vibrations. Vehicle motions are measured by the two transformation techniques as described in this invention.

While a particular embodiment of the invention has been shown and described, modifications may be made, and it is intended in the following claims to cover the embodiments which fall within the true spirit and scope of the invention.

What is claimed is:

1. A self contained strapped down inertial guidance system combining all axis, all attitude navigation comprising:

a vehicle in which said inertial system is mounted,

two wide angle, two-degree-of-freedom gyros having their cases rigidly mounted to said vehicle said gyros oriented so that their momentum vectors are non-parallel and having a predetermined span of angular freedom between said null and spin axes,

means for torquing said gyros at constant rates in a bang-bang torque fashion so that the long term torquing rates of said gyros equal the rotational rate of said vehicle whereby all vehicle restrictions are removed, and

means for computing corrections for said angular deviation between the null and spin axes by use of the electrical outputs of said gyro pickoffs.

2. The inertial guidance system of claim 1 comprising:

accelerometer means having three linearly independent axes for providing acceleration signals along said three axes to said computing means for transforming said gyro and acceleration signals into gyro coordinate signals.

3. The inertial guidance system of claim 2 comprising:

means in said computing means operative upon said gyro coordinate signals for generating navigation coordinate signals whereby the position and velocity of said vehicle is obtained.

4. The inertial guidance system of claim 3 comprising:

means for combining a source of gravitational acceleration signals with said navigation coordinate signals whereby the effect of the earth's gravitational attraction is computed during the flight of said vehicle.

5. The inertial guidance system of claim 4 comprising:

a first integration circuit in said computing means for computing the velocity of said vehicle, and

a second integration circuit in said computing means connected to the output of said first integrating circuit for computing the position of said vehicle.

6. The inertial navigation system of claim 5 comprising:

means for computing a transformation from gyro momentum vector referenced coordinate frame, to a navigational coordinate frame such as a locally vertical frame wherein the Z axis is always along the local vertical direction, and

means for computing necessary corrections for rotation rate of navigation frame with respect to inertial space.

7. A self-contained strapped down inertial navigation system for determining the attitude, position and velocity of a vehicle in which the navigation system is mounted comprising:

two wide angle, two-degree-of-freedom gyros having their cases rigidly mounted to said vehicle for providing attitude angles and angular rate signals along three orthogonally displaced axes,

accelerometer means for providing signals representative of the acceleration along said three linearly independent axes,

a first transformation matrix connected to the output of said gyros and accelerometers for transforming said gyro and accelerometer signals from body coordinates to gyro coordinates, and

a second transformation matrix connected to the output of said first matrix and said gyros for transforming said gyro coordinates into navigation coordinates.

8. The method of determining the attitude, position, and velocity of a vehicle in a self-contained strapped down inertial navigation system comprising:

torquing two wide angle, two degree of freedom gyros in such a manner so that only the long term torquing rates must equal those of said vehicle and so that all vehicle attitude restrictions are removed,

maintaining a predetermined span of angular freedom between the null axes and the spin axes of said gyros,

computing corrections for said angular deviation between said null axis and spin axis by use of the electrical output of the gyro pickoffs,

computing the overall angular relationship between the body fixed frame and navigation frame by combining the said connection for angular deviation between said null axis and spin axes with said angular relationship between the gyro coordinate frame and navigation frame,

measuring the vehicle acceleration by means of a linearly independent triad of accelerometers rigidly mounted to said vehicle,

computing vehicle acceleration in navigation coordinates by transforming said vehicle acceleration into navigation coordinates by means of the matrix comprised of said vehicle attitude and augmenting it with local gravitational acceleration, and

computing position and velocity by doubly integrating said acceleration in navigation coordinates subject to necessary coordination for rotation of the navigation frame.

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