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SENSITIVITY CHARACTERIZATION OF A NOVEL MEMS VIBRATING RING GYROSCOPE

Abstract

Micro-Electro-Mechanical (MEMS) inertial sensors that make up the inertial measurement unit (IMU) play an important role in various technologies. This is due to their highly miniaturized designs and low power consumption while maintaining high sensitivity and robustness. An important component of the IMU is the MEMS gyroscope, which enables the measurement of angular velocity by utilizing the Coriolis force. The MEMS gyroscope has been developed and improved over the past few decades for higher sensitivity, and lower nonlinearity. In this paper, the sensitivity analysis and testing of a MEMS Vibrating Ring Gyroscope (VRG) for miniaturized space attitude systems is presented. The structure was designed and simulated using Coventor MEMS+. The gyroscope sensing and driving modes were mode-matched using perforated inertial masses to increase sensitivity. C-shaped springs were used to increase structure compliance and consequently improve shock resistance. Device fabrication was done using the MEMSCAP SOIMUMPs foundry process on a 25 m thick silicon layer. Resonance frequency of the device was obtained by simulation and found to be 43.7 KHz. The gyroscope was driven at its resonance frequency, which allows for in-plane compression and expansion. A signal generator was used to apply two identical AC signals with 180-degree phase difference while a DC signal was provided to the proof-mass of the device to bias it into resonance. The device was mounted on a single axis rate table, and varying rates of angular velocity were applied. The output signal was filtered, attenuated, and amplified using a high precision evaluation board with an MS3110 Universal Capacitive Readout IC. Sensitivity of the device was logged utilizing an oscilloscope and a DAQ.

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