ISF Simulation in Cadence (Transient Analysis)

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

$$\Rightarrow \boxed{\Gamma(\omega_0\tau) = \frac{\Delta t}{T_0} \cdot 2\pi \cdot \frac{q_{max}}{\Delta q}}$$

1) Δq should be { not too small → numerical error; not too large → Nonlinearity }
2) Δt should be measured after amplitude settles down. (steady state solution)
3) Impulse should be injected after oscillator stabilizes.
4) Step size in Δt should be small.
5) Transient sim. error tolerance should be small.

SIMULATION PROCEDURE

Step 1) Setting the Transient time step

Time step : Default : $\frac{t_{transient}}{1000} = 10\,ps \simeq \frac{T_0}{10}$

Need atleast $\frac{T_0}{1000} \simeq T_{step} = 100\,fs$ → 10fs to be Conservative.

Step 2) Setting Impulse location & T_{max}.

i) Look at freq function to find steady state.

ii) Look at cosine difference spectrum to verify steady state. (make sure to clip the signal).

iii) Plot freq function of cosine difference to find T_{probe}.

T_{pulse} & T_{probe} are set

Sim Setup TEST

$$\cos(x) - \cos(x-\phi) = \cos(x) - \cos x \cos\phi - \sin x \sin\phi$$

$$\simeq -\phi \sin x$$

$$= \boxed{-\phi \sin(\omega_0 t)}$$

↳ indicates a stable phase shift.

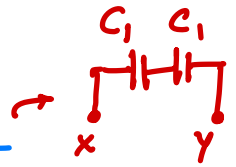
iv) Use cross function to find zero crossing when impulse if ϕ. Set significant digits to 16 & note down value.

$$T_{i=0} = 15.622391566\, e^{-9} = 15.622 e^{-9} + 0.39156 e^{-12}$$

> Subtract it from cross output. ADE output truncates it so break it up into different unit scales.

> Check that out is $\simeq 0$ before running sweeps.

Step 3) : Testing the linear response range.



$$q_{max} = V_p^{diff} \times C_{out} = 580mV \times 145fF$$

$$= 84.1\ fC \simeq 10^{-13}\ C$$

$\Rightarrow$ Δq should be less than $\frac{q_{max}}{10^2} = 10^{-15}\ C$

$$\Delta q = I_{pulse} \cdot \underbrace{\Delta t_{pulse}}_{T_0/100} = \underbrace{I_{max}}_{\downarrow} \times 1pS$$

10^{-12}

$1mA$

set to $1\mu A$

Step 4) : Simulate ISF by sweeping impulse location over 1 period.