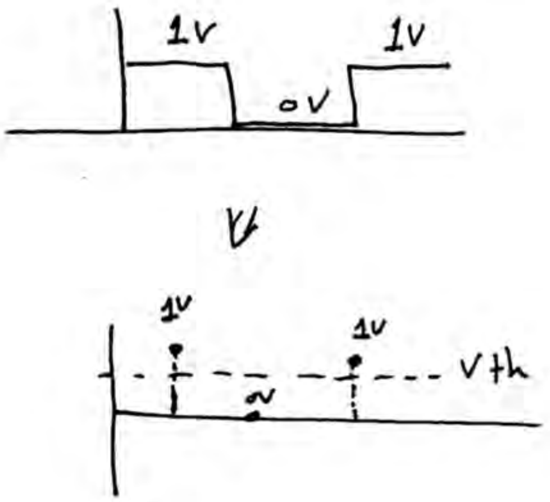
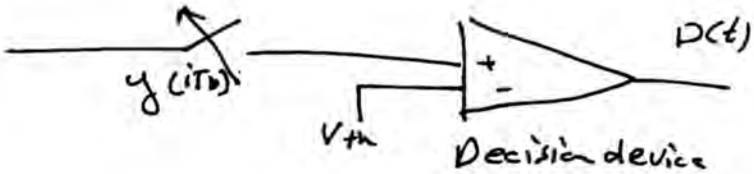
Digital Comm.

communcation II
18\2\2013
Lecture 5

Decision device :-





This operation is equivelant to multiplying the digita signal by the impulse function, the received signal D(t) is outputed by the following equation :-

$$\boxed{\begin{aligned} D(t) &= 1 \quad \text{if} \quad y(iT_b) > V_{th} \\ D(t) &= 0 \quad \text{if} \quad y(iT_b) < V_{th} \end{aligned}}$$

The Problem is to find the best choice of V_{th} such that overall net error Prob (Average error rate) of 1's and 0's is minimum. if $y(t)$ = is a unipolar signal, and the Probability of transmitted zero's is $P(0T)$ and the Probability of transmitted one's is $P(1T)$:

$$\boxed{V_{th} = \frac{\ln q + (A^2/2\sigma^2)}{A/\sigma^2}}$$

$$\boxed{P(0T) + P(1T) = 1}$$

where: $q = \dfrac{P(0T)}{P(1T)}$

σ^2 = Variance of noise.

A = Amplitude of one's

V_{th} = V threshold

if $q = 1$, $P(0T) = P(1T)$ [Practical case].

$$V_{th} = \frac{A}{2}$$

Ex: Equiprobable binary signals are represented as 0, +2 volts. For AWGN with $\sigma^2 = 0.16$ Volt^2, Find the optimum threshold setting?

