ECE 615 - Lecture 23

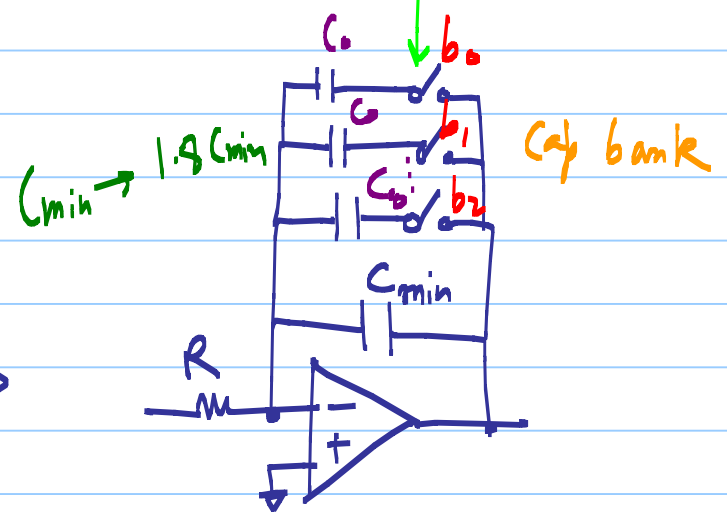
Note Title 11/21/2013

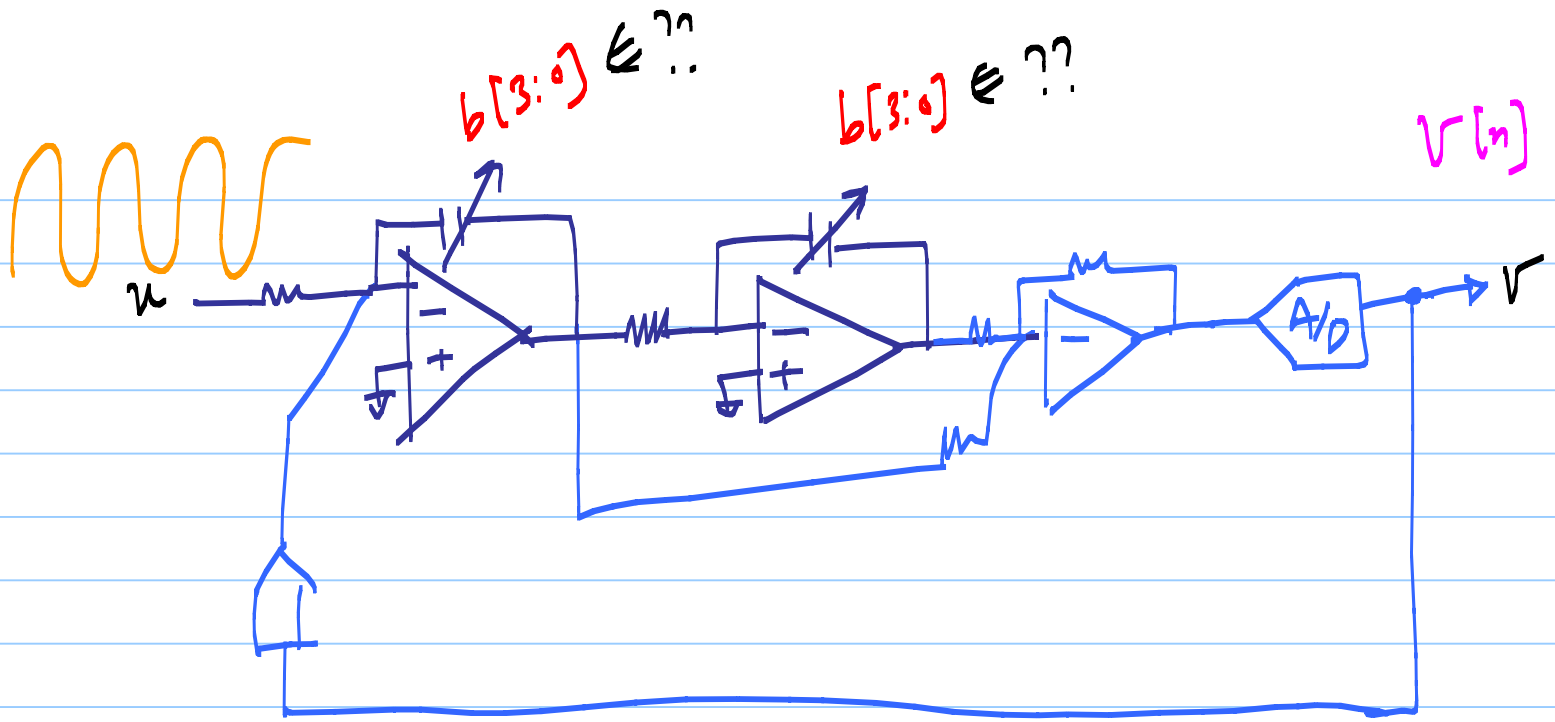
* RC time constant variation:

