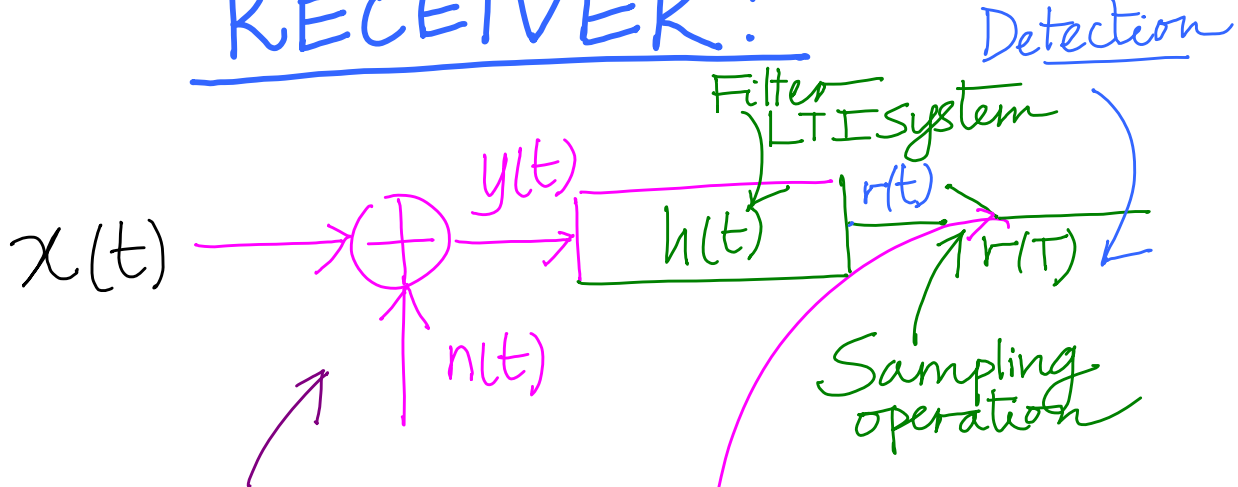
DIGITAL COMMUNICATION

RECEIVER:



SCHEMATIC OF DIGITAL COMM. RECEIVER

Sampled at T
T = Symbol Duration

$$r(t) = y(t) * h(t)$$

impulse response of LTI System or Receive Filter

$$= \int_{-\infty}^{\infty} y(t-\tau)\, h(\tau)\, d\tau$$

convolution

Substitute in expression for $r(t)$.

$$y(t) = x(t) + n(t)$$

Additive Noise channel.

$a_0 p(t) = x(t)$ For simplicity

a_0: Symbol; $p(t)$: Pulse

$$y(t) = a_0 p(t) + n(t)$$

$$r(t) = \int_{-\infty}^{\infty} \left(a_0 p(t-\tau) + n(t-\tau)\right) \times h(\tau)\,d\tau$$

Sampled at T

$$r(T) = \int_{-\infty}^{\infty} \left(a_0 p(T-\tau) + n(T-\tau)\right) \times h(\tau)\,d\tau .$$

$$= a_0 \cdot \int_{-\infty}^{\infty} p(T-\tau)\,h(\tau)\,d\tau + \int_{-\infty}^{\infty} n(T-\tau)\,h(\tau)\,d\tau$$

Signal Component — Noise Component

How to choose filter $h(\tau)$?

Design

Objectives: 1. Maximize Signal Power
2. Minimize Noise Power
= Maximize Signal to Noise power Ratio (SNR)

$$SNR = \frac{\text{Signal Power}}{\text{Noise Power}}$$

Fundamental Quantity For analysis of performance of a communication System.

Signal: $a_0 \cdot \int_{-\infty}^{\infty} p(T-\tau)\, h(\tau)\, d\tau$

Signal Power $= E\left\{ \left| a_0 \cdot \int_{-\infty}^{\infty} p(T-\tau)\, h(\tau)\, d\tau \right|^2 \right\}$

$= E\{|a_0|^2\}\, E\left\{ \left| \int_{-\infty}^{\infty} p(T-\tau)\, h(\tau)\, d\tau \right|^2 \right\}$

$= E\{a_0^2\}\, E\left\{ \left(\int_{-\infty}^{\infty} p(T-\tau)\, h(\tau)\, d\tau \right)^2 \right\}$

Symbols are random

P_d = Power of Data Symbols.

$P_d = E\{|a_0|^2\}$.

Since $p(t)$, $h(t)$ are Fixed, these are Deterministic.

$$= \frac{P_d \left(\int_{-\infty}^{\infty} p(T-\tau) \cdot h(\tau)\, d\tau \right)^2}{\text{Signal Power}}$$