sol $q = 1$

$$V_{th} = \frac{\ln(1) + (A^2/2\sigma^2)}{(A/\sigma^2)}$$

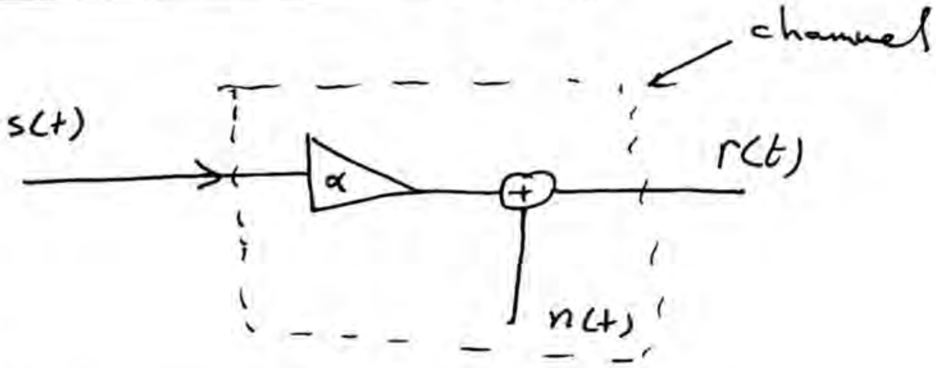
$$V_{th} = A/2 = \frac{2}{2} = 1$$

Mathematical Models of chanels :-

we are going to look at three chanel models :-

1. Additive noise channel.
2. Linear time - Variant filter chanel.
3. Linear time Variant filter chanel.

1 - Additive noise chanel :-



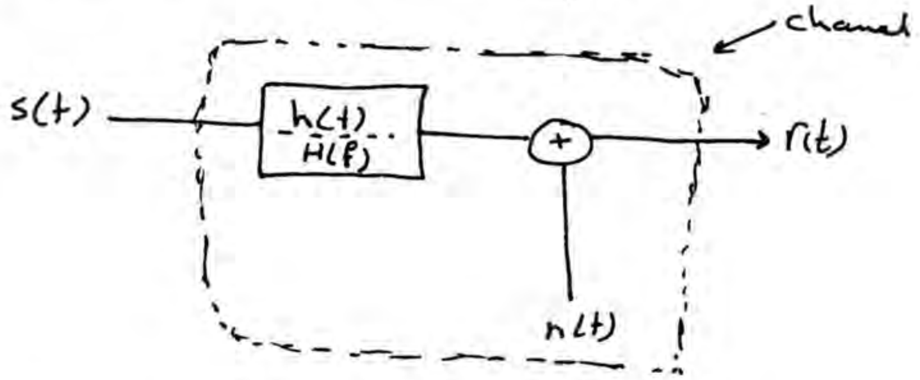
where $s(t)$ - transmitted signal
$n(t)$ - additive noise (may multiplied)
$r(t)$:- received signal
α : chanel gai

if $s(t)$ is

$$r(t) = \alpha\, s(t) + n(t)$$

$n(t)$; if $n(t)$ is gassian so it is called additive white gaussian noise.

2) linear time - invariant channel:-



$r(t) = s(t) * h(t) + n(t)$ (time)

$R(f) = S(f)\,H(f) + N(f)$ (freq)

$h(t)$: stays constant over communication Period ["$h(t)$ filter does not change with time"].

$$\boxed{s(t) * h(t) = \int_{\tau=-\infty}^{+\infty} s(t) \cdot h(t-\tau) \cdot d\tau}$$

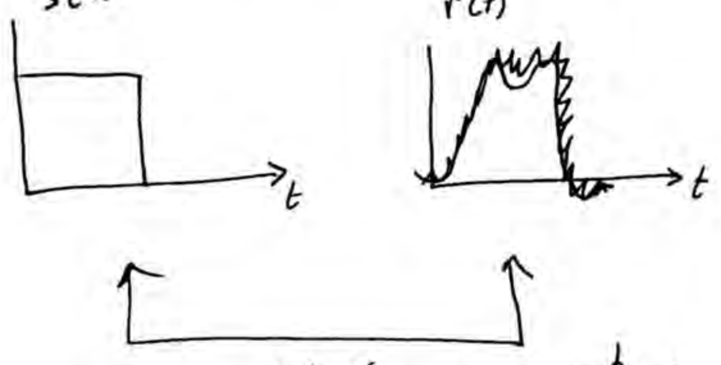
$s(t)$ is known what is transmitted

The distortion in this channel:-

(A) attenuation (can not collect the power put in).

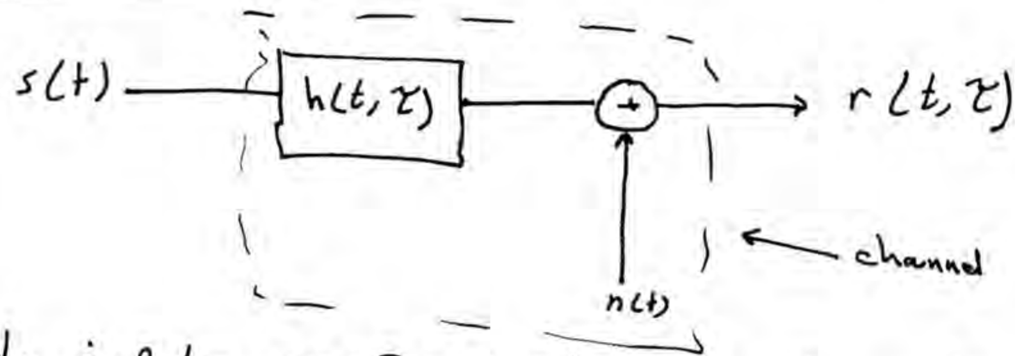
(B) addition of noise.

(C) modification of signal spectrum (mag. and phase).



Not the same shape but look the same shape (digital)

3) Linear time Variant :-



AS the impulse response change, the output will also cha-
-nge.

The impulse Response of the channel will change every τ. The Math formula is :-

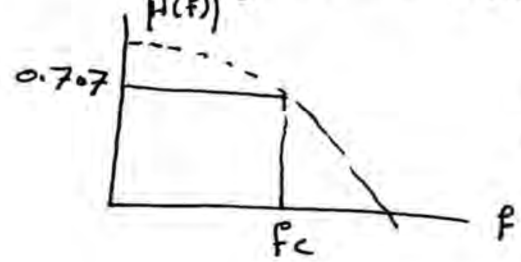
$$r(t,\tau) = s(t) * h(t,\tau) + n(t)$$

$$= \int_{\mu=-\infty}^{\infty} s(\mu)\, h(t-\mu, \tau)\, . d\mu + n(t)$$

This require convolution every time

Examples
[redacted] :-

- Linear time invariant ⟶ wire-line electrical channel.
  They behave like a L.P.F



twisted pair $f_c \approx 100$ KHZ
coaxial cable $f_c \approx 100$ MHZ

- linear time variant ⟶ wireless channel