MEMS AND MICROSENSORS – 2024/2025

COMSOL Multiphysics: completing a 3-axis MEMS gyroscope

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Introduction

In the last class, you analyzed the design of a yaw MEMS gyroscope, which can be used to sense z-axis angular rates. The task for this class is very simple: just design a device to sense y-axis (or x-axis) angular rates, i.e. a pitch or roll gyroscope. The task is to have a drive frequency of 22 kHz, and the same mismatch of the former class (1.1 kHz). At the end of the class, if you have time, check also the effects of over- or under-etching, as done for the yaw device. Useful formulas for torsional devices are given below.

parameter	***range or value***
Drive frequency	22 kHz
Desired mode split	1.1 kHz
Process thickness	20 µm
Minimum spring width	1 µm
Available device length	700-900 µm
Available device width	350-600 µm

$$\omega_0 = \sqrt{k/I} \qquad I = 3r_1^2 m_1 \qquad k = 2G\frac{w_s^3 h}{3l_s}$$

Suggestions: design a drive frame similar to the yaw device, but leave some space in between to connect the two halves of the sense frame, so to implement a "torsional accelerometer of the Coriolis force". See the sketch below. Help yourself with an initial drawing and a parametric design.