Software

Symbolic Processing Combined With Model-Based Reasoning

A computer program for the detection of present and prediction of future discrete states of a complex, real-time engineering system utilizes a combination of symbolic processing and numerical model-based reasoning. One of the biggest weaknesses of a purely symbolic approach is that it enables prediction of only future discrete states while missing all unmodeled states or leading to incorrect identification of an unmodeled state as a modeled one. A purely numerical approach is based on a combination of statistical methods and mathematical models of the applicable physics and necessitates development of a complete model to the level of fidelity required for prediction. In addition, a purely numerical approach does not afford the ability to qualify its results without some form of symbolic processing.

The present software implements numerical algorithms to detect unmodeled events and symbolic algorithms to predict expected behavior, correlate the expected behavior with the unmodeled events, and interpret the results in order to predict future discrete states. The approach embodied in this software differs from that of the BEAM methodology (aspects of which have been discussed in several prior *NASA Tech Briefs* articles), which provides for prediction of future measurements in the continuous-data domain.

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-45172.

Presentation Extensions of the SOAP

A set of extensions of the Satellite Orbit Analysis Program (SOAP) enables simultaneous and/or sequential presentation of information from multiple sources. SOAP is used in the aerospace community as a means of collaborative visualization and analysis of data on planned spacecraft missions. The follow-

ing definitions of terms also describe the display modalities of SOAP as now extended: In SOAP terminology,
• "View" signifies an animated three-dimensional (3D) scene, two-dimensional still image, plot of numerical data, or any other visible display derived from a computational simulation or other data source;
• "Viewport" signifies a rectangular portion of a computer-display window containing a view;
• "Palette" signifies a collection of one or more viewports configured for simultaneous (split-screen) display in the same window;
• "Slide" signifies a palette with a beginning and ending time and an animation time step; and
• "Presentation" signifies a prescribed sequence of slides.

For example, multiple 3D views from different locations can be crafted for simultaneous display and combined with numerical plots and other representations of data for both qualitative and quantitative analysis. The resulting sets of views can be temporally sequenced to convey visual impressions of a sequence of events for a planned mission.

This work was done by Robert Carnright of Caltech and David Stodden and John Coggi of The Aerospace Corporation for NASA's Jet Propulsion Laboratory.

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Spreadsheets for Analyzing and Optimizing Space Missions

XCALIBR (XML Capability Analysis LIBRary) is a set of Extensible Markup Language (XML) database and spreadsheet-based analysis software tools designed to assist in technology-return-on-investment analysis and optimization of technology portfolios pertaining to outer-space missions. XCALIBR is also being examined for use in planning, tracking, and documentation of projects. An XCALIBR database contains information on mission requirements and technological capabilities, which are related by use of an XML taxonomy. XCALIBR incorporates a standardized

interface for exporting data and analysis templates to an Excel spreadsheet. Unique features of XCALIBR include the following:
• It is inherently hierarchical by virtue of its XML basis.
• The XML taxonomy codifies a comprehensive data structure and data dictionary that includes performance metrics for spacecraft, sensors, and spacecraft systems other than sensors. The taxonomy contains >700 nodes representing all levels, from system through subsystem to individual parts.
• All entries are searchable and machine readable.
• There is an intuitive Web-based user interface.
• The software automatically matches technologies to mission requirements.
• The software automatically generates, and makes the required entries in, an Excel return-on-investment analysis software tool.
• The results of an analysis are presented in both tabular and graphical displays.

This program was written by Raphael R. Some, Anil K. Agrawal, Akos J. Czikmantory, Charles R. Weisbin, and Hook Hua of Caltech and Jon M. Neff, Mark A. Cowdin, Brian S. Lewis, Juana Iroz, and Rick Ross of The Aerospace Corp. 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-41911.

Processing Ocean Images To Detect Large Drift Nets

A computer program processes the digitized outputs of a set of downward-looking video cameras aboard an aircraft flying over the ocean. The purpose served by this software is to facilitate the detection of large drift nets that have been lost, abandoned, or jettisoned. The development of this software and of the associated imaging hardware is part of a larger effort to develop means of detecting and removing large drift nets before they cause further environmental damage to the ocean and to shores on which they sometimes impinge.