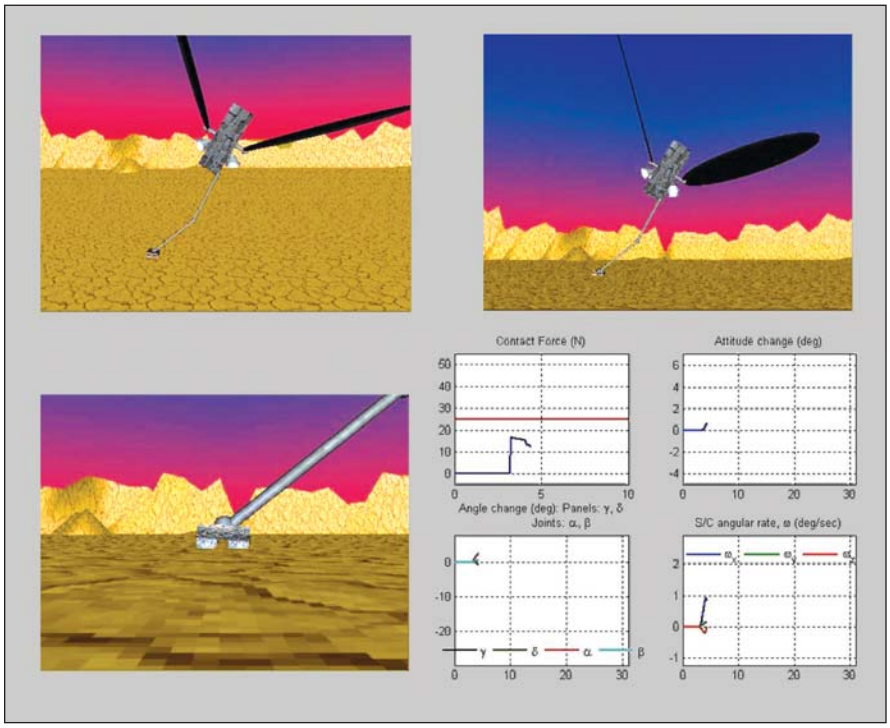
Spacecraft Guidance, Navigation, and Control Visualization Tool

NASA's Jet Propulsion Laboratory, Pasadena, California

G-View is a 3D visualization tool for supporting spacecraft guidance, navigation, and control (GN&C) simulations relevant to small-body exploration and sampling (see figure). The tool is developed in MATLAB using Virtual Reality Toolbox and provides users with the ability to visualize the behavior of their simulations, regardless of which programming language (or machine) is used to generate simulation results. The only requirement is that multi-body simulation data is generated and placed in the proper format before applying G-View.

G-View allows the user to visualize the behavior of a multi-body system (i.e. a spacecraft, the translations and rotations of the spacecraft body components, thruster firings, and thrust magnitude) by simultaneously showing plots of various relevant states and parameters. In G-View, the user can easily manipulate the location, zoom, translation, and direction of the camera, thus providing a wide range of options for viewing the behavior of specific spacecraft components, such as the solar panels, mechanical arms, brush-wheel sampler, joints, etc.

G-View is easily modifiable and can be adjusted to specific design or simulation requirements. For example, one mode of usage is to create movie clips for a batch-collected set of data. This provides a visual aid supporting iterative design methods and an efficient tool for generating presentations. G-View can also be applied to a computer simulation one frame at a time. This is especially beneficial when applied to simulation environments that require long running times. By extracting visualization data at specific time instants, the user can assess whether the simulation has the desired behavior or if something is wrong and is not worth continuing. In this manner, G-View can save significant time when simulating complex scenarios, and improve troubleshooting efficiency.



Comet GN&C example of G-View.

This work was done by Milan Mandic, Behcet Acikmese, and Lars Blackmore 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47197.

Mission Operations Planning and Scheduling System (MOPSS)

Goddard Space Flight Center, Greenbelt, Maryland

MOPSS is a generic framework that can be configured on the fly to support a wide range of planning and scheduling applications. It is currently used to support seven missions at Goddard Space Flight Center (GSFC) in roles that include science planning, mission planning, and real-time control.

Prior to MOPSS, each spacecraft project built its own planning and scheduling capability to plan satellite activities and communications and to create the commands to be uplinked to the spacecraft. This approach required creating a data repository for storing planning and scheduling information, building user interfaces to display data, generating needed scheduling algorithms, and implementing customized external interfaces. Complex scheduling problems that involved reacting to multiple variable situations were analyzed manually. Operators then used the results to add commands to the schedule. Each architecture was unique to specific satellite requirements.

MOPSS is an expert system that automates mission operations and frees the flight operations team to concentrate on critical activities. It is easily reconfigured by the flight operations team as the mission evolves. The heart of the system is a custom object-oriented data layer mapped onto an Oracle relational database. The combination of these two technologies allows a user or system engineer to capture any type of scheduling or planning data in the system's generic data storage via a GUI.

