



MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, October 10 2024 at 13:30, D. Dan and Betty Kahn Building, Room 217.

Online: <https://technion.zoom.us/j/92334093990>

Auto Resonance Driving of Frequency Modulated Coriolis Vibratory Gyroscopes

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A gyroscope is a device used for measuring rates of rotation or for tracking orientation in space. State-of-the-art Micro-Electro-Mechanical-Systems (MEMS) gyroscopes are integrated in many smartphones, where they are used to measure orientation. The simplest and most common type of MEMS gyroscope consists of a vibrating structure that has two degrees of freedom (DOF) and is suspended within a rotating frame. In such a device rate of rotation is determined by measuring specific features of the dynamic response which are modulated by Coriolis forces. Accordingly, these devices are named Coriolis Vibratory Gyroscopes (CVG). In essence, a CVG is constructed from two resonators that are coupled by Coriolis forces.

There are two types of CVGs, which differ in the strategy employed to sense rates of rotation. The first type is an Amplitude Modulation (AM) gyro, which relates to the modulation of the velocity amplitudes of the two DOFs to sense rates of rotation. The second type is a Frequency Modulation (FM) gyro, which relates to the modulation of the frequency of vibrations to sense rates of rotation.

In the present study we consider FM gyroscopes in which the two DOFs are distinctly different in *each* of their respective parameters. The mismatch between the two DOFs represents a substantial challenge, and we present a rigorous and systematic approach to address it. Additionally, we consider a new implementation for Auto Resonance (AR) driving scheme which ensures each DOF is locked into its effective natural frequency. We demonstrate that even for a mismatched system, the new implementation of AR yields a linear relation between the rate of rotation of the system and the effective frequency of vibrations. In this respect, the results of our investigation have the potential of bringing the concept of FM gyros with AR driving, closer to practical commercial implementation.

Note: the seminar will be given in Hebrew