Study Sheet

Noise: an unwanted, random fluctuation in
the signal

Shannon's Theorum
Theoretical limit for error-free transmission in a communications system in the presence of noise
Source Data Rate: R [bits/sec]

$$C = B\log_2(1 + S/N)\ [bits/sec]$$

Information Source: a system that produces messages (waveforms or signals)

• Digital/Discrete Information Source: Produces a finite set of possible messages
• Digital/Discrete Waveform: A function of time that can only have discrete values
• Digital Communication System: Transfers information from a digital source to a digital sink

Sampling Theory
Covert analog to digital
$F_s \geq 2B$

Average Normalized Power

$$P = \langle w^2(t) \rangle = lim_{T\to\infty}\frac{1}{T}\int_{-\frac{T}{2}}^{\frac{T}{2}} w^2(t)dt$$

$$P_{PEP} = \frac{A_C^2}{2}\{1 + \max[m(t)]\}^2$$

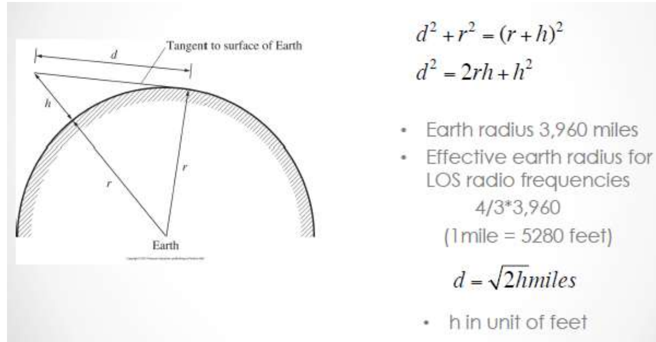
$$w(t) = Asin(2\pi f_0 t) \to W(f) = \frac{A}{2}[\delta(f + f_0) + \delta(f - f_0)]$$

$$w(t) = Acos(2\pi f_0 t) \to W(f) = \frac{A}{2}[\delta(f - f_0) + \delta(f + f_0)]$$

$$w(t) = \prod\left(\frac{t}{T}\right) = \{ \begin{matrix} 1\,, |t| \leq \frac{T}{2} \\ 0, |t| > \frac{T}{2} \end{matrix}$$

DSBSC Signal
$s(t) = A_c m(t) cos\ \omega_c t$
Spectrum
$$S(f) = \frac{Ac}{2}[M(f - f_c) + M(f + f_c)]$$
the percentage of modulation on a DSB-SC signal is infinite. Furthermore, the modulation efficiency of a DSB-SC signal is 100%, since no power is wasted in a discrete carrier.

An upper single sideband (**USSB**) signal has a zero-valued spectrum for $|f| < f_c$, where fc is the carrier frequency.



Entropy

$$H = \sum_{J=1}^{M} P\,I_j = \sum_{j=1}^{m} P_j \log_2\left(\frac{1}{P_j}\right)\ bits$$

m is the number of possible different source messages and Pj is the probability of transmitting the jth message Digital source, m is finite

Convolution

$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau)g(t-\tau)\,d\tau$$
$$= \int_{-\infty}^{\infty} f(t-\tau)g(\tau)\,d\tau.$$

Convolution Property ($\omega(t) = \sin(2\pi f_1 t)\cos(2\pi f_2 t)$
$\frac{1}{4j}[\delta(f - f_1 - f_2) + \delta(f - f_1 + f_2) -$

% positive modulation = $\frac{Amax - Ac}{Ac} * 100 = \max[m(t)] * 100$

% negative modulation = $\frac{Ac - Amin}{Ac} * 100 = -\min[m(t)] * 100$

% modulation = $\frac{Amax - Amin}{2Ac} * 100 = \frac{max\,[m(t)] - min\,[m(t)]}{2} * 100$

$$\langle s^2(t) \rangle = \underbrace{\tfrac{1}{2}A_c^2}_{\text{discrete carrier power}} + \underbrace{\tfrac{1}{2}A_c^2\langle m^2(t)\rangle}_{\text{sideband power}}$$

the sideband power of a DSB-SC signal is four times that of a comparable AM signal with the same peak level. In this sense, the DSB-SC signal has a fourfold power advantage over that of an AM signal.

A lower single sideband (**LSSB**) signal has a zero-valued spectrum for $|f| > f_c$, where fc is the carrier frequency.