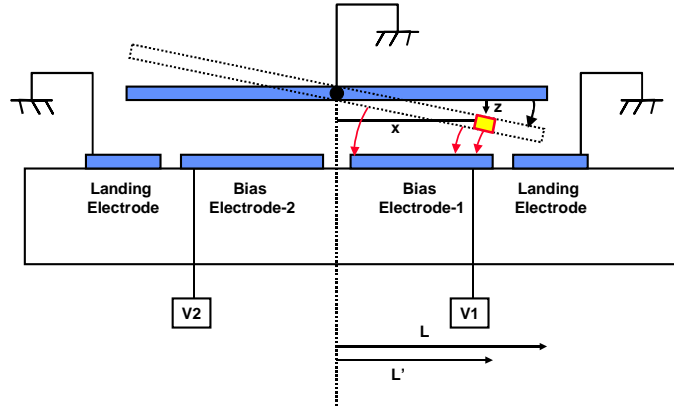


1. Consider the simplified DMD with rectangular electrodes (instead of diagonal one in real DMD):



- a) Derive the expression for electrostatic torque:

$$\tau_a = \frac{\epsilon \cdot V_a^2}{2} \cdot \frac{W}{\tan^2 \theta_M} \left\{ \frac{1}{\alpha^2} \left[\ln(1 - \alpha\beta) + \frac{\alpha\beta}{1 - \alpha\beta} \right] \right\}$$

- b) Assume the dimension of this DMD is $L = 8 \mu\text{m}$, $L' = 6 \mu\text{m}$, $W = 16 \mu\text{m}$ (width), maximum deflection angle = 10° , plot the torque versus angle curves for three voltages: $V_a = 5$, 10, and 30 V.
- c) Assume the spring is made of Al with the following dimensions: length = $6 \mu\text{m}$, width = $1 \mu\text{m}$, thickness = $0.06 \mu\text{m}$. Estimate the compliance of the torsion spring.
- d) Find the pull-in voltage and angle numerically.