Design Optimization of a Meso-scale Coriolis Vibratory Gyroscope

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Abstract

The disk resonator gyroscope (DRG) is a meso-scale, high performance, compact and planar new generation Coriolis vibratory gyroscope which is suitable for space applications. Angular rate measurement utilizes the precession of a pair of degenerate modes of a perfectly balanced (axisymmetric) DRG resonator under the influence of the Coriolis force. This pair of operating modes is usually referred as the n=2 pair of modes and each one of these is spatially separated from the other by an angle of 45 degrees.

This paper discusses how the thickness of the quartz resonator is finalized, based on results of simulations performed on COMSOL®. The two-dimensional geometry of the resonator is prepared in the COMSOL GUI and extruded to obtain the three-dimensional model. Material properties are assigned and the following studies are conducted. Initially, Eigen-frequency studies are performed from the Structural Mechanics interface for various thickness values using the Parametric Sweep feature. Certain thickness regimes are selected so as to avoid coupling between the operating modes and other modes. Next the Thermo-Elastic losses are estimated utilizing the MEMS Module. Subsequently, the effect of a thin gold film on the quality factor of the DRG is studied. Finally, the thickness that optimizes most of the design requirements is obtained.