Software

Software for Checking Statecharts

HiVy is a software tool set that enables verification through model checking of designs represented as finite-state machines or statecharts. HiVy provides automated translation of (1) statecharts created by use of the MathWorks Stateflow® program to (2) Promela, the input language of the Spin model checker, which can then be used to verify, or trace logical errors in, distributed software systems. HiVy can operate directly on Stateflow models, or its abstract syntax of hierarchical sequential automata (HSA) can be used independently as an intermediate format for translation to Promela. In a typical design application, HiVy parses and reformats Stateflow model file data using the programs *SfParse* and *sf2hsa*, respectively. If the parsing effort is successful, an abstract syntax tree is delivered into a file named with the extension ".hsa." If the design comprises several model files, they may be merged into one ".hsa" file before translation into Promela. Stateflow scope is preserved, and name clashes are avoided in the merge process. The HiVy program *hsa2pr* translates the model from the intermediate HSA format into Promela. Additionally, HiVy provides through translation a list of all statechart model propositions that are the means for formalizing linear temporal logic (LTL) properties about the model for Spin verification.

This tool set was written by Paula Pingree of Caltech/JPL and Erich Mikk (independent consultant) 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-30847.

Program Predicts Broadband Noise From a Turbofan Engine

Broadband Fan Noise Prediction System (BFaNS) is a computer program that, as its name indicates, predicts the broadband noise generated by the fan stage of a turbofan engine. This noise is the sum of (1) turbulent-inflow noise, which is caused by turbulence impinging on leading edges of the fan and the fan exit guide vane and (2) self noise, which is caused by turbulence convecting past the corresponding trailing edges. The user provides input data on the fan-blade, vane, and flow-path geometries and on the mean and turbulent components of the flow field. BFaNS then calculates the turbulent-inflow noise by use of D. B. Hanson's theory, which relates sound power to the inflow turbulence characteristics and the cascade geometry. Hanson's program, BBCASCADE, is incorporated into BFaNS, wherein it is applied to the rotor and stator in a stripwise manner. The spectra of upstream and downstream sound powers radiated by each strip are summed to obtain the total upstream and downstream sound-power spectra. The self-noise contributions are calculated by S. A. L. Glegg's theory, which is also applied in a stripwise manner. The current version of BFaNS is limited to fans with subsonic tip speeds.

This program was written by Bruce L. Morin of United Technologies for **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, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17307.

Protocol for a Delay-Tolerant Data-Communication Network

As its name partly indicates, the Delay-Tolerant Networking (DTN) Bundle Protocol is a protocol for delay-tolerant transmission of data via communication networks. This protocol was conceived as a result of studies of how to adapt Internet protocols so that Internet-like services could be provided across interplanetary distances in support of deep-space exploration. The protocol, and software to implement the protocol, is being developed in collaboration among experts at NASA's Jet Propulsion Laboratory and other institutions. No current Internet protocols can accommodate long transmission delay times or intermittent link connectivity. The DTN Bundle Protocol represents a departure from the standard Internet assumption that a continuous path is available from a host computer to a client computer: It provides for routing of data through networks that may be disjointed and may be characterized by long transmission delays. In addition to networks that include deep-space communication links, examples of such networks include terrestrial ones within which branches are temporarily disconnected. The protocol is based partly on the definition of a message-based overlay above the transport layers of the networks on which it is hosted.

This work was done by Jordan Torgerson, Adrian Hooke, Scott Burleigh, and Kevin Fall of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1)*

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Software Implements a Space-Mission File-Transfer Protocol

CFDP is a computer program that implements the CCSDS (Consultative Committee for Space Data Systems) File Delivery Protocol, which is an international standard for automatic, reliable transfers of files of data between locations on Earth and in outer space. CFDP administers concurrent file transfers in both directions, delivery of data out of transmission order, reliable and unreliable transmission modes, and automatic retransmission of lost or corrupted data by use of one or more of several lost-segment-detection modes. The program also implements several data-integrity measures, including file checksums and optional cyclic redundancy checks for each protocol data unit. The metadata accompanying each file can include messages to users' application programs and commands for operating on remote file systems.

This program was written by Kathleen Rundstrom, Son Q. Ho, Michael Levesque, Felicia Sanders, Scott Burleigh, and John Veregge of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1)*

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