Ditigal Transmitters and Recievers

February 14, 2018

Contents

1 Lecture 1 - History of Communication

This is mt, I have not a copy of these notes. Mainly discussed how in the last 120 years we/society has gone from using semophores to using modern fast as light coms.

2 Lecture 2 - A cont. of lecture 1

More info I don't have a copy of. . . .

3 Lecture 3

4 Lecture ?

:DATE: *<2018-02-05 Mon>*

Use correlators to match input to possible transmitted waveforms

5 Lecture ?

5.1 Transmitter

5.2 Reciever

two bits per symbol - four possible wave forms

symbol	bits	four possible waveforms
0	00	0^0
1	01	90^0
2	10	180^0
3	11	270^0

6 Lecture ?

6.1 Fourier Transfrom

- **F** {g(t)} = G(f) = $\int_{-\inf}^{\inf} g(t)e^{-j2\pi ft}$

- $\mathbf{F}^{-1}$ {G(f)} = g(t) = $\int_{-\inf}^{\inf} G(f)e^{j2\pi ft}$

6.1.1 TODO Properties: verify that 6.1.1 is correct

- Linearity
  - $\mathbf{F}\ a_1x_1(t) + a_2x_2(t)$ = a_1 $\mathbf{F}\ x_1(t)$ + a_2 $\mathbf{F}\ x_2(t)$
- Time Shift
  - $\mathbf{F}\ x(t - T_0)$ = $\int_{-\inf}^{\inf} x(t - t_0)e^{-j2\pi ft}$
    λ = t-t_0
    = $e^{-j2\pi f} \int_{-\inf}^{\inf} x(\lambda + t_0)$
    = e^{-j2_0} $\int_{-\inf}^{inf} x(\lambda)e^{-2\pi f\lambda}d\lambda$ (EQ1)
    = e^{-2j_0} X(f)
- Frequency Property
  - $\mathbf{F}^{-1}X(f - f_0) = e^{j2\pi f_0t} \int_{-\inf}^{\inf} x(t)$

6.2 TODO Graham-Schmidt: check matrix algebra book on this topic.

:DEADLINE: *<2018-02-05 Mon>*

- Signals S_1(t),...,S_m(t)
- basis functions ϕ_n(t),...,ϕ_n(t), N $\neq$ M
- $S_i(t) = \sum n = 1NS_{in}\phi_n(t)$
- $\mathbf{S_i}$ = [S_{i1} S_{i2} ... S_{in}]

6.2.1 1st signal

E_{s1} = $||S_1||^2$
$\phi_1 = \frac{S_1(t)}{\sqrt{E_{s1}}}$
$S_{11} = \sqrt{E_{s1}}$

6.2.2 2nd – Nth signal

Creating a new basis function

S_{21} = <S_2(t),ϕ_1(t)>
r_2(t) = S_2(t) - S_{21} ϕ_1(t) <– orthogonal to ϕ_1(t)
`If remainted r_i(t) = 0 skip the steps below`

- The part of signal 2 that can't be represented by ϕ_1(t).

  E_{r2} = $||r_2(t)||^2$

  $\phi_2(t) = \frac{r_2(t)}{\sqrt{E_{r2}}}$

  $S_{22} = \sqrt{E_{r2}}$

- others

  S_{ni} = <S_n(t) , ϕ_i(t)> for ϕ_i(t) which are defined.

  r_i(t) = S_i(t) - $\sum\{S_{in}\}$ ϕ_n(t)

:DATE: *<2018-02-09 Fri>*

6.3 Distortionless System

x(t) $-> ->$ y(t)

6.3.1 Acceptable

- Amplification//

$y(t) = K x(t)$//

- Delay

$y(t) = x(t - t_0)$, $t_0: positive integer, positive required for causality$//

- Overall//

$y(t) = Kx(t - t_0)$

6.4 Freq representation

$Y(f) = Ke^{-j2\pi f t_0} X(f) = H(f)X(f)$ Linear time invariant. where $H(f) = Ke^{-j2\pi f t_0}$

$h(t) = K\delta(t - t_0)$

6.5 Bode rep

$H(f) = Ke^{-j2\pi f t_0}$

$H(f) = K < -constantMag(gain)$

$\angle H(f) = -2\pi f t_0 < -linear, slope = -2\pi f$

Group Delay: $t_g(f) = \frac{-1}{2\pi}\frac{d}{df}(\angle H(f))$

6.6 Filters

- ideal

- realistic
  - Lowpass
  - Highpass
  - Bandpass
  - Bandstop

filter type	ideal	realistic
lowpass	sharp rect around center	hill flat top
highpass		
bandpass		
bandstop		

