Automated Design of Restraint Layer of an Inflatable Vessel

A Mathcad computer program largely automates the design and analysis of the restraint layer (the primary load-bearing layer) of an inflatable vessel that consists of one or more sections having cylindrical, toroidal, and/or spherical shape(s). A restraint layer typically comprises webbing in the form of multiple straps. The design task includes choosing indexing locations along the straps, computing the load at every location in each strap, computing the resulting stretch at each location, and computing the amount of undersizing required of each strap so that, once the vessel is inflated and the straps thus stretched, the vessel can be expected to assume the desired shape.

Prior to the development of this program, the design task was performed by use of a difficult-to-use spreadsheet program that required manual addition of rows and columns depending on the numbers of strap rows and columns of a given design. In contrast, this program is completely parametric and includes logic that automatically adds or deletes rows and columns as needed. With minimal input from the user, this program automatically computes indexing locations, strap lengths, undersizing requirements, and all design data required to produce detailed drawings and assembly procedures. It also generates textual comments that help the user understand the calculations.

This program was written by Gary Spexarth of **Johnson Space Center**. *Further information is contained in a TSP (see page 1).*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-0837. Refer to MSC-23906.

TMS for Instantiating a Knowledge Base With Incomplete Data

A computer program that belongs to the class known among software experts as output truth-maintenance-systems (output TMSs) has been devised as one of a number of software tools for reducing the size of the knowledge base that must be searched during execution of artificial-intelligence software of the rule-based inference-engine type in a case in which data are missing. This program determines whether the consequences of activation of two or more rules can be combined without causing a logical inconsistency. For example, in a case involving hypothetical scenarios that could lead to turning a given device on or off, the program determines whether a scenario involving a given combination of rules could lead to turning the device both on and off at the same time, in which case that combination of rules would not be included in the scenario.

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-42710.

Simulating Flights of Future Launch Vehicles and Spacecraft

Marshall Aerospace Vehicle Representation in C (MAVERIC) is a computer program for generic, low-to-high-fidelity simulation of the flight(s) of one or more launch vehicle(s) or spacecraft. MAVERIC is designed to accommodate multi-staged vehicles, powered serially or in parallel, with multiple engines, tanks, and cargo elements. Engines can be of jet or conventional rocket types, using either liquid or solid propellants.

MAVERIC includes generic subsystem software models for propulsion systems, mass properties, reaction control systems, aerodynamic properties, guidance systems, and navigation systems. Simulations can be started at points other than liftoff. Also included are guidance-system software models that accommodate the ascent, orbit, coasting, deorbiting, entry, terminal-area-energy-management, approach, and landing phases of flight.

Options to use different wind profiles and atmospheres are included. A Monte Carlo capability is provided for modeling dispersions associated with atmospheric effects (including winds), propulsion, navigation, aerodynamics, and mass properties. Failures of engines and other subsystems can be modeled. The program is written in the C programming language, which makes it possible for the program to have high degrees of modularity, reusability, and maintainability, thereby also facilitating modification for modeling new vehicles.

This program was written by James W. McCarter of **Marshall Space Flight Center**. *Further information is contained in a TSP (see page 1).*

This invention is owned by NASA, and a patent application has been filed. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31989-1.

Control Code for Bearingless Switched-Reluctance Motor

A computer program has been devised for controlling a machine that is an integral combination of magnetic bearings and a switched-reluctance motor. The motor contains an eight-pole stator and a hybrid rotor, which has both (1) a circular lamination stack for levitation and (2) a six-pole lamination stack for rotation. The program computes drive and levitation currents for the stator windings with real-time feedback control. During normal operation, two of the four pairs of opposing stator poles (each pair at right angles to the other pair) levitate the rotor. The remaining two pairs of stator poles exert torque on the six-pole rotor lamination stack to produce rotation. This version is executable in a control-loop time of 40 μs on a Pentium (or equivalent) processor that operates at a clock speed of 400 MHz. The program can be expanded, by addition of logic blocks, to enable control of position along additional axes. The code enables adjustment of operational parameters (e.g., motor speed and stiffness, and damping parameters of magnetic bearings) through computer keyboard key presses.

This program was written by Carlos R. Morrison 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-17964-1.

