Problem with Common-Mode

• What if $I_L < \frac{I_{\text{ail}}}{2}$?
  • Will capacitive feedback solve this?

• Typical solution: Common-mode feedback
  • Sense CM at output
  • Adjust some knob to alter CM
**Common-Mode Sensing**

- Simplest CM sensor: pair of resistors
- Resistors load the OTA (reduce gain)
  - If make R large, get slow $V_{\text{cm}}$ tracking
  - Is this a problem?

**Sensing Scheme #2**

- Isolated CM sensing
  - Works reasonably well
  - But hard to use with wide swing amplifier output
Capacitive Sensing

- Capacitive sensing avoids DC loading
  - (still creates AC load though)
- Needs to be reset to remove initial offset
  - Just like capacitive feedback

Adjusting Common-Mode

- Really only two knobs:
  - Knob A: adjust load current
  - Knob B: adjust tail current
Example Common-Mode Feedback

- Secondary amplifier enforces $V_{cm} = V_{cm_{\text{ref}}}$
- Place dominant pole at $V_{bp}$, or $V_{cm}$?

CMRR Fix

- What if two PMOS transistors aren’t perfectly matched?
Capacitive CMFB

- How to choose $C_{cm}$?
  - "Small": CM loop gain low
  - "Large": Loading on diff. output high

Initialization
“Continuous” CMFB