written by Shanti Rao 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-44361.