BLIND OFFSET MANEUVERS WITH THE TWO-GYRO/FSS SYSTEM

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One of the more demanding tests of the new two-gyro/FSS attitude control system is the accuracy with which the telescope pointing can be positioned to observe objects invisible (in visual light) to the IUE Fine Error Sensors (FES). Objects of this type are acquired by blind offset techniques, where the telescope is maneuvered a short distance to the invisible target from a nearby star. In general, maneuver errors of 2 arcseconds or less are required in order for the target to end up reasonably well-centered in the 10 X 20 arcsecond large aperture.

Under the three-gyro system offset maneuvers were performed in exactly the same manner as the much longer target-to-target maneuvers. The maneuver, consisting of a sequence of single-axis slews, is first calculated by the ground command computer and then sent to the spacecraft where they are executed one axis (pitch, yaw, or roll) at a time. Three-gyro system blind-offset maneuver errors were less than 1 arcsecond for slews less than 10 arcminutes and less than 2.5 arcseconds for slews less than 30 arcminutes.

The same blind offset maneuvering procedure with the two-gyro system yields unacceptably large errors (> 5 arcseconds), even for maneuvers of a few arcminutes, because the pitch, or beta angle, control mode for these maneuvers must use the Fine Sun Sensor (FSS). There are two primary reasons for the larger errors. First, the angular resolution of the FSS is 15 arcseconds in beta, and second, the beta angle of the target changes up to 2.5 arcseconds/minute due to solar motion.

Following the gyro failure in August a new technique for blind offset acquisitions was developed. The slews are performed with both pitch and yaw axes on gyro control without use of the FSS for pitch control. The FSS is still used for roll axis control. This is the same control mode used for normal acquisition slews (e.g. moving the target from the FES reference point to one of the spectrograph apertures). The offset maneuver is calculated from the difference in right ascension and declination between the target and offset star. This difference is converted to pitch and yaw angles using a Cartesian transformation. The spacecraft roll angle is the rotation angle from right ascension and declination to pitch and yaw. The OBC executes the computed slews in both axes simultaneously at a constant slew rate, typically 10 arcseconds/second.

The accuracy of this technique was tested on five dates during the past two months by maneuvering between SAO catalog stars in selected fields. There were no special criteria in selecting the stars other than that they be separated by 2 to 40 arcminutes. The coordinates for all stars were corrected for proper motion using the data in the SAO catalog. The maneuvering tests were performed at beta angles of 62°, 52°, 48°, 36°, and 34°.

Figure 1 shows the total maneuver error as a function of offset slew distance. For maneuvers of 15 arcminutes or less one may expect the errors to be less than 2 arcseconds, and possibly less than 1 arcsecond. While some maneuvers of 15 to 30 arcminutes in length have errors less than 1 arcsecond, this accuracy may not be possible in general. We do not know the extent to which coordinate inaccuracies in the SAO catalog positions and proper motions contribute to these errors. Additional maneuvering tests are planned.

Figure 2 shows the pitch component of the maneuver errors plotted versus slew distance. The pitch error is of particular importance because the pitch direction is nearly parallel with the minor axis of the large aperture. The data show that the pitch and yaw errors are uniformly distributed about zero and that the error in either axis will be less than 2 arcseconds for slews less than 15 arcminutes provided the coordinates are accurate. The offset maneuvers performed at beta angles of 48° and 36° and at 62° and 52° were performed between the same sets of stars. There is no evidence in the data for a beta-angle dependence in the maneuver accuracy.

