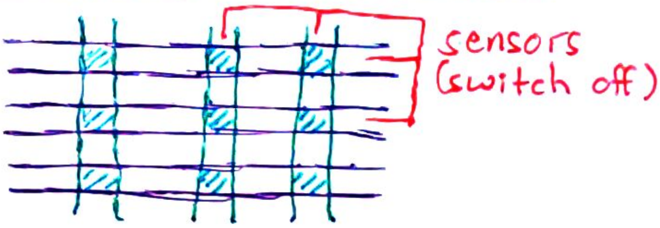
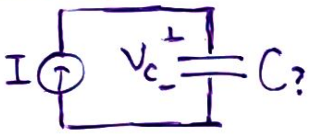
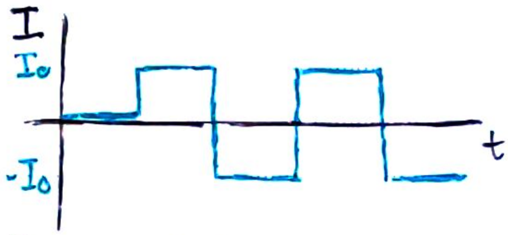
EECS 16A ## 10.31 LECTURE 18

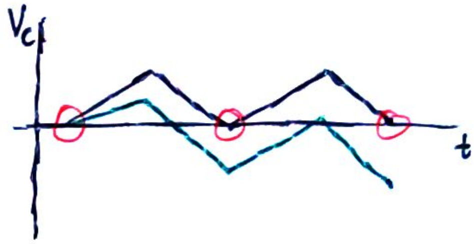
Capacitive Touch — Scaling Up



Drift



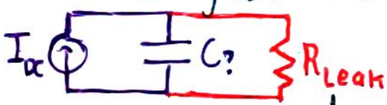


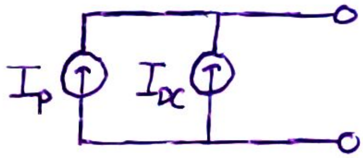


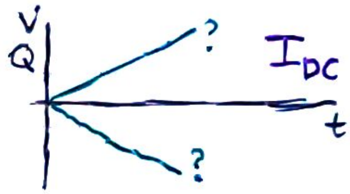
Imperfect Square Wave

$$I(t) = I_{SQ\,Perfect}(t) + I_{DC}$$

This is just 2 sources!







↳ To drain the charge on C?

Transition from time k to k+1? $t_1 = kT_{step}$ $t_2 = (k+1)T_{step}$

$Q_c(k) \to Q_c(k+1)$? $Q_c(k+1) = Q_c(k) + I_{DC}T_{step} - \frac{V_c}{R_L} \cdot T_{step}$

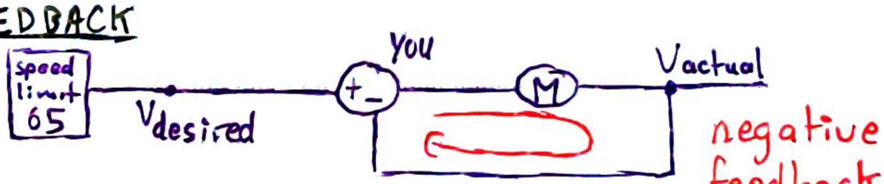
make T_{step} small so $V_c(t)$ is ~constant

$Q \to V \longrightarrow V_c(k+1) = V_c(k) + \left(I_{DC} - V_c/R_L\right) \cdot T_{step}/C_?$

$+\Delta q$ $-\Delta q$ ≈ 0 w/o extreme R_L

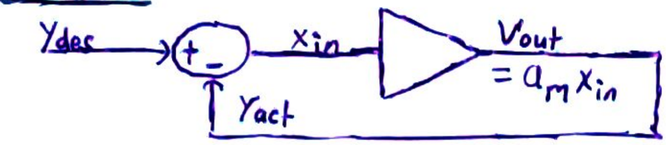
Op-Amps

Feedback



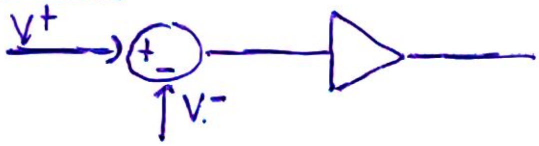
Assume an infinitely powerful Ⓜotor to control your speed as accurately as possible.

MODEL



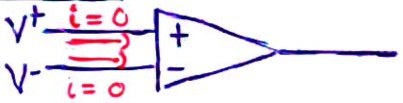
$Y_\Delta = Y_{des} - Y_{act} = 0$ ↳ $a_m \to \infty$

OP-AMP



$V_o = a_v(V^+ - V^-)$

SYMBOL

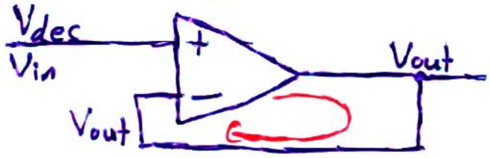


$V_o = a_v(V^+ - V^-)$ $a_v \to \infty$

$V^+ = V^-$ w/negative feedback

OP-AMP EXAMPLE

ex



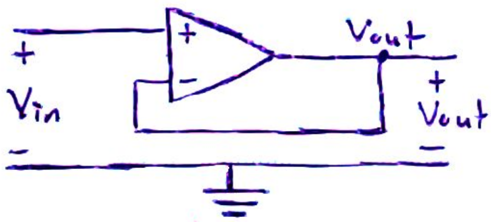
$V^+ = V^-$ $V_{in} = V_{out}$

$V_{out} = a_v(V_{in} - V_{out})$

$V_{out} = \frac{a_v}{a_v + 1} \cdot V_{in} \to \lim_{a_v \to \infty} \frac{a_v}{a_v + 1} = 1$

$V_{out} = V_{in}$

ex



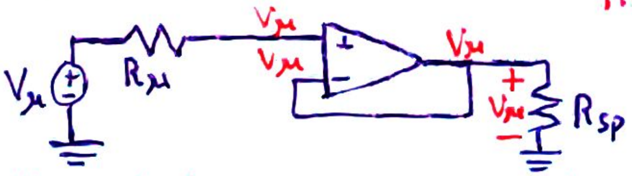
$V_{in} = V_{out}$

ex μPhone & Speaker

$V_{sp} = V_\mu \cdot \frac{R_{sp}}{R_{sp} + R_\mu} = \sim 8\mu V$

$P_{sp} = V^2/R = \sim 8\ pW$

this will generate no sound!



$V^+ = V_\mu - V_{R\mu}$

$V_{R\mu} = i R_\mu$ $i = 0$ (ideal opamp)

$V^+ = V_\mu = V^- = V_{sp}$

the ideal op-amp can deliver necessary current to the speaker!