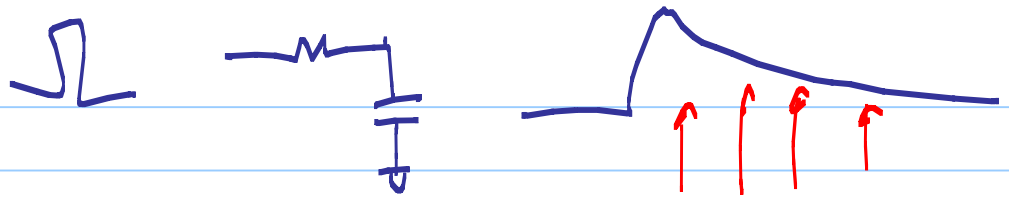
R-tuning

C-tuning

RC-tuning



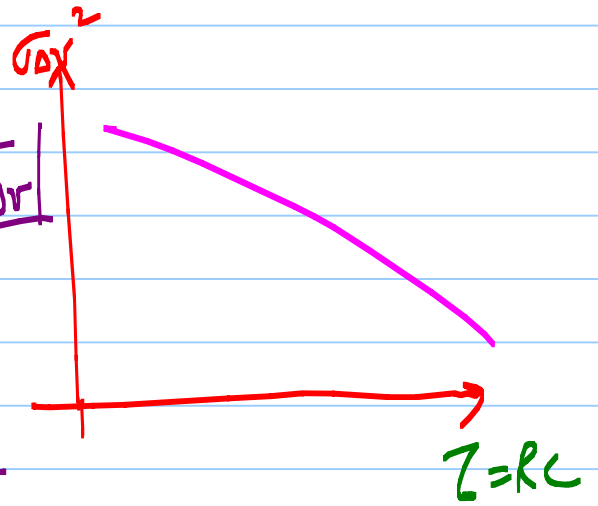

b[3:0] ∈ ??
b[3:0] ∈ ??
v[n]
u
A/D
v



$$\Delta v = v[n] - v[n-1]$$

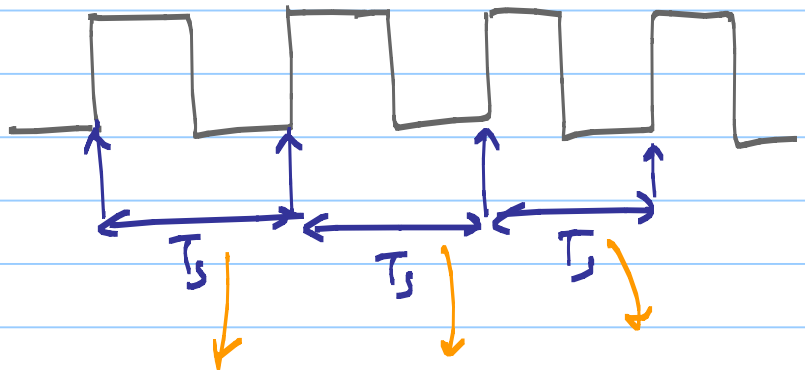
$$\sigma_{\Delta v}^2$$

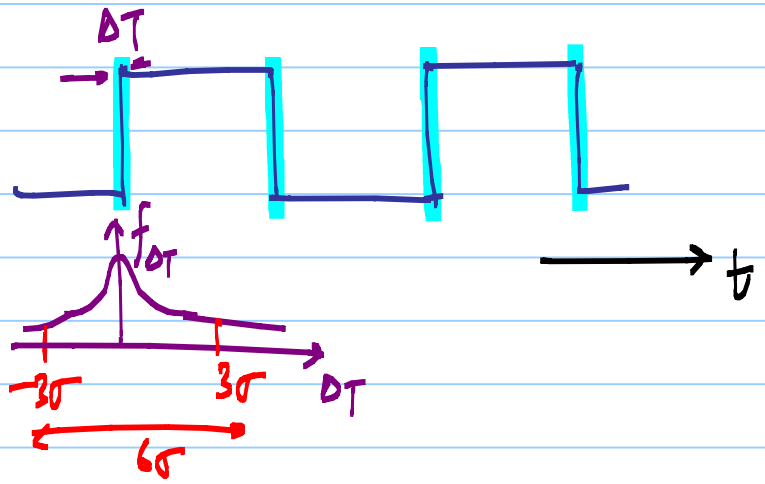
$$\sigma_{\Delta v}^2 = \frac{\sum_{i=1}^{N} \left(\Delta v[n] - \mu_{\Delta v[n]}\right)^2}{N}$$

