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EASTERN TEST RANGE

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FROM: George L. Silver

SUBJECT: Improvement of GYRO DRIFT DATA by USE of INERTIAL MODE

Reference: STG Memo # 1200

A phenomenon affecting the NBD term of some of the Block II Gyros used in the CM and LM Guidance and Navigation System has recently been identified, and perturbation measurements made on available gyros at the MIT/IL, Cambridge. (Reference STG Memo 1200.)

The NBD perturbation were noted to occur in gyros which had been subjected to extended periods of "Static" Coarse Align mode, and required several hours to return to the nominal Bias Drift value after a MODE change to Fine Align (Inertial Mode).

IMU Performance test parameter stability can therefore be improved by changing the preferred IMU mode during pre-flight periods of required IMU operate power on, warm up, and other such times as a specific IMU mode is not required to support specific planned tests, from Coarse Align, at 0^{o} 0^{o} 0^{o}, to Fine Align (Inertial) Mode with the Inner Gimbal Axis aligned with the Earth Rate Vector.

The above orientation will allow long periods of Fine Align (Inertial) Mode before the Earth Rate generates large Middle Gimbal Angles. The time period available would be dependent upon the initial mode change gyro alignment and existing drift terms. Realignment to the desired orientation would not be mandatory until the Middle Gimbal Angle neared or reached Gimbal lock indication limits and then because the Computer programs will change the Mode to Coarse Align at a Middle Gimbal Angle of $+85^{o}$. Unexpected main power perturbation with Middle Gimbal Angles greater than $\mp 70^{o}$ is not thought to be a problem but additional Gyro and Servo protection would be provided by realigning to the desired orientation once the Middle Gimbal Angle nears or reaches the Gimbal lock indication limits (Murphy's Law).

The general equations, to Coarse Align the positive Inner Gimbal Axis parallel to the Earth Rate vector are given below for IMU orientations which has the positive Outer Gimbal (case) axis vertical, i.e.: installed in the Spacecraft and certain of the G&N System Test Fixture orientations.

OGA cmd = 270° - Z_{NB} Azimuth

IGA cmd = 0°

MGA cmd = Latitude of test location

The G&N System could then be set inertial by V40N20E (Zero Encode).

The Inertial Subsystem test Stations results would also benefit from using a warmup or pretest mode which did not allow the Gyros to remain in the stops for extended periods prior to Gyro coefficient testing. The Gimbal command angles for inertial mode would possibly vary from the general case cited above due to different IMU Case orientations used in ISS. However, the applicable Gimbal and Table Angles are obvious. Gyro pulse torquing to maintain Gyro servoed nulls would also be acceptable.

A specific effort should be made to perform the one hour warm up prior to the start of the IMU Performance Tests, which are done under Computer Program control, in the herein stated Fine Align (Inertial) orientation to minimize the data scatter of the NBDY, NBDZ and NBDX terms and allow more realistic compensation to be computed for these important in-flight terms.

The OA hortizontal YSMup, parking position is not changed or implied to be affected by this memo.

Very truly yours,

George L. Silver

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GLS:ab

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