Displaying Properties of PDFs

Ames Research Center, Moffett Field, California

PDFVis is a computer program that assists in visualization of uncertainty as represented by a probability density function (PDF) located at each grid cell in a spatial domain. PDFVis performs the following functions:

- Creates maps of first, second-, and third-order statistics of the PDFs, displaying the maps simultaneously in one image;
- Provides an interactive probe that displays various forms of density estimates (e.g., histogram or kernel density estimator) of the PDF at a grid cell or larger region selected by the user;
- For grid cells in a row or column selected by the user, it displays surfaces of the PDFs as shaded walls and as color-mapped wall according to a scalar variable selectable by the user;
- Displays the modality (basically, the number of peaks) and the locality of the peaks of the PDF in each grid cell;
- Provides a capability for querying the modalities of the PDFs on the basis of ranges and other criteria specified by the user; and
- Facilitates interactivity by providing simple user command keys.

This program was written by David Kao and Jennifer Dungan of Ames Research Center and David Kao of The Regents of the University of California Santa Cruz. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to the Ames Technology Partnerships Division at (650) 604-2954. Refer to ARC-15039-1

Modular Filter and Source-Management Upgrade of RADAC

Goddard Space Flight Center, Greenbelt, Maryland

In an upgrade of the Range Data Acquisition Computer (RADAC) software, a modular software object library was developed to implement required functionality for filtering of flight-vehicle-tracking data and management of tracking-data sources. (The RADAC software is used to process flight-vehicle metric data for real-time display in the Wallops Flight Facility Range Control Center and Mobile Control Center. This software is part of the Range Control/Range Safety System used to contain impacts of debris from flight-vehicle operations.) The library includes implementations of tracking-data editing and filtering techniques that can be readily found in the literature and was constructed to facilitate future incorporation of implementations of other, more-exotic filtering techniques. A pragmatic technique is used to maintain statistics on differences between measurements and estimates of positions in order to compute a figure of merit for each radar, Global-Positioning-System, or inertial-navigation-system source of tracking data.

An automatic source-qualification technique is implemented to enable optional replacement of a pre-existing manual data-qualification function. The library was written in the C++ language and was designed to be hosted within an application program running on virtually any computing platform.

This program was written by R. James Lanzi and Donna C. Smith of Goddard Space Flight Center. Further information is contained in a TSP (see page 1).

GSC-14974-1

Automatic Command Sequence Generation

NASA’s Jet Propulsion Laboratory, Pasadena, California

Automatic Sequence Generator (Autogen) Version 3.0 software automatically generates command sequences for the Mars Reconnaissance Orbiter (MRO) and several other JPL spacecraft operated by the multi-mission support team. Autogen uses standard JPL sequencing tools like APGEN, ASP, SEQGEN, and the DOM database to automate the generation of uplink command products, Spacecraft Command Message Format (SCMF) files, and the corresponding ground command products, DSN Keywords Files (DKF). Autogen supports all the major multi-mission mission phases including the cruise, aerobraking, mapping/science, and relay mission phases.

Autogen is a Perl script, which functions within the ‘mission operations’ UNIX environment. It consists of two parts: a set of model files and the autogen Perl script. Autogen encodes the behaviors of the system into a model and encodes algorithms for context-sensitive customizations of the modeled behaviors. The model includes knowledge of different mission phases and how the resultant command products must differ for these phases. The executable software portion of Autogen, automates the setup and use of APGEN for constructing a spacecraft activity sequence file (SASF). The setup includes file retrieval through the DOM (Distributed Object Manager), an object database used to store project files. This step retrieves all the needed input files for generating the command products.

Depending on the mission phase, Autogen also uses the ASP (Automated Sequence Processor) and SEQGEN to generate the command product sent to the spacecraft. Autogen also provides the means for customizing sequences through the use of configuration files. By automating the majority of the sequencing generation process, Autogen eliminates many sequence generation errors commonly introduced by manually constructing spacecraft command sequences. Through the layering of commands into the sequence by a series of scheduling algorithms, users are able to rapidly and reliably construct the desired uplink command products.

With the aid of Autogen, sequences may be produced in a matter of hours instead of weeks, with a significant reduc-
tion in the number of people on the se-
quence team. As a result, the uplink 
product generation process is signifi-
cantly streamlined and mission risk is sig-
nificantly reduced. Autogen is used for 
operations of MRO, Mars Global Sur-
veyor (MGS), Mars Exploration Rover 
(MER), Mars Odyssey, and will be used 
for operations of Phoenix. Autogen Ver-
sion 3.0 is the operational version of Au-
togen including the MRO adaptation for 
the cruise mission phase, and was also 
used for development of the aerobraking 
and mapping mission phases for MRO.

This software is available for commercial 
licensing. Please contact Karina Edmonds 
of the California Institute of Technology at 
(626) 395-2322. Refer to NPO-43638.

Generating Scenarios When Data Are Missing
NASA’s Jet Propulsion Laboratory, Pasadena, California

A computer program implements the 
algorithm described in “Hypothetical 
Scenario Generator for Fault-Tolerant Di-
agnosis” (NPO-42516), NASA Tech Briefs, 
Vol. 31, No. 6 (June 2007), page 71. To re-
capitulate: the Hypothetical Scenario 
Generator (HSG) is being developed in 
conjunction with other components of 
artificial-intelligence systems for auto-
mated diagnosis and prognosis of faults 
in spacecraft, aircraft, and other complex 
engineering systems. The HSG accepts, 
as input, possibly incomplete data on the 
current state of a system (see figure).

The HSG models a potential fault sce-
nario as an ordered disjunctive tree of 
conjunctive consequences, wherein the 
ordering is based upon the likelihood 
that a particular conjunctive path will be 
taken for the given set of inputs. The 
computation of likelihood is based partly 
on a numerical ranking of the degree of 
completeness of data with respect to satis-
faction of the antecedent conditions of 
prognostic rules. The results from the 
HSG are then used by a model-based arti-
ficial-intelligence subsystem to predict re-
alistic scenarios and states.

This program was written by Mark James 
and Ryan Mackey 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-43097.

CASPER Version 2.0
NASA’s Jet Propulsion Laboratory, Pasadena, California

The Continuous Activity Scheduling 
Planning Execution and Replanning 
(CASPER) computer program has been 
updated to version 2.0. A prototype ver-
ion was reported in “Software for Con-
tinuous Replanning During Execution” 
(NPO-20972), NASA Tech Briefs, Vol. 26, 
No. 7 (April 2002), page 67. To recapit-
ulate: CASPER is designed to perform 
automated planning of interdependent 
activities within a system subject to re-
quirements, constraints, and limitations 
on resources.

In contradistinction to the traditional 
concept of batch planning followed by 
execution, CASPER implements a con-
cept of continuous planning and replan-
ning in response to unanticipated changes (including failures), integrated with execution. Improvements over 
other, similar software that have been in-
corporated into CASPER version 2.0 in-
clude an enhanced executable interface 
to facilitate integration with a wide 
range of execution software systems and 
supporting software libraries; features to 
support execution while reasoning 
about urgency, importance, and im-
pending deadlines; features that enable 
accommodation to a wide range of com-
puting environments that include vari-
ransation central processing units and ran-
dom-access-memory capacities; and im-
proved generic time-server and 
time-control features.

This program was written by Steve Chien, 
Gregg Rabideau, Daniel Tran, Russell 
Knight, Caroline Chouinard, Tara Estlin, 
Daniel Gaines, Bradley Clement, and An-
thony Barrett 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-41987.