CATEGORY 5 - SUPPORTING INFRASTUCTURE

Six-Degree-of-Freedom Test Facility

by Michelle Bittel, Lockheed Engineering & Sciences Company

Shuttle to Space Station docking has become an important issue in the last few years. Docking sensors have been proposed that will provide the high precision measurements required for the fuel efficient rendezvous and docking of space vehicles. These sensors also will be used for satellite servicing and orbital assembly. The performance of the docking sensors must be tested before they are implemented in a space environment. A 6-DOF test facility has been developed at the Tracking and Communications Section, Johnson Space Center, to test the static and dynamic accuracies of docking sensors. A candidate sensor is evaluated by comparing the sensor's static position and velocity measurements to the more accurate 6-DOF system.

The facility comprises very robust hardware. An air-bearing 12-meter granite rail system highlights the system. Five rotary stages provide rotational movement. Additional hardware supporting the facility include a GPS time receiver, a rate meter, and a metrology system. A centralized computer with associated software controls the facility. The 6-DOF facility can provide one degree of translation (range) and five degrees of rotation (bearing angles and attitude). Range accuracies are 10.0 microns/meter while rotational accuracies are $\pm$ 0.001 degrees.

The 6-DOF Test Facility hardware is fully integrated. Software has been developed in-house to support system operation. The system has been tested statically and the operational parameters verified. System accuracies remain to be determined. Dynamic testing of the facility is expected to begin shortly. Several companies (such as McDonnell Douglas, Autonomous Technologies, and General Dynamics) are scheduled to test sensors in the next few months. The 6-DOF facility will be available for use in November 1991.

Soviet Automated Rendezvous and Docking System Overview

By Elaine M. Hinman and David Bushman/MSFC

The Soviets have been performing automated rendezvous and docking for many years. Its has been a reliable mode of resupply and reboost for years.

During the course of the Soviet space program, the autodocking system has evolved. The earlier IGLA system has been replaced with the current KURS system. Both systems are radar-based. The variation in strength between antennas is used for computing relative positions and attitudes. The active spacecraft has a transponder. From discussions with Soviet engineers, it seems the docking process can be controlled either from the ground or from the active (docking) spacecraft's onboard computer.

The unmanned Progress resupply ships regularly dock with the current MIR Space Station. The Soyuz T spacecraft incorporated the IGLA system, and the later Soyuz TM and Progress M Series spacecraft incorporated the KURS. The MIR Complex has both systems installed. The rear port and the KVANT docking port have the IGLA system installed to support earlier Progress ships that uses the IGLA. The first Soyuz TM docking occurred In May of 1986, while the first Progress M docked in September of 1989.

Questions addressed during the presentation: How is Attitude Determined? Roll is sensed using directional antennas and both chase vehicle and Station is held in attitude hold.

What optical targets are used for contingency? The MIR optical target appears to be similar to the Apollo docking target.