ISS Solar Array Management

The International Space Station (ISS) Solar Array Management (SAM) software toolset provides the capabilities necessary to operate a spacecraft with complex solar array constraints. It monitors spacecraft telemetry and provides interpretations of solar array constraint data in an intuitive manner. The toolset provides extensive situational awareness to ensure mission success by analyzing power generation needs, array motion constraints, and structural loading situations.

The software suite consists of several components including samCS (constraint set selector), samShadyTimers (array shadowing timers), samWin (visualization GUI), samLock (array motion constraint computation), and samJet (attitude control system configuration selector). It provides high availability and uptime for extended and continuous mission support. It is able to support two-degrees-of-freedom (DOF) array positioning and supports up to ten simultaneous constraints with intuitive 1D and 2D decision support visualizations of constraint data. Display synchronization is enabled across a networked control center and multiple methods for constraint data interpolation are supported. Use of this software toolset increases flight safety, reduces mission support effort, optimizes solar array operation for achieving mission goals, and has run for weeks at a time without issues.

The SAM toolset is currently used in ISS real-time mission operations.

This work was done by Estevancio Brown of United Space Alliance for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-24425-1

SPOT Program

A Spacecraft Position Optimal Tracking (SPOT) program was developed to process Global Positioning System (GPS) data, sent via telemetry from a spacecraft, to generate accurate navigation estimates of the vehicle position and velocity (state vector) using a Kalman filter. This program uses the GPS onboard receiver measurements to sequentially calculate the vehicle state vectors and provide this information to ground flight controllers. It is the first real-time ground-based shuttle navigation application using onboard sensors.

The program is compact, portable, self-contained, and can run on a variety of UNIX or Linux computers.

The program has a modular object-oriented design that supports application-specific plugins such as data corruption remediation pre-processing and remote graphics display. The Kalman filter is extensible to additional sensor types or force models. The Kalman filter design is also strong against data dropouts because it uses physical models from state and covariance propagation in the absence of data.

The design of this program separates the functionalities of SPOT into six dif-
different executable processes. This allows for the individual processes to be connected in an a la carte manner, making the feature set and executable complexity of SPOT adaptable to the needs of the user. Also, these processes need not be executed on the same workstation. This allows for communications between SPOT processes executing on the same Local Area Network (LAN). Thus, SPOT can be executed in a distributed sense with the capability for a team of flight controllers to efficiently share the same trajectory information currently being computed by the program.

SPOT is used in the Mission Control Center (MCC) for Space Shuttle Program (SSP) and International Space Station Program (ISSP) operations, and can also be used as a post-flight analysis tool. It is primarily used for situational awareness, and for contingency situations.

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Integrated Hybrid System Architecture for Risk Analysis

A conceptual design has been announced of an expert-system computer program, and the development of a prototype of the program, intended for use as a project-management tool. The program integrates schedule and risk data for the purpose of determining the schedule applications of safety risks and, somewhat conversely, the effects of changes in schedules on changes on safety. It is noted that the design has been delivered to a NASA client and that it is planned to disclose the design in a conference presentation.

This work was done by Gary P. Moynihan, Daniel J. Fonseca, and Paul S. Ray of the University of Alabama for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

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