April 1971

Brief 71-10087

NASA TECH BRIEF

Manned Spacecraft Center

Performance Evaluation System for Inertial Navigation Equipment

A real-time laboratory testing system has been set up to study the inertial characteristics of gyroscopic devices. The system, consisting of an instrument support package, a dynamic test table, torque control electronics, and a computer with real-time capability, is particularly intended for use in evaluating the performance of prototype gyroscopic strapdown units in inertial-grade attitude-reference systems. It may also find application in the maintenance and alignment of existing inertial navigation systems, for example, on commercial aircraft.

The support package contains three, orthogonally mounted, inertial reference integrating gyroscopes. The gyros are mounted in adjustable alignment fixtures and are normalized by separate sets of supporting components-signal-generator preamplifiers, magnetic-suspension capacitors, quadrature-adjustment networks, and temperature controls. An optical cube mounted on the package serves as the gyro alignment reference.

The package is mounted on a precision four-axis test table by means of a high thermal resistance adjustable plate. This mounting allows precise static orientation of the support package for gyro drift-rate determination, as well as end-to-end integrated attitude-reference tests. The test table position can be calibrated to within $\pm 10^{-5}$ rad. (± 2 arc-sec). Constant rotation rates up to 1 rad/sec and oscillatory rates up to 10 Hz can be obtained about two of the table's rotary axes.

The torque control electronics for each gyro is a digital, ternary pulse, torque-to-balance control loop. The torque-to-balance configuration is used, as opposed to single-axis platform mechanization, because it represents the most direct implementation of the strapdown concept.

The control functions by applying a variable restraining torque to the gyro to maintain its output axis at a null position. The restraining torque is applied to the gyro as a sequence of pulses, representing quantized measurements of equivalent rotation about the gyro input axes. Control sensitivity, in terms of the threshold detection (quantization) level, is approximately 2^{-15} rad.

The torque measurements are processed through various attitude-maintenance algorithms in a commercially available general-purpose computer to provide an analytical representation of the package attitude with respect to an inertial coordinate frame.

Note:

Requests for further information may be directed to:

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Reference: TSP71-10087

Patent status:

No patent action is contemplated by NASA.

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under contract to
Manned Spacecraft Center
(MSC-13542)

Category 02,03