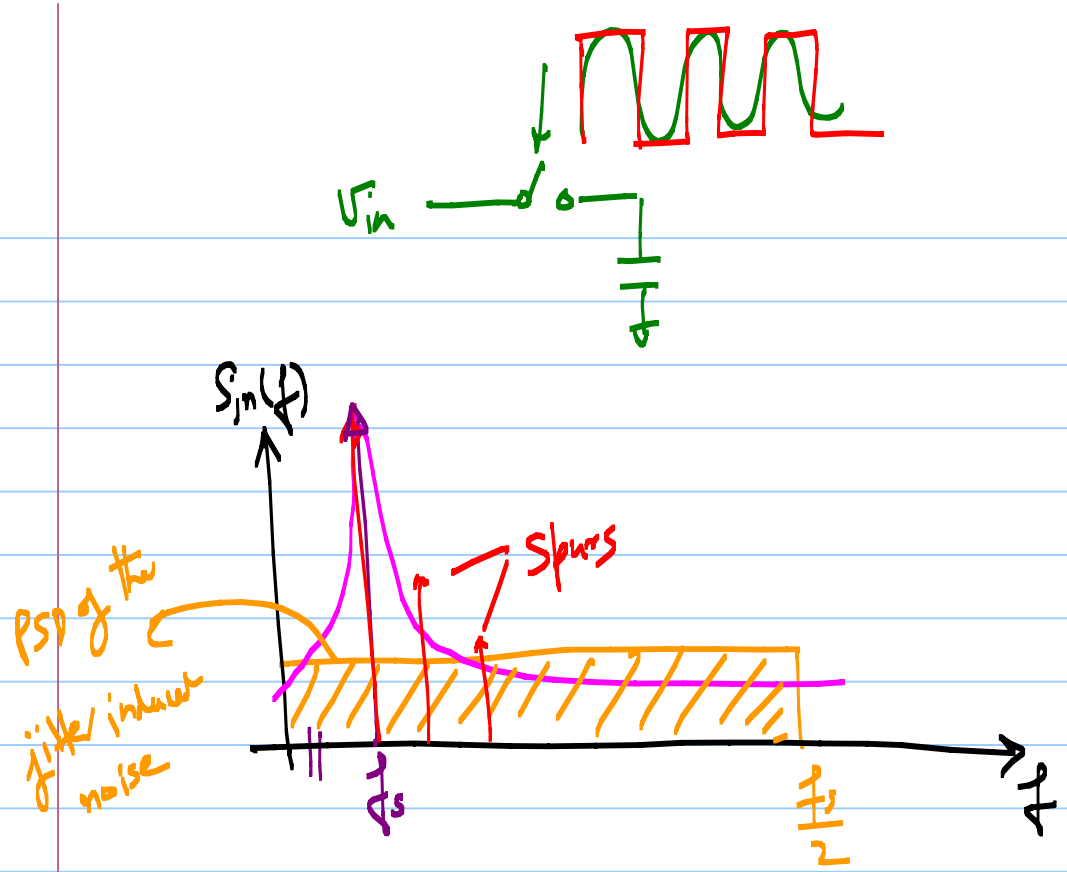


DT-ΔΣ	CT-ΔΣ
✗ $R_i = \frac{C_I}{C_f}$ ← 0.1%	$\frac{1}{RC}$ ← ±40%
	$\frac{g_m}{C}$
"Clock frequency scaling"	f_s
✗ $f_s = 100MHz \Rightarrow 150MHz$	$\frac{1}{sT_s}$

