
COMSOL Multiphysics: completing a 3-axis MEMS accelerometer

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Introduction

In the last class, you designed an in-plane MEMS accelerometer, which can be used to sense x- and y-axis accelerations. The task for this class is very simple: just design a torsional z-axis MEMS accelerometer that matches the same sensitivity performance of the in-plane one, so to complete a 3-axis module. The parameters to match for your design are simply those reported in the Table. The useful formulas to assist your calculation are reported below (assume α can vary between 0.85 and 0.95; x_m is the mean distance of the parallel plate electrodes from the rotational axis; r_1 is the width of the smallest half of the accelerometer, the other one being twice this value).

parameter	range or value
Resonance frequency	3-5 kHz
Sensitivity	5 fF/g
Vertical gap	1.5 μm
Available device length	700-900 μm
Available device width	350-600 μm

$$S_{mech} = 2\alpha \frac{C_0}{g} \cdot \frac{1}{\omega_0^2} \cdot \frac{x_m}{2 \cdot r_1} \quad \omega_0 = \sqrt{k/I} \quad I = 3r_1^2 m_1 \quad k = 2G \frac{w_s^3 h}{3l_s}$$