View metadata, citation and similar papers at core.ac.uk

April 1971

brought to you by T CORE

Brief 71-10087

NASA TECH BRIEF

Manned Spacecraft Center



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

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 realtime 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 fouraxis 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 op-

posed 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:

Technology Utilization Officer Manned Spacecraft Center, Code JM7 Houston, Texas 77058 Reference: TSP71-10087

Patent status:

No patent action is contemplated by NASA.

Source: Richard A. McKern of Massachusetts Institute of Technology under contract to Manned Spacecraft Center (MSC-13542)

Category 02,03

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights.