Lecture 24: Gyroscopes & Sensing Circuits I

- **Announcements:**
- First 15 minutes of class were for HKN to lead course evaluations
- HW#6 now due Thursday, April 19, at 10 a.m.
- HW#7 will be online soon (today)
- Module 14 on Sensing Circuits online
- Module 15 on Gyros, Noise, & MDS online
- Project slide #2 due Friday, April 20
- I will be at the EECS Retreat this coming Thursday, so the lecture will be recorded and on video accessible via the lecture link on the course website
- Next Tuesday, I will be in Singapore, so again, the lecture will be recorded and on video
- Please watch both of these lectures before class on Thursday, next week
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- Reading: Senturia, Chpt. 14, Chpt. 16, Chpt. 21
- Lecture Topics:
  - Gyroscopes
- Reading: Senturia, Chpt. 14
- Lecture Topics:
  - Detection Circuits
    - —Velocity Sensing
    - —Position Sensing
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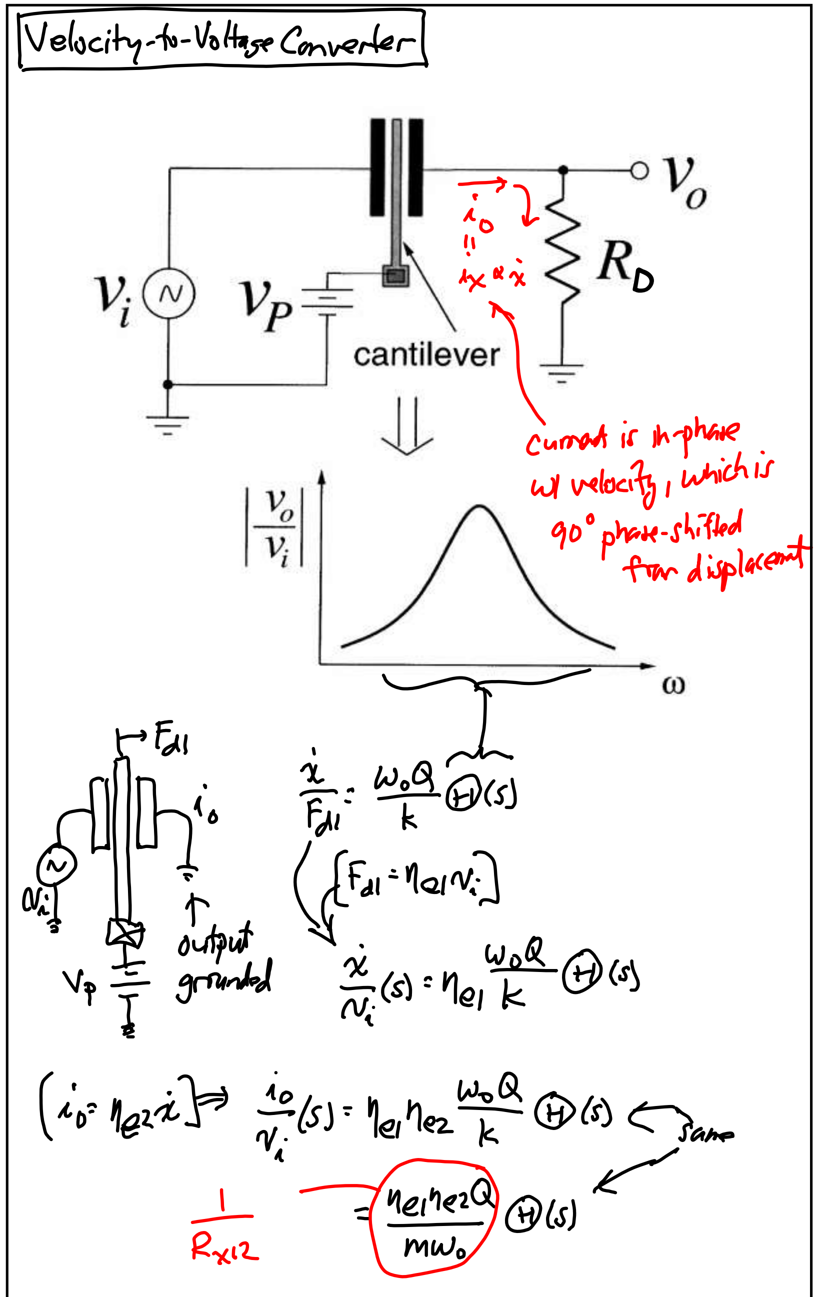
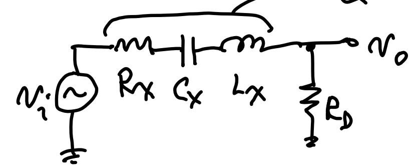
- **Last Time:**
- Started gyroscopes by going through slides 1-6 in Module 15
- Now, continue with this …



Now, include R_D:

$$Q = \frac{\omega_o L_x}{R_x}$$



$$\frac{v_o}{v_i}(s) = \frac{R_D}{R_x + \frac{1}{sC_x} + sL_x + R_D} = \cdots \text{math} \cdots$$

$$= \underbrace{\frac{R_D}{R_x + R_D}}_{\text{Gain Term}} \; \underbrace{\frac{s\left(\frac{R_x + R_D}{L_x}\right)}{s^2 + s\left(\frac{R_x + R_D}{L_x}\right) + \frac{1}{L_x C_x}}}_{\text{Freq. Shaping Term}}$$

$$\left[Q = \frac{\omega_o L_x}{R_x} \rightarrow Q' = \frac{\omega_o L_x}{R_x + R_D} \rightarrow \frac{R_x + R_D}{L_x} = \frac{\omega_o}{Q'} \right]$$

$$\frac{v_o}{v_i}(s) = \frac{R_D}{R_x + R_D} \; \frac{s(\omega_o/Q')}{s^2 + s(\omega_o/Q') + \omega_o^2}$$

$$\frac{v_o}{v_i}(s) = \frac{R_D}{R_x + R_D} \cdot \Theta(s, Q')$$

$$Q' = Q\left(\frac{R_x}{R_x + R_D}\right)$$

Problem: $Q' < Q$

We've lost Q! ✗