THE RECENT ONE-GYRO TEST

Richard Arquilla
Computer Sciences Corporation

On September 23, 1991, SOC and OCC personnel performed a spacecraft test of the current one-gyro system. This version of the system incoporates changes to the Fine Sun Sensor algorithm, calibration and gyro scale factors intended to improve the one-gyro maneuvering accuracy, and allows the use of filtered (i.e., weighted) FES data when tracking a star. This note briefly considers the implications of the test results for science operations.

It is clear that the maneuvering capability of the present system is drastically improved over earlier versions. A series of maneuvers having pitch and yaw legs approximately 10 degrees in length and covering betas from 89 to 30 degrees shows slew errors frequently less than 1' in each axis, the largest error being 3.2' in yaw. Surprisingly, the largest error is not associated with the slew from beta 40 to 30 degrees, which was extremely accurate. Significantly, a maneuver from beta 82 to 109 degrees having a yaw leg of approximately 25 degrees, and a return slew to beta 82 degrees having a yaw leg of 57 degrees show slew errors quite typical (if not better) than those expected from the two-gyro system. The largest maneuver errors are actually found for two short slews between betas 89 and 84 and having legs approximately 5 degrees in length. These errors likely result from the manner in which the spacecraft accelerates to and from maximum slew speed, and in these cases the target was still well within the FES field of view. These results indicate that while intermediate slews may still be necessary to move between the most widely separated targets, the slew lengths can be appreciable implying a corresponding increase in the system efficiency.

Only FES #2 was active for the test, so that all acquisitions were made using a single FES. The target stars were generally brighter than 6.5 magnitude. While all of the targets were located successfully, somewhat more overhead is required for acquisitions in the one-gyro system. It is highly desirable to allow the S/C to "fully" stabilize (especially in roll; the satellite will always oscillate to some extent in yaw when in default mode) following a maneuver. This stabilization is achieved within minutes. Of more importance is the system's performance when tracking on faint stars, since many IUE targets have slow track guide stars. While such tracking is noisy even in the two-gyro system, its relevance to the one-gyro system is illustrated by the results of an attempt to track on a very faint star (approximately 60 counts s/o, marginal in any circumstances) in the presence of the FES scattered light. The FES lost track on this star but did not lose star presence, and the spacecraft moved over 4 degrees in yaw in approximately one minute. Since the remaining gyro was used for pitch control, this position error could not be corrected by going back to default mode (i.e., "zeroing the ABGs"). It is almost certain that relatively simple software changes can prevent such large, rapid movements of the spacecraft in such situations, and means for further improving the stability of the FES tracking on faint stars are being developed.

During the course of this test SOC staff obtained the first spectrum using the one-gyro system (LWP 21319). The target was Delta-2 Lyrae (mv=4.3). This target has the property important to a successful one-gyro exposure; it has an identifiable guide star with a well determined position relative to the target. The exposure was taken with the LWP camera in low dispersion with an exposure time of 52 seconds. The proper guide star (1145 counts f/o) position was calculated using information from a previous exposure, and the target was placed in the aperture by first bringing the target to the reference point, locating the guide star, moving the guide star to the predicted position, and tracking on the star there. The OBC tracked the guide star using raw FES data; a test of the system's ability to use filtered FES data indicates that even greater tracking stability can be achieved. Initial analysis of the image indicates that the spacecraft pointing was accurate to approximately an arcsecond, and the profile of the star's magnesium line appears to be quite normal. The image was read down with the target at the reference point, but with track on; the maneuver to the next target was not calculated until after the image was read down. This procedure of minimizing the time delay between the calculation and execution of a maneuver is likely to be common when using the one-gyro system, at least initially, to ensure the accuracy of the maneuvers.

A spacecraft test of the one-gyro system was held on September 23, 1991. The maneuvering capability of the system has been greatly improved, indicating that slews of appreciable length can now be made on the system. All targets were acquired successfully. SOC staff obtained the first spectrum, an LWP low dispersion exposure of the star Delta-2 Lyrae, using the one-gyro system. The system is now capable of supporting a subset of normal IUE science operations. Efforts will be made to improve the system's ability to accurately track faint guide stars, and to implement an improved version of the one-gyro operations procedures.