NASA TECH BRIEF

Improved Gas Ring Laser

A method has been devised to improve the sensing resolution of a gas ring laser in a gimballess gyroscope system or inertial rotation sensor. The effects of mode coupling which occurs between the two contracirculating light beams generated by laser rotation are minimized by oscillating at high frequency the radiation sources within the ring laser. Several methods which have been used to minimize mode coupling effects in the ring laser introduce other undesirable operating characteristics when it is used as a rotating sensor.

In the new method, piezoelectric-driven corner mirrors of the ring laser are oscillated in a direction parallel to their surfaces and the plane of rotation. The piezoelectric-mirror combinations are driven at their resonant frequencies by a simple oscillator circuit. Resonant oscillations could be sustained at frequencies of 1 or 2 MHz, with amplitudes of fractions of a micron. Under these conditions, the rms velocities of the mirrors would be tenths of a meter per second, with a resultant rms Doppler shift in the scattered light of the order of a MHz from the optical frequencies of the traveling waves.

By this method, phase variation of the scattered light is made to occur at a much greater rate than has been achieved by previous methods. This method does not introduce any nonreciprocal element into the ring laser cavity which might become a new source of error. The sidewise motion of the mirrors does not impart any Doppler shift to the traveling-wave sustained oscillations. This method applies to volume scattering from within mirror and Brewster plates as well as to surface scattering from mirrors and Brewster plates. The scattering centers themselves are periodically spatially displaced, resulting in additional rapid phase variation.

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457 (f)], to the Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.

Source: J. D. Coccoli and J. R. Lawson
of Massachusetts Institute of Technology
under contract to
Manned Spacecraft Center
(MSC-11584)

Category 02