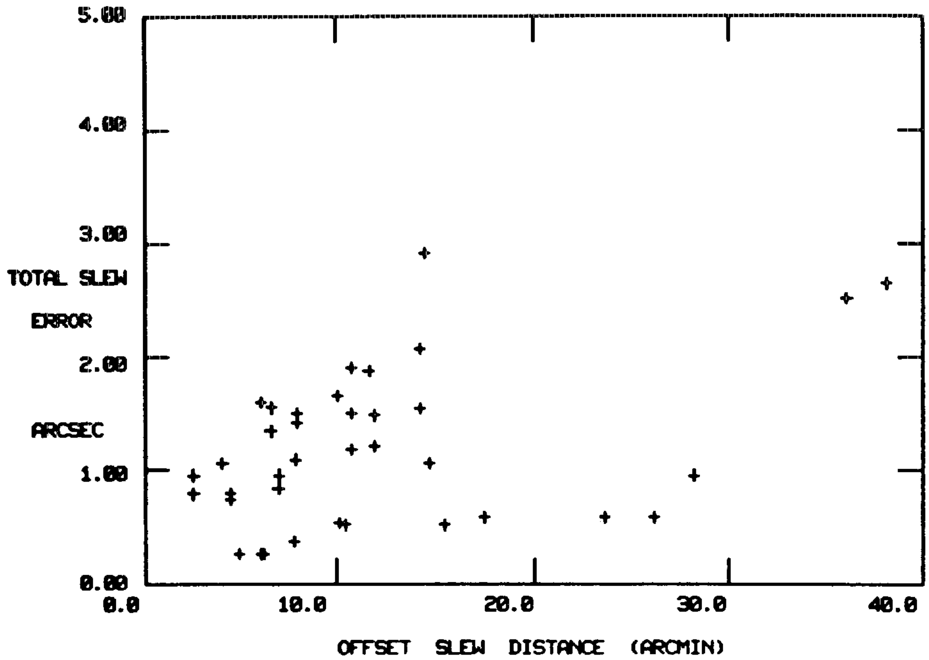

Figure 1. Blind offset maneuver accuracy results. Total slew errors are shown as a function of offset distance.

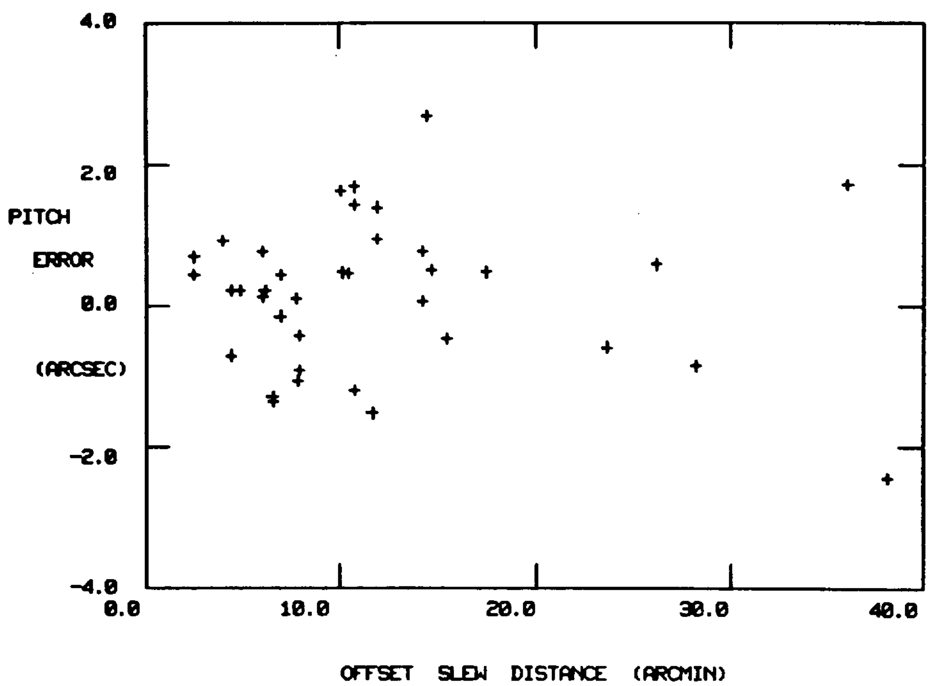

Figure 2. Blind offset maneuver pitch errors are shown as a function of offset distance. The large aperture minor axis is 10 arcsec and nearly parallel with the pitch direction.