MOPSS uses CORBA in conjunction with a multi-tier architecture to allow multiple users to concurrently view and edit schedule data. The adaptable architecture of MOPSS also enables easy integration of tools and models to satisfy new system requirements. MOPSS has two clients: an X/MOTIF client and a Java client. The Java client is effective over the Web and has been used by remote MAP mission scientists and engineers to monitor spacecraft integration tests.

The most obvious use of MOPSS is for control of commercial satellites. In the television industry, MOPSS could be used to schedule TV commercials on broadcast television based on FCC rules, demographics, and program content. In the medical field, MOPSS could be used to schedule and optimize use of hospitals in a network and resources within hospitals. In the power industry, MOPSS can be used to schedule nuclear power plant maintenance. The education and transportation fields are also candidates.

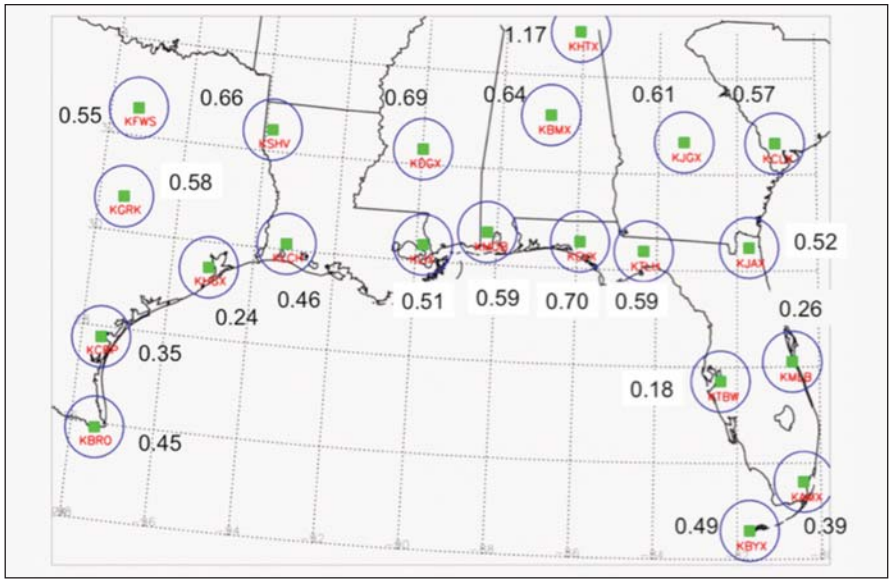
This work was done by Terri Wood of Goddard Space Flight Center and Paul Hempel of Computer Sciences Corp. Further information is contained in a TSP (see page 1).. GSC-15858-1

Global Precipitation Mission Visualization Tool

Goddard Space Flight Center, Greenbelt, Maryland

The Global Precipitation Mission (GPM) software provides graphic visualization tools that enable easy comparison of ground- and space-based radar observations. It was initially designed to compare ground radar reflectivity from operational, ground-based, S- and C-band meteorological radars with comparable measurements from the Tropical Rainfall Measuring Mission (TRMM) satellite's precipitation radar instrument. This design is also applicable to other ground-based and space-based radars, and allows both ground- and space-based radar data to be compared for validation purposes.

The tool creates an operational system that routinely performs several steps. It ingests satellite radar data (precipitation radar data from TRMM) and ground-based meteorological radar data from a number of sources. Principally, the ground radar data comes from national networks of weather radars (see figure). The data ingested by the visualization tool must conform to the data formats used in GPM Validation Network Geometry-matched data product generation. The software also performs match-ups of the radar volume data for the ground- and space-based data, as well as statistical and graphical analysis (including two-dimensional graphical displays) on the match-up data.



Location of Validation Network match-up sites and associated site grid domains in the southeastern U.S.

The visualization tool software is written in IDL, and can be operated either in the IDL development environment or as a stand-alone executable function.

This work was done by Mathew Schwaller of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15785-1

Thermal Protection System Imagery Inspection Management System —TIIMS

Lyndon B. Johnson Space Center, Houston, Texas

TIIMS is used during the inspection phases of every mission to provide quick visual feedback, detailed inspection data, and determination to the mission management team. This system consists of a visual Web page interface, an SQL database, and a graphical image generator. These combine to allow a user to ascertain quickly the status of the inspection process, and current determination of any problem zones.

The TIIMS system allows inspection engineers to enter their determinations into a database and to link pertinent images and video to those database entries. The database then assigns criteria to each zone and tile, and via query, sends the information to a graphical image generation program. Using the official TIPS database tile positions and sizes, the graphical image generation program creates images of the current status of the orbiter, coloring zones, and tiles based on a predefined key code. These