range, velocity, and bearing information. Multiple targets are utilized to provide relative attitude data. The design requirements were to utilize existing space-qualifiable technology and require low system power, weight, and size yet operate from 0.3 to 150 meters with a range accuracy greater than 3 millimeters and a range rate accuracy greater than 3 mm per second. The field of regard for the system is +/- 20 degrees. The transmitter and receiver design features a diode laser, microlens beam steering, and power control as a function of range. The target design consists of five target sets, each having seven 3-inch retroreflectors, arranged around the docking port. The target map is stored in the sensor memory. Phase detection is used for ranging, with the frequency range-optimized. Coarse bearing measurement is provided by the scanning system (one set of binary optics) angle. Fine bearing measurement is provided by a quad detector. A MIL-STD-1750 A/B computer is used for processing. Initial test results indicate a probability of detection greater than 99% and a probability of false alarm less than 0.0001. The functional system is currently at the MIT / Lincoln Lab for demonstration.

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Contact Dynamics Testing of Automated Three-Point Docking Mechanism

by Kenneth H. Rourke, TRW

An evaluation of an OMV docking mechanism, based on an adaptation of the Shuttle Flight Support System Pallet Berthing Mechanism has been completed. The mechanism uses automatically actuated motorized latches to engage towel bars on the target satellite. LED sensors establish the towel bar position within the capture envelope and the latch capture commands are issued. Then, locking pawls engage the bar, locking and pre-loading the mechanism. Two series of tests were conducted to test nominal and failure mode captures and to evaluate design parameters such as LED sensor locations, automatic closure algorithms, latch closure velocity, position/velocity entry envelopes, and closure method. The first test series involved single latch testing on the Flat Floor Facility, 6 DOF Facility and an analytic simulation model. The intent was to compare results in order to validate the various facilities. Reasonably good agreement was achieved. The second test series repeated the single latch testing on the refurbished 6 DOF Facility to validate the facility modifications. The individual latches were tested under free-drift conditions for functionality and performance. Next, the three-latch configuration underwent parametric testing. Test results validated the improved fidelity of the 6 DOF Facility and verified successful docking at the required entry velocity. The tests determined the "best" design parameter definitions and concluded that the locking pawls should not lock until all three latches completely close.

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TRAC Based Sensing For Autonomous Rendezvous

By Louis Everett Texas A&M University, and
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The Targeting Reflective Alignment Concept (TRAC) sensor is to be used in an effort to support an Autonomous Rendezvous and Docking (AR&D) flight experiment. The TRAC sensor uses a fixed-focus, fixed-iris CCD camera and a target that is a combination of active and passive components. The system experiment is anticipated to fly in 1994 using two Commercial Experiment Transporters (COMETs). The requirements for the sensor are: bearing error less than or equal to 0.075 deg; bearing error rate less than 0.3 deg/sec; attitude error less than 0.5 deg. and; attitude rate error less than 2.0 deg/sec. The range requirement depends on the range and the range rate of the vehicle.

The active component of the target is several "kilo-bright" LEDs that can emit 2500 millicandela with 40 milliwatts of input power. Flashing the lights in a known pattern eliminates background illumination.

The system should be able to rendezvous from 300 meters all the way in to capture.