



## Orthogonal Mode Laser Gyro

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### OTHER INFORMATION

#### KEYWORDS

Coupling, Sensing, Gyroscope,  
Ring Laser Gyroscope,  
Orthogonal, Frequency Lock-  
up, Rotation, Optical Signals

#### CATEGORIZED AS

- ▶ **Optics and Photonics**
  - ▶ All Optics and Photonics
- ▶ **Sensors & Instrumentation**
  - ▶ Other
- ▶ **Transportation**
  - ▶ Aerospace
  - ▶ Automotive
- ▶ **Engineering**
  - ▶ Robotics and Automation

#### RELATED CASES

2016-772-0

## BACKGROUND

Gyroscopes are devices used to sense rotation and are typically used in inertial navigation of objects and vehicles, particularly when reliance on a magnetic compass is insufficient or not possible. Mechanical gyroscopes, the simplest and most common type of gyroscope, are typically quite large. Additionally, they are sensitive to shock and vibration, can have poor reliability due to fabrication tolerances, and experience mechanical wear over time. This makes them suboptimal for applications requiring small size and high accuracy, such as in aircraft, missiles, and satellites. Ring laser gyroscopes (RLG), which sense changes in orientation by exploiting the Sagnac effect, are more suitable for these applications due to their compactness and lack of moving parts. However, they suffer from frequency lock-up, which prevents them from sensing small rotations below a certain threshold. Therefore, there is a need for a ring laser gyroscope that does not exhibit frequency lock-up at low rotation rates.

## DESCRIPTION

Researchers at the University of California, Santa Barbara have significantly improved the sensitivity of ring laser gyroscopes by preventing frequency lock-up with modifications to the counter-propagating optical beams. By making the clockwise and counterclockwise propagating beams orthogonal, the light signals will not become injection-locked to an identical frequency, which would typically result in a rotation reading of zero. Orthogonality is imparted by a non-reciprocal element that is optically coupled with the optical path. This non-reciprocal element can either impart a frequency difference on the two counter-propagating signals (to avoid interference), or it can provide the signals with orthogonal polarizations.

## ADVANTAGES

- ▶ Mitigates frequency lock-up, enabling sensing of small rotations
- ▶ Balanced optical gain in clockwise and counterclockwise directions
- ▶ Tunable frequency
- ▶ Eliminates requirement of a mechanical dither

## APPLICATIONS

- ▶ Inertial navigation systems (INS) in guided missiles, aircraft, spacecraft, and ships
- ▶ Self-driving vehicles
- ▶ Robotics

## PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,180,325	01/15/2019	2016-772

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Bonding of Heterogeneous Material for Improved Yield and Performance of Photonic Integrated Circuits](#)
- ▶ [Epitaxial Laser Integration on Silicon Based Substrates](#)
- ▶ [Improved Dynamic Range in RF Communication Over Optical Fiber](#)

- ▶ A Hybrid Silicon Laser-Quantum Well Intermixing Wafer Bonded Integration Platform
- ▶ Integrated Reconfigurable Circulator
- ▶ Magneto-Optic Modulator
- ▶ Quantum Dot Photonic Integrated Circuits
- ▶ Ring Resonator-Based Optical Isolator and Circulator
- ▶ Integrated Dielectric Waveguide and Semiconductor Layer
- ▶ Loss Modulated Silicon Evanescent Lasers
- ▶ Monolithically Integrated Laser-Nonlinear Photonic Devices
- ▶ Misfit Dislocation Free Quantum Dot Lasers

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