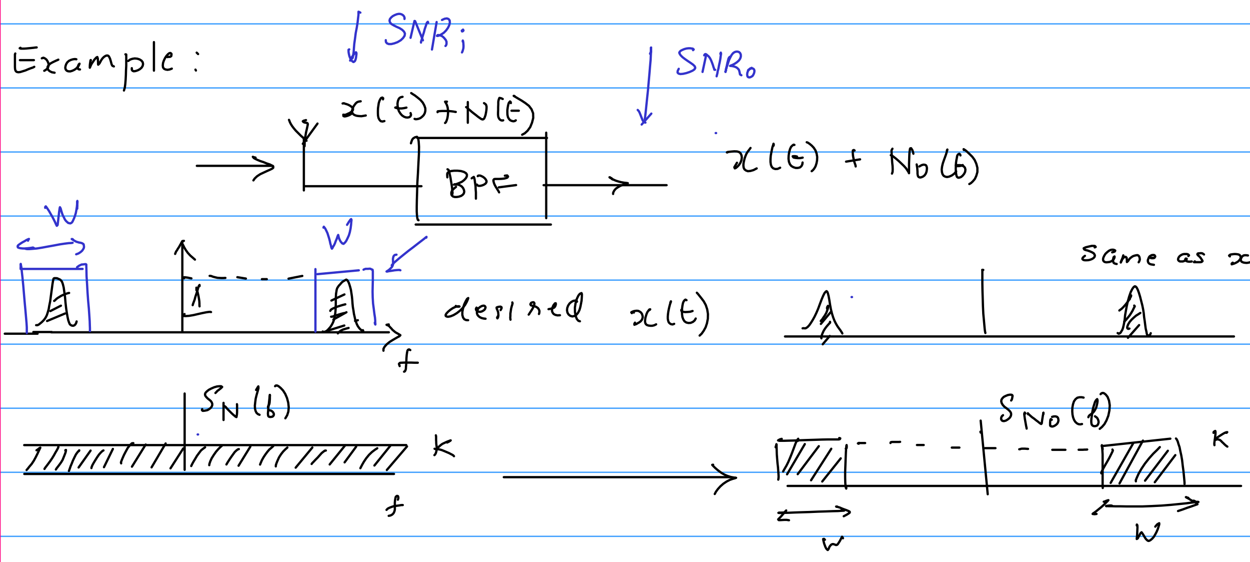
Revieω:

* $PSD(o/p) = PSD(i/p) \cdot |H(f)|^2$ → $X(f) \cdot H(f) = Y(f)$

$x(t) \rightarrow \boxed{h(t)} \rightarrow y(t)$

Example:

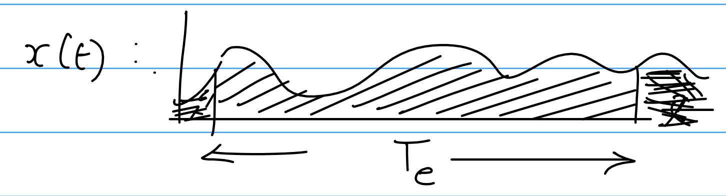


Signal to noise ratio:

assume signal consists of a desired signal $x(t)$ and a noise or unwanted signal $N(t)$

let P_x be power of $X(t)$ and P_N be power of $N(t)$

$SNR = P_x / P_N$.



T_e is such that

$$\int_{T_e} (x(t))^2 \cdot dt = 0.99 \int x(t)^2 \cdot dt$$

$$P_x = (E_x / T_e)$$

$$P_N = \int_{-\infty}^{\infty} S_N(f) \cdot df$$

$SNR_i = 0$ → model issue

$SNR_o = \left(\frac{E_x / T_e}{2KW} \right)$ → DSBSC receivers, SSB, AM, FM — BPFs need to have the same B/W as the signal — for IF filters.

Digression. suppose $(X(t))$ is a WSS RP.

$$\int_{-\infty}^{\infty} S_X(f) \cdot df = \mathbb{E}(X(t)^2) \rightarrow \text{deterministic}$$

$$\int_{-\infty}^{\infty} S_X(f)\, e^{-j2\pi f \tau} \cdot df = R_X(\tau) \rightarrow \text{deterministic.}$$

$$= \mathbb{E}\, X(t) X(t+\tau).$$

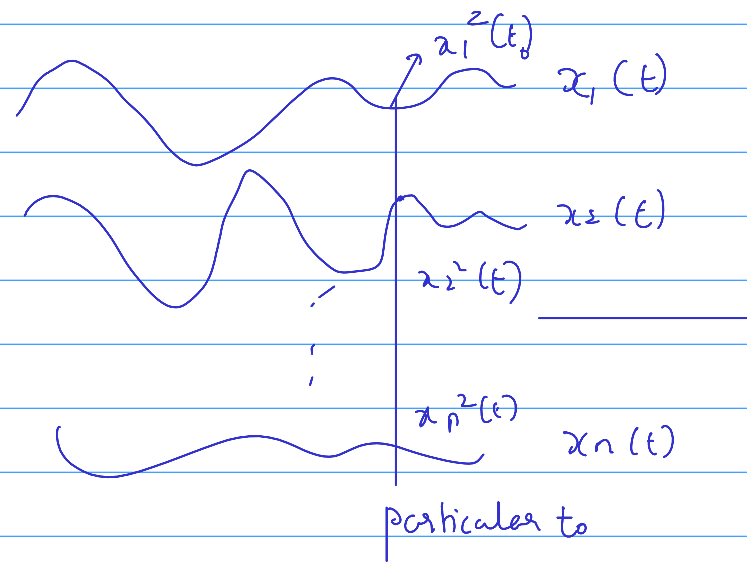
how is $\mathbb{E}\, X(t)^2$ computed?

→ $\int f_{X(t)}(x) \cdot x^2 \cdot dx$

↓ interpret $\mathbb{E}$ as averages.

$X \sim f_X(x)$ $x_1, x_2, x_3 \cdots, x_n$

$$\bar{x}_n = \left(1/n \sum_{1}^{n} x_i \right) \rightarrow \int f_X(x) \cdot x \cdot dx \;\; = \mathbb{E} X.$$

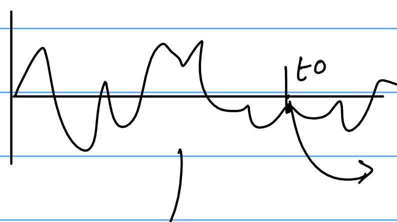


→ $\bar{x^2}(t)$ → $\mathbb{E}\, X^2(t)$

ensemble averages.

Consider receiving a signal corrupted with noise

a receiver sees a particular sample path of noise



SNR at t_0 using $\mathbb{E}\, N(t)^2$

power for this sample path (and for any sample path)

$$\lim_{T_0 \to \infty} \left(\frac{1}{T_0} \int_{-T_0/2}^{T_0/2} (N(t))^2 \cdot dt \right) = \text{Time averaged noise power}$$

For a class of random processes which are called Ergodic