7 LEcture ? -

:DATE: *<2018-02-12 Mon>*

7.1 TODO Project

7.2 Fourier Series - Fourier Transform Relationship

7.2.1 Fourier Series

F.S. $g(t) = \sum_{-\inf}^{\inf} G_n e^{jn2ßf_0 t}$

F.T. $G(g) = *F * g(t)$ &= $\sum_{\text{- inf}}^{\text{inf}}$ $\mathrm{G_n}$ **F** {$\mathrm{e^{jn2\pi\ f_ot}}$}\$ $= \sum G_n \delta(f - f_0)$ -inf -> inf.

7.3 Energy spectral density???????????

$E_g = \int_{-\inf}^{\inf} |G(f)|^2 df$

$x(t)->h(t)->y(t)$

$X(f)->H(f)->Y(f)$

$E_y = \int_{-\inf}^{\inf} |X(f)H(f)|^2 df = \int_{f_0-f}^{f_0+|deltaf}$ **Energy Spectral Density**

$\Psi_x(f_0) = \lim_{\Delta f->0} \frac{1}{\Delta f} \int_{f_0-\frac{\Delta f}{2}}^{f_0+\frac{\Delta f}{2}} |X(f)|^2 df = |X(f_0)|^2$

Energy $E_x = \int \Psi_x(f) df$

Energy int bandwith *B centered at F_1 $\int_{-f_1-\frac{*B*}{2}}^{-f_1+\frac{*B*}{2}} \Psi_x(f) df = \int_{f_1-\frac{*B*}{2}}^{f_1+\frac{*B*}{2}} \Psi_x(f) df$

8 TODO get units for

let: \$g(t) = Π(t$\frac{}{Whatbanwidthcapacitydoweneedtopassexactly}$90

$E_g = \int |g(t)|^2 dt =$ \$g(t) -> "Ideal LPF bandwidth B" -> y(t) 90%E_g = 0.9T energy

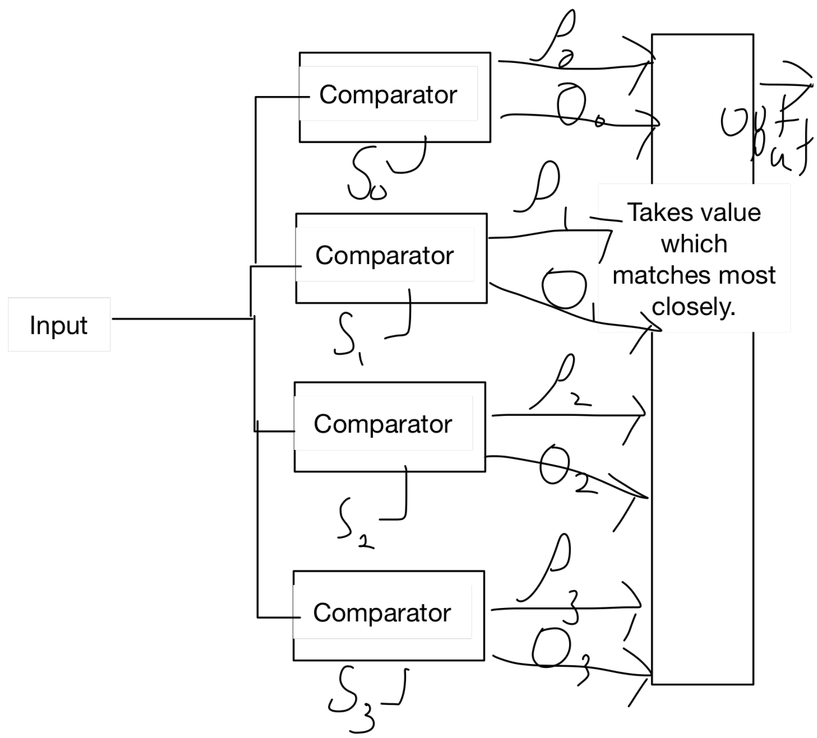

Figure 1: internals of Ditigal reciever with two-bit decode