A Test Set for Satellite Based Mechanical Structures

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Products Used:

LabWindows®/CVI, DAQ, VXI, and GPIB

Abstract

A customer requires a flexible test system for stimulating and monitoring a collapsible satellite reflector array. The system must control motors and monitor telemetry switches and hinge angles as well as a large number of strain gages.

The Challenge

Provide a flexible and economical system for exercising and monitoring satellite reflector arrays.

The Solution

The test system consists of a mixture of PC based DAQ interfaces and VXI hardware controlled by LabWindows/CVI.

Figure 1 - Structure Test System

The Test System

The test system is housed in dual 19" racks as shown in Figure 1. A rack mount PC running Windows 95 controls operation of the test set. The PC contains a variety of interfaces, including a PC-DIO-96, AT/GPIB-TNT, and a pair of AT-MIO-64E3 interfaces.

The PC-DIO-96 interface provides control for a relay chassis used to route the output of two Hewlett-Packard® power supplies to motors and pyrotechnic release devices. The DIO interface also monitors the state of telemetry switches used to determine when the unit has reached a travel limit.

The AT/GPIB-TNT connects to two Hewlett-Packard programmable power supplies and a National Instruments® GPIB-VXI/C Slot 0 Resource Manager. The VXI chassis contains an assortment of Hewlett-Packard and Racal switches and an HP VXI multimeter. The multimeter is used to measure resistance of strain gage cables and monitor the operation of pyrotechnic restraint devices.

The AT-MIO-64E3 interfaces are connected to an array of SC-2043-SG Strain Gage signal conditioning interfaces. In addition to monitoring strain gages, the MIO interfaces monitor hinge angles by reading voltages from potentiometers connected to the hinges.

Software for the test system is divided into several functional areas: configuration management, self test, adjustment and calibration, and test operation and control.

Configuration management allows the operator to define the unit under test. The name for each sensor, and all necessary scaling and calibration information is entered via the configuration management forms.

Self test verifies the operation of the DAQ, GPIB, and VXI hardware in the system.

The adjustment form provides a real time strip chart of one MIO input to allow the operator to monitor strain gage channels while adjusting the bridge null potentiometers on the SC-2043-SG interfaces. The calibration forms allow the operator to measure the resistance of the cables between the test set and the unit under test.

Test operation and control is the primary function of the system. To accommodate the requirement for many different tests, the software is designed around an acquisition and control engine. The engine allows the user to create command scripts that control the sequence of operation of the system. The scripts define what sensors to monitor and operation termination limits for the sensors.

One of the major challenges of this system was finding a way to display large amounts of information in a format easily interpretable by the operator. The system is capable of monitoring 88 strain channels and up to 78 telemetry switches. Fortunately, the display requirements do not include displaying all sensor values at one time. Instead, three child panels are used to ‘scroll’ through sets of inputs. Strain gages are displayed as numeric slide controls, telemetry switches are horizontal slide switches, and angle potentiometer and power supply voltage and current are displayed numerically.

The basic data acquisition rate of the system is 20 Hz. All sensor data is time tagged and logged to file in spread sheet importable format for data analysis and reduction. At the 20 Hz rate, a one hour test accumulates a significant amount of data. To help manage the size of the data log file, the script allows the user to change the recording rate. To accommodate different recording resolutions for different portions of the script, the recording rate may be changed on the fly.

Results

The selection of a flexible scripting technique for implementation of this system required considerable up front effort to design and develop the script interpreter. However, this effort quickly proved to be invaluable in saving time and rework as enhancements were requested by the customer once they began testing their structures.

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