4/11/13

Lec 38

More sophisticated Models

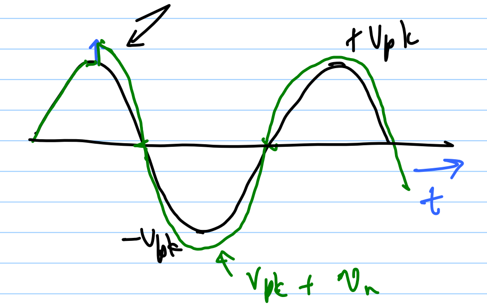
1) Abidi PN model

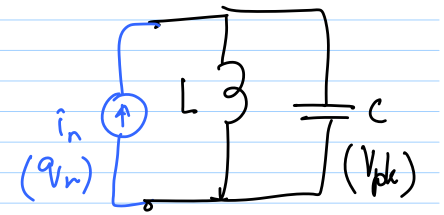
"Physical processes of phase noise in differential LC oscillators", CICC, 2000

— determine expression for F

$$\boxed{F = 2 + \frac{8\gamma R I_T}{\pi V_0} + \gamma \cdot \frac{f}{g} g_m R}$$

2) Hajimiri-Lee Model





Impulse Response for phase

$$h_\varphi(t,\tau) = \frac{\Gamma(\omega_0\tau)}{q_{max}} \cdot u(t-\tau)$$

q_{max} = max charge displacement across cap.

$\Gamma(\omega_0\tau)$ = Impulse Sensitivity function

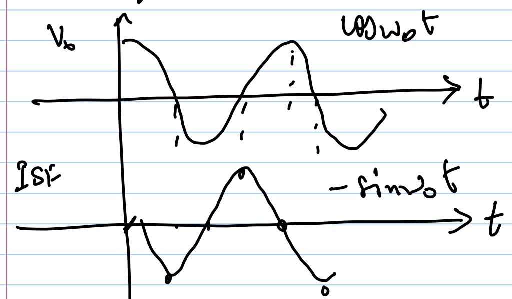
t = observation time

τ = impulse injection instant

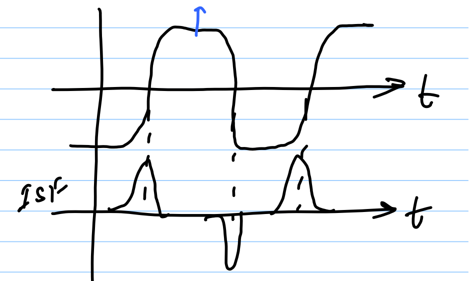
$$\varphi(t) = \frac{1}{q_{max}} \int_{-\infty}^{t} \Gamma(\omega_0\tau)\, i(\tau)\, d\tau$$

$i(\tau)$ = noise current

$\varphi(t)$ = total phase @ t



LC-osc.



Ring osc.

$\Gamma(\omega_0 \tau)$ = deriv. of o/p waveform

— best obtained from simulations

$$\Gamma(\omega_0 \tau) = \text{periodic @ } 2\pi$$

$$= \frac{c_0}{2} + \sum_{n=1}^{\infty} c_n \cos(n\omega_0 \tau + \theta_n)$$

$$\varphi(t) = \frac{1}{q_{max}} \left[\frac{c_0}{2} \int_{-\infty}^{t} i(\tau)\,d\tau \right.$$

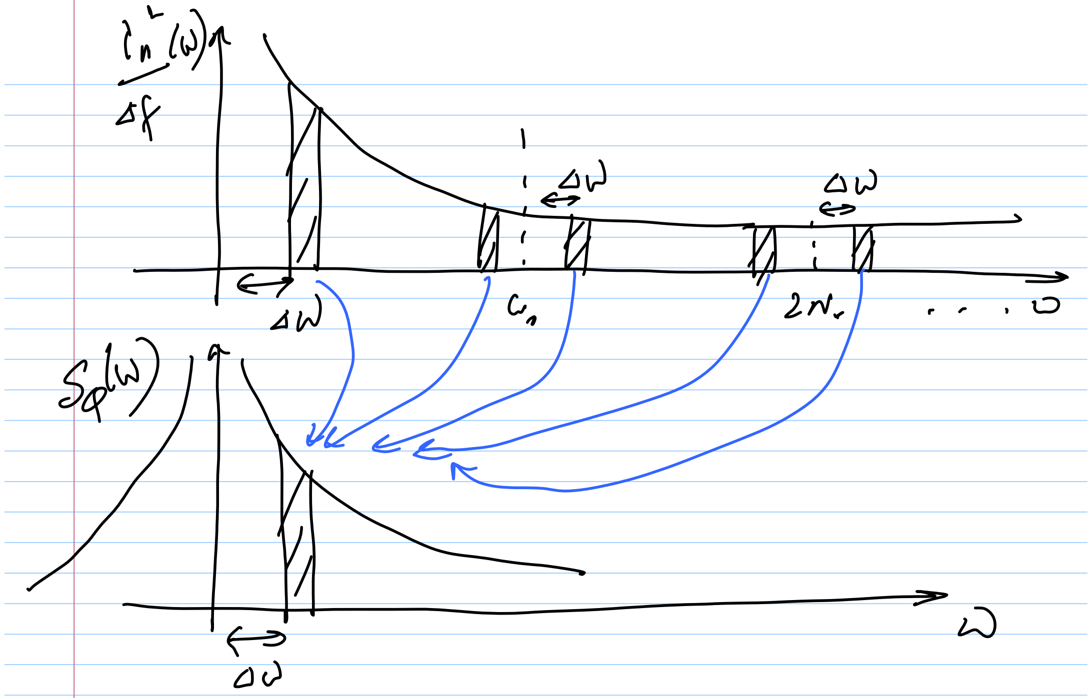
$$\left. + \sum_{n=1}^{\infty} c_n \int_{-\infty}^{t} i(\tau) \cos(n\omega_0 \tau)\,d\tau \right]$$

$$V_0(t) = \cos(\omega_0 t + \varphi(t))$$

$i_n(t) \rightarrow \varphi(t) \rightarrow$ SSB spot noise

current @ $(m\omega_0 + \Delta\omega)$

$\rightarrow$ gives component @ $\Delta\omega$



$$\Delta\omega_{1/f^3} = \omega_{1/f} \cdot \left(\frac{\Gamma_{dc}}{\Gamma_{rms}} \right)^2$$