**Introduction**

A MEMS torsional paddle (Figure 1) can be considered as a potential device for bio/chemical sensing [1]. The Quality Factor (QF) is inversely proportional to energy loss of the resonator and can determine the sensitivity. Prediction of the QF is important for optimization and precise dynamic performance analysis of such a sensor. In this study, the geometrical effect (anchors’ length, position and device thickness) on air damping and Quality factor of the torsional paddle are investigated using COMSOL Multiphysics® 4.4.

**Computational method**

- The Fluid-Structure Interaction interface was used.
- 2-D model was developed. Angular displacement \( \theta(t) = \theta_0 \sin(\omega t) \) is applied on opposite sides to produce the moment (Figure 3).
- Fluid is in continuous regime and classified as a laminar and incompressible fluid.
- Time domain analysis was performed.

\[
\rho \omega^2 u_{fluid} - \nabla \cdot (\rho \nabla u_{fluid}) + \rho u_{fluid} \times (\nabla \times u_{fluid}) + F = 0
\]

\[
\rho u_{fluid} \eta = \rho \omega^2 u_{fluid}
\]

**Results**

- Figure 4: eigenfrequency and air flow distribution around the paddle (length x width x thickness=10 x 8 x 0.2 μm²). (a,b) anchors at the centre, (c,d) anchors offset from the centre.

- Figure 5: (a) phase difference between the damping torque and angular velocity, (b) sine and cosine components of damping torque

- Table 1: Summarized simulation results (L=anchors’ length, t=thickness, f=resonance frequency, T(max)=damping torque, D=damping ratio, Q=quality factor)

- Table 2: Summarized sensitivity value for paddle

**Conclusion**

The effect of geometrical parameters on the behavior of the MEMS torsional resonator was investigated. It was shown that by changing these parameters the quality factor could be enhanced which consequently could have significant results on the sensitivity of the sensor. The fabrication of the resonator by Focused ion beam would be the next step to verify these results.

**Reference**