Machine Aided Indexing and the NASA Thesaurus

Machine Aided Indexing (MAI) is a Web-based application program for aiding the indexing of literature in the NASA Scientific and Technical Information (STI) Database. MAI was designed to be a convenient, fully interactive tool for determining the subject matter of documents and identifying keywords. The heart of MAI is a natural-language processor that accepts, as input, any user-supplied text, including abstracts, full documents, and Web pages. Within seconds, the text is analyzed and a ranked list of terms is generated. The 17,800 terms of the NASA Thesaurus serve as the foundation of the knowledge base used by MAI. The NASA Thesaurus defines a standard vocabulary, the use of which enables MAI to assist in ensuring that STI documents are uniformly and consistently accessible. Of particular interest to traditional users of the NASA Thesaurus, MAI incorporates a fully searchable thesaurus display module that affords word-search and hierarchy-navigation capabilities that make it much easier and less time-consuming to look up terms and browse, relative to lookup and browsing in older print and Portable Document Format (PDF) digital versions of the Thesaurus. In addition, because MAI is centrally hosted, the Thesaurus data are always current.

This program was written by Bill von Ofenheim for **Langley Research Center**. *For further information, access http://mai.larc.nasa.gov.*
LAR-17110-1

Arbitrating Control of Control and Display Units

The ARINC 739 Switch is a computer program that arbitrates control of two multi-function control and display units (MCDUs) between (1) a commercial flight-management computer (FMC) and (2) NASA software used in research on transport aircraft. (MCDUs are the primary interfaces between pilots and FMCs on many commercial aircraft.) This program was recently redesigned into a software library that can be embedded in research application programs. As part of the redesign, this software was combined with software for creating custom pages of information to be displayed on a CDU. This software commands independent switching of the left (pilot's) and right (copilot's) MCDUs. For example, a custom CDU page can control the left CDU while the FMC controls the right CDU. The software uses menu keys to switch control of the CDU between the FMC or a custom CDU page. The software provides an interface that enables custom CDU pages to insert keystrokes into the FMC's CDU input interface. This feature allows the custom CDU pages to manipulate the FMC as if it were a pilot.

This program was written by Michael M. Madden of **Langley Research Center** *and Paul C. Sugden of Unisys Corp. Further information is contained in a TSP (see page 1).*
LAR-17178-1

Web-Based Software for Managing Research

aeroCOMPASS is a software system, originally designed to aid in the management of wind tunnels at Langley Research Center, that could be adapted to provide similar aid to other enterprises in which research is performed in common laboratory facilities by users who may be geographically dispersed. Included in aeroCOMPASS is Web-interface software that provides a single, convenient portal to a set of project- and test-related software tools and other application programs. The heart of aeroCOMPASS is a user-oriented document-management software subsystem that enables geographically dispersed users to easily share and manage a variety of documents. A principle of "write once, read many" is implemented throughout aeroCOMPASS to eliminate the need for multiple entry of the same information. The Web framework of aeroCOMPASS provides links to client-side application programs that are fully integrated with databases and server-side application programs. Other subsystems of aeroCOMPASS include ones for reserving hardware, tracking of requests and feedback from users, generating interactive notes, administration of a customer-satisfaction questionnaire, managing execution of tests, managing archives of metadata about tests, planning tests, and providing online help and instruction for users.

This program was written by Sherwood T. Hoadley; Anthony M. Ingraldi; Kerry M. Gough; Charles Fox, Jr.; Catherine K. Cronin; Andrew G. Hagemann; Guy T. Kemmerly; and Wesley L. Goodman of **Langley Research Center**. *For further information, access http://aerocompass.larc.nasa.gov.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Langley Research Center, at (757) 864-3521. Refer to LAR-16442.

Driver Code for Adaptive Optics

A special-purpose computer code for a deformable-mirror adaptive-optics control system transmits pixel-registered control from (1) a personal computer running software that generates the control data to (2) a circuit board with 128 digital-to-analog converters (DACs) that generate voltages to drive the deformable-mirror actuators. This program reads control-voltage codes from a text file, then sends them, via the computer's parallel port, to a circuit board with four AD5535 (or equivalent) chips. Whereas a similar prior computer program was capable of transmitting data to only one chip at a time, this program can send data to four chips simultaneously. This program is in the form of C-language code that can be compiled and linked into an adaptive-optics software system. The program as supplied includes source code for integration into the adaptive-optics software, documentation, and a component that provides a demonstration of loading DAC codes from a text file. On a standard Windows desktop computer, the software can update 128 channels in 10 ms. On Real-Time Linux with a digital I/O card, the software can update 1024 channels (8 boards in parallel) every 8 ms.

This program was written by Shanti Rao of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-43107.