



3D Telemetry Visualization Aids in Analyzing Flight Data

Understanding the meaning of a collection of data is a familiar challenge for scientists and engineers. While tools are available to collect terabytes of data per event, understanding this data is another story. Because humans can process three-dimensional visual representations more easily than numeric or graphical data, visualization tools provide the means for comprehending large data sets. Sandia/CA's Distributed Visualization and Data Services Group focuses on the applied research and development of tools to aid this kind of data analysis.

One example is the 3D Telemetry Visualization System (3D TVS), which is being developed to solve this data comprehension challenge for missiles and other in-flight vehicles. 3D TVS is an interactive 3D environment used to simulate, monitor, and reconstruct complex flight dynamics. System performance characteristics can also be expressed visually. Flight data, such as yaw, pitch, and roll rate, are applied to a solid 3D model to simulate the in-flight characteristics of the instrumented vehicle. The initial program development was targeted at real-time and post-flight analysis but can also be used for pre-flight simulations.

Concept Validation Process

The 3D TVS concept was validated using post-processed flight data from a completed re-entry vehicle (RV) test, known as Instrumented Data Flight (IDF-1). Audio and attitude data were applied to a solid model of the RV to provide engineers with a 3D simulation of the RV during its flight. The engineers could relate audio events in the RV to the movement they were seeing in the simulation. From this, they gained new insights into flight events.

Real-Time Test

The 3D TVS concept was demonstrated during the recently completed IDF-3 Real-Time Flight experiment. During the flight, real-time data was transmitted to Sandia/CA and was used to visually track the RV's flight path. This information was projected onto the 160-degree curved screen in the Visualization Design Center (VDC).



Jeff Jortner shown standing in Visualization Design Center.

Jeff received his BS (1977), MS (1982), and PhD (1986) in Mechanical Engineering from Louisiana State University. He joined Sandia in January 1987 and is currently in Distributed Visualization and Data Services (8963). His research interest is in visualization tools and environments for engineering analysis.

The data used during the flight was a subset of the entire data stream with a sample rate of once per second. The real-time flight data was processed with a simple filtering technique to eliminate spurious data points caused by transmission noise. The data was fed into the Satellite Tool Kit (STK) software developed by Analytical Graphics Inc. STK was chosen for use in 3D TVS because of its ability to handle motion in multiple coordinate systems, its algorithmic robustness, and its visualization capabilities.

Current Activity

We are continuing to utilize the IDF-3 data to further develop the capabilities of the 3D TVS. We are now using higher fidelity data from the flight to examine the separation event (time period when RV separates from the launch platform). As part of the upcoming FTU-17 flight we will develop a pre-flight simulation as well as post-processing data after the flight.



Success Proves Concept

The success of the milestones up to this point has proven that visualization tools are effective aids to the engineering analysis of telemetry data. The 3D TVS concept has been shown as useful in many elements of mission design, planning, execution, and evaluation.

3D TVS is funded under Advanced Simulations and Computing (ASCI) Advanced Deployment with support from the ASCI Views program.

The current participants in the project are Jeff Jortner (8963) and Vince DeSapio (8963). The IDF-1 simulation was developed by Gary Templet (8963) and Jerry Friesen (8963). The 2002 Weapon Interns and the Advanced Systems (8222) group were responsible for development of the IDF-3 Real-time Telemetry System. We are now working with departments 8231, 8232, 8233, 8235, 15426, and 2334 for the FTU-17 and future flights.