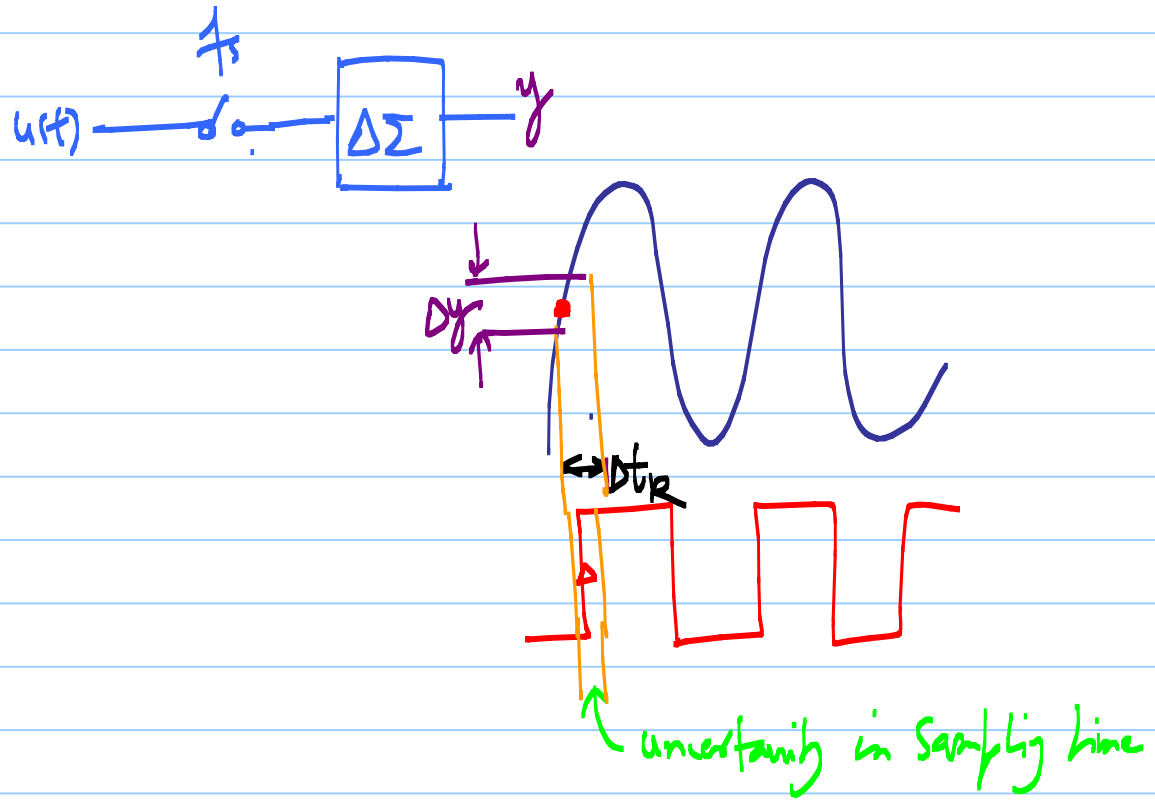
Clock Jitter






V_{in}
$S_{in}(f)$
Spurs
PSD of the
jitter induced
noise
f_s
$\frac{f_s}{2}$
f

DT ΔΣ



$$u = A \sin(\omega_{in} t)$$

$$\frac{du}{dt} = A\omega_{in} \cdot \cos(\omega_{in} t) \quad \Rightarrow \quad \left|\frac{du}{dt}\right| \leq A\omega_{in}$$

jittery sampled input $= u(kT_s + \Delta t_k)$

$$\approx \underbrace{u(kT_s)}_{\text{Sampled input}} + \boxed{\Delta t_k \cdot \left.\frac{du}{dt}\right|_{t=kT_s}}$$

error due to jitter

m.s. value of the error due to jitter $= E\left[\left\{ \Delta t_k \cdot A\omega_{in} \cos(\omega_{in} t)\Big|_{kT_s} \right\}^2\right]$

$= E[\Delta t_k^2] \cdot E\left[A^2 \omega_{in}^2 \cos^2(\omega_{in} t)\right]$

$= E[\Delta t_k^2] \cdot \frac{A^2 \omega_{in}^2}{2}$

$P_j = \sigma_j^2 \cdot \frac{A^2 \omega_{in}^2}{2}$

Jitter limited SNR $= SNR_j = \frac{A^2/2}{\sigma_j^2 \cdot \frac{A^2}{2} \cdot \omega_{in}^2} = \frac{1}{\sigma_j^2 \omega_{in}^2}$

$$SNR_j = -20 \log_{10}(2\pi f_{in} \sigma_j) \quad dB$$