Lecture 4C (07/20/22)

Announcements

• Midterm next Monday
  • Review Session this Saturday
    3-5pm  Soda 306 (HP Auditorium)
Agenda

- Capacitive Touchscreens Review
- Charge Sharing
- Comparators
Capacitive Touchscreens Review

W/O Touch

W/ Touch

$C_3 \parallel C_1 \parallel C_2$
Charge Sharing: Jargon

Switches: $X$ will be closed during phase i and open during the rest.

Floating: Node on which no electrons can enter or exit.

(e.g. ...)
Charge Sharing Example 1

For the circuit below, calculate the value of all node voltages at the end of phase 2:
Step 1

- Label all terminals + currents

\[ V_s \]

\[ I_{Th} \]

\[ I_{TIE} \]
Step 2

Draw the circuit in each phase

\[ V_s \]

\[ \phi_1 \quad \phi_2 \]
Step 3

Identify all floating nodes in $\Phi_2$
Step 4

Pick a floating node. Identify all capacitor plates touching that node. Find the charge on those plates from $\phi_1$. 
Step 5

Find the total charge of the floating node in $Q_2$ as a function of node voltages.
Step 6  ★  Conservation of charge

Set the two total charges (from step 4 + 5) equal to each other.
Step 7

Repeat for each floating node in $Q_2$
Step 8

Repeat for next phase
Charge Sharing: Important Notes

1. Phase 1 should be completely solvable by NVA
2. Floating nodes in phase 2 don’t have to exist in phase 1
3. The key idea here is conservation of charge. It adds one more equation to our system to solve for unknowns in phase 2
Charge Sharing: Example 2
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Op-Amps
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Let \( \beta = A(U_+ - U_-) + \frac{V_{DD} + V_{SS}}{2} \)

\[ u_{out} = \begin{cases} V_{SS} & V_{SS} < \beta \\ \beta & \beta \\ V_{DD} & V_{DD} > \beta \end{cases} \]
OpAmps as Comparators

What happens if $A \to \infty$?