NASA TECH BRIEF

Conceptual Nonorthogonal Gyro Configuration for Guidance and Navigation

Future extended space missions and supersonic transport applications will require guidance and navigation systems of high reliability. To achieve this, some form of redundancy will have to be employed. An investigation has been made into the use of non-orthogonal sensor configurations to provide such redundant capabilities. An optimal configuration using six single-degree-of-freedom inertial reference gyroscopes has been defined and analyzed. The gyroscope input axes are arrayed in a unique symmetrical pattern that corresponds to the array of normals to the faces of a regular dodecahedron.

A complete data processing and self-contained failure detection-and-isolation mechanism has been defined for this symmetrical configuration. The data reduction technique permits satisfactory system performance even with three of the six gyros inoperative. When more than three gyros are operative, a statistical weighting procedure has been implemented to define a "best" estimate of vehicle rates. A minimum computational processing technique has also been defined.

The failure-isolation mechanism operates on the basis of gyro output comparisons, and provides the data processing scheme with reorganization capabilities. Isolation of any two failures and detection of the presence of a third is achieved for either instrument performance degradation or catastrophic failures.

This system has been formulated in a strap-down configuration to attain maximum redundancy, and analysis indicates an appreciable improvement in reliability over orthogonal redundant guidance system configurations, including those employing nine gyros. The concepts formulated in this study are also directly applicable to other inertial instruments.

Notes:

1. This development is in conceptual stage only, and as of date of publication of this Tech Brief, neither a model nor prototype has been constructed.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B67-10433

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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Category 01