Lecture 23b: Circuit Problems & Gyros

Announcements:
- HW#9 due Wednesday, 4/21, at 12 noon
- Project Slide Set #2 due Friday, April 16
- Module 13 on “Equivalent Circuits II” online
- Module 15 on “Gyros, Noise, & MDS” online
- This lecture finishes yesterday’s lecture after problems with my Surface pen. This is happening during the Friday discussion section.

Today:
- Reading: Senturia, Chpt. 6, Chpt. 14
- Lecture Topics:
  - Current Modeling
    - Output Current Into Ground
    - Input Current
    - Complete Electrical-Port Equiv. Ckt.
  - Impedance & Transfer Functions
- Reading: Senturia, Chpt. 14, Chpt. 16, Chpt. 21
- Lecture Topics:
  - Gyros

Last Time:
- Interrupted by pen problems
- Now, finish the lecture …
\[
\frac{\text{\(\frac{\text{\(L_x\)}}{N_x}\)}}{(\text{\(j\omega\))}} = \left[\frac{\text{\(j\omega L_{x12} + \frac{1}{j\omega C_{x12}} + R_{x12}\)}}{1}\right]^{-1}
\]

Where \(L_{x12} = \frac{f_x}{\eta_{e1} \eta_{e2}}\), \(C_{x12} = \eta_{e1} \eta_{e2} C_{x}\), \(R_{x12} = \frac{f_x}{\eta_{e1} \eta_{e2}}\)

Separate into magnitude \& frequency response components:

\[
\frac{\text{\(I_{\text{\(L_x\)}}(s)\)}}{\text{\(N_x\)}} = \frac{sL_x}{sL_x + \frac{1}{sC_{x12} + R_{x12}}} = \frac{sL_x}{s^2L_xC_x + \frac{1}{L_xC_x} + \frac{sC_x}{L_xC_x}}
\]

\[
\left[\frac{1}{L_xC_x} \text{\(\omega_0^2\)}, \frac{\omega_0}{L_x} \text{\(Q\)} \right] = \frac{R_x}{L_x} \frac{\text{\(\omega_0\)}}{L_x} \frac{\text{\(\omega_0\)}}{L_x} \frac{\text{\(\omega_0\)}}{L_x}
\]

\[
\frac{\text{\(I_{\text{\(L_x\)}}(s)\)}}{\text{\(N_x\)}} = \frac{1}{R_x} \frac{\omega_0}{L_x} \text{\(\Theta(s)\)}
\]

Magnitude = Gain Term

Freq. Shaping Term

\[
\text{\(\Theta(s)\)}
\]

\[
\text{\(\text{\(\frac{\text{\(L_x\)}}{N_x}\)}}(s)\)
\]

\[
\frac{1}{R_x}
\]

\[
\omega_0
\]

\[
\omega
\]

\[
\text{\(\Theta(s)\)}
\]

(we'll see this later)