Design and Simulation of 3D MEMS Piezoelectric Gyroscope using COMSOL Multiphysics®

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Introduction: Tracking the position of an object is an important engineering problem that finds many application areas including military, industrial, medical, and consumer applications. This problem is effectively solved with gyroscopes. This paper presents a piezoelectric gyroscope with a proof mass packed between piezoelectric slabs in all directions. Fig 1 shows our design of MEMS piezoelectric gyroscope.

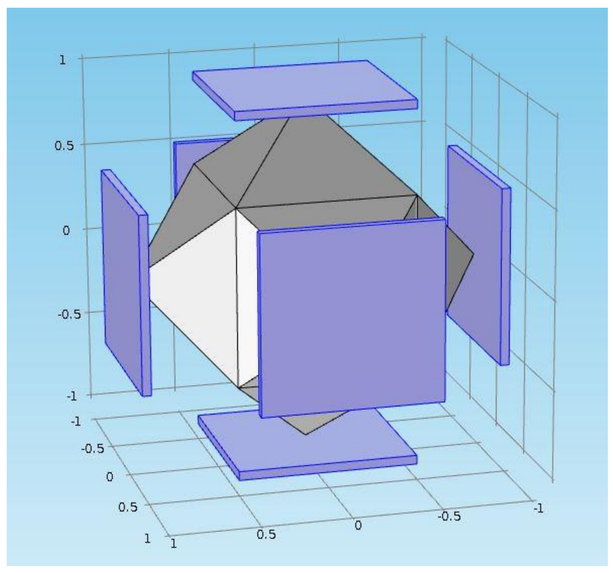
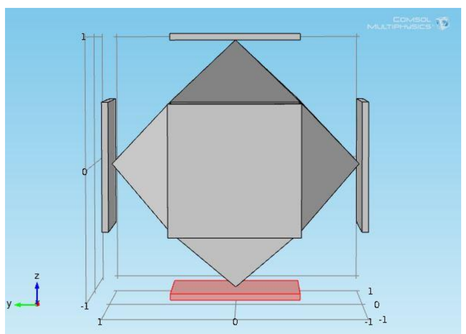
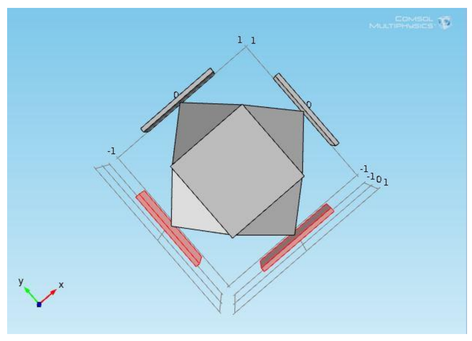


Figure 1. Design of piezoelectric gyroscope

Computational Methods: When the body is oriented from its position the angular displacement is measured by comparing the force exerted on each piezoelectric slabs. The physics interfaces that we used are piezoelectric devices and solid mechanics.





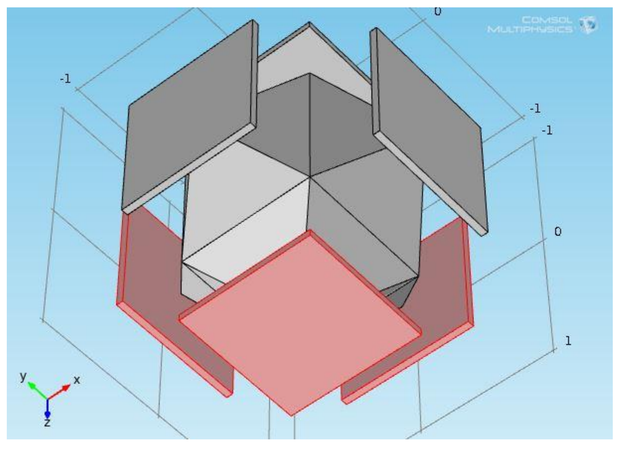


Figure 2. Working of gyroscope

Results: The deformation in the different piezoelectric slabs depends on angular displacement of the body, Eigen frequency analysis is done to inspect the deformation and potential generated in the piezoelectric slabs

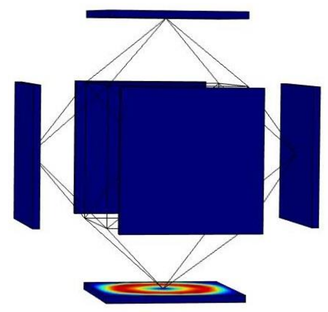


Figure 3. Deformation in piezoelectric slab

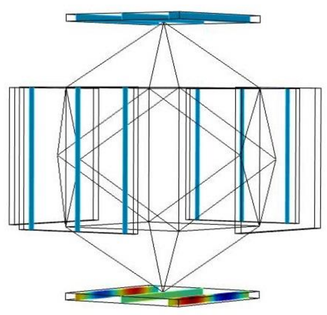


Figure 4. Potential generated

Material applied for the proof mass	Max deformation	Potential generated
Structural steel	50x10^-7um	0.018V
Platinum	25x10^-6um	0.083V

Table 1. Simulation results

Conclusion: MEMS technology exploits the existing microelectronics infrastructure to create complex machines on a micrometer scale. Extensive applications for these devices are Tracking the position of an object, military, industrial, medical, consumer applications and perfect for gaming.

References:

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