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Week #1 Exercises

RMS, dB, etc

$y(t) \leftarrow \oplus \leftarrow x(t)$ evaluated; $n(t)$ noise

when $n(t)=0$, $x(t)=y(t)$ = true signal

Assume $x(t)=\sum_i A_i \sin 2\pi f_i t+\phi_i$

A_i = Amplitude (zero to peak)

ψ_x = rms value $= \left[\langle x^2(t)\rangle_t\right]^{1/2}$ where $\langle\ \rangle_t \rightarrow$ time average

$\psi_x = 0.707\,A$ for purely sinusoidal

$\psi_x^2 = \langle x^2(t)\rangle_t$ = mean-square value

$L_x = 10 \log_{10}\left(\psi_x^2/\psi_{ref}^2\right)$, ψ_{ref} = ref rms

~~(dB)~~ always write as dB re ψ_{ref}

units $x \rightarrow$ V, m/s^2, Pa, $t \rightarrow$ s

$\psi_x^2 = V^2$, ψ_{ref} in $20\mu Pa$, 1g, 1V

✓ Check FFT magnitude units for your matlab code

DSP Parameter in s, Hz

time resolution = h (s), time record = T (s), sampling freq = f_s (Hz), max freq of interest = f_m (Hz) $\le f_s/2$

freq resolution = Δf (Hz), number of points = N

$t = nh$, $T = Nh$, $\Delta f = 1/T$, $f_s = N\Delta f$

n: any point in time (integer)

$f_s = 1/h$, $N h \Delta f = 1$

Any two parameters are independent

Matlab Exercises

A. Calibrate the matlab code by assuming pure sine wave at 250 Hz with 0.1g rms. Vary $n(t)$ levels. Calculate all DSP parameters, ψ_x^2, dB, etc with proper units. Check both time and freq domain plots. Compare analytical and simulated (matlab) results. Annotate the matlab script.