EE16A - Lecture 17 Notes

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Check Negative Feedback

Inverting Amplifier

1. Set any input to 0 (Replace all voltage sources with short circuits, all current sources with open circuits)
2. Dink the output
   - Check how V_err and V_in are changing (increase/decrease)
   - Positive feedback loop: dink causes V_out to slam into a rail
   - Negative Feedback Loop: dink minimized V_err and causes V_out to track V_in
3. Allows you to apply GR 2: $V^+ = V^-$

Check Negative Feedback

Design Example 1 Using only R's & op-amps & voltage sources, implement a current source whose value is proportional to a central voltage

1. State the Goal: Voltage Controlled Current Source (VCCS)
   - Control Voltage (V_c) to create a fixed current ($g_m V_c$ (g_m = Amps/V))
   - Value of current source depends on control voltage
   - 4 terminals (2 terminal for voltage, 2 terminals to create current at the output)
   - 2 separate circuits, but no current between the two circuits
2. Describe a Strategy: Block Diagram
   - Need relationship between voltage and current (Ohm's Law)
   - Measure voltage $\rightarrow$ pass through resister $\rightarrow$ measure output current
3. Implement the strategy: Voltage Source and Resistor
   - Simplest circuit that satisfies the criteria of the strategy and goal: Voltage source and resistor
     - Only 2 nodes (1 voltage source) - need 4
     - Create additional loop after resistor (at 0 volts to get $I = \frac{V}{R}$ and not allow current to flow into it: OpAmp)
   - OpAmp
     - Connect the circuit after the R to one of the inputs of the OpAmp to divert the current away from ground, but maintain $0I$ and $0V$ (O^+)
     - Connect the other input to ground
     - Connect the OpAp output terminal as the remaining (O^-)
4. Verify That the Strategy Works
   - If you dink the output O^-, the input from the original circuit will always increase, which means it must be V^- and the other has to be V^+ to maintain negative feedback.

- GR1: $I^+ = I^- = 0$; GR 2:$V_c = V_R$ (KVL)
- $I = \frac{V_R}{R} = \frac{V_c}{R}$, By design, I flows through output terminals in original goal ($I = \frac{V_c}{R} = g_m V_c$)
- V_c is not open circuit, like goal wants, so add a buffer (opamp) between voltage source and rest of the circuit