11-7-2018 Modulation Techniques

Bandwidth of Base Band Signal

CMPE245 Embedded Wireless. Nov.7.2018.

Homework: RF(LORA) Board to the class (Show & Tell).

1pt Nov.11 (Monday). SCH, Block Diagram, Connectivity Table;

Today's Topics: Modulation Technique.

Ref: github/hualili; → Base Band Signal Last 2 Slides.

① ASK, FSK, PSK Waveforms In Time Domain. ②

Properties for Signals & their Frequency Char. e.g. Fourier Transform.

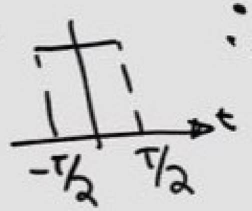
Property 1: $\boxed{g_T(t) \longleftrightarrow AT\frac{\sin \pi f T}{\pi f T}}$ ...(1)

(Gate Function)

find 9600 bps Base Band Signal's B.W? $T_b = \frac{1}{9600}$, $B.W = 2/T$

↑ A Single bit (9600 bps)

Example:



∴ B.W = 9600×2 Hz.

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Sampling Technique and Formulation

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Property 2: If $g(t) \leftrightarrow G(f)$ and $h(t) \leftrightarrow H(f)$

then

$$g(t)h(t) \leftrightarrow G(f) * H(f) \quad \dots (2)$$

Property 3: If $g(t) \leftrightarrow G(f)$, and $h(t) \leftrightarrow H(f)$

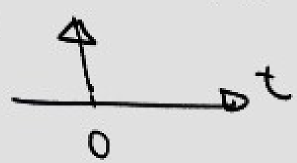
then

$$g(t) * h(t) \leftrightarrow G(f)H(f) \quad \dots (3)$$

Property 4: Sampling Property (Based ON Eqn (2))

First, Define

$$\delta(t) = \begin{cases} +\infty & t = 0 \\ 0 & o/w \end{cases} \quad \dots (4)$$



$$\int_{-\infty}^{+\infty} \delta(t)\,dt = \int_{-\infty}^{-\Delta} \delta(t)\,dt + \lim_{\Delta \to 0} \int_{-\Delta}^{+\Delta} \delta(t)\,dt + \int_{+\Delta}^{+\infty} \delta(t)\,dt = 0 + 1 + 0 \quad \dots (5)$$

then

$$g(t)h(t)\Big|_{h(t)=\delta(t)} = g(t)\delta(t) \rightarrow \int_{-\infty}^{+\infty} g(t)\delta(t)\,dt = \int_{-\infty}^{-\Delta} \cdot \;(\phi) + \int_{-\Delta}^{+\Delta} + \int_{+\Delta}^{+\infty} (\phi) = g(0)$$

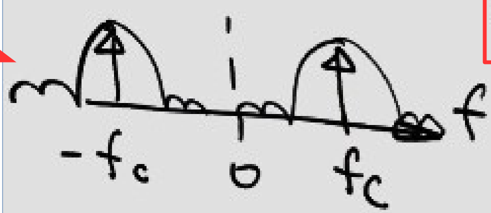
11-7-2018 Spectrum After Modulation

NonLinear.

Since Eqn(2), we have $G(f) = A\tau \frac{\sin \pi f\tau}{\pi f\tau}$

$$H(f) = FT[h(t)] \Big|_{h(t) = A_c \cos 2\pi f_c t} = \frac{A}{2}\left[\delta(f - f_c) + \delta(f + f_c)\right]$$

Spectrum after modulation



$$G(f) * H(f) = A_g\tau \frac{\sin \pi f\tau}{\pi f\tau} * \frac{A_c}{2}\left[\delta(f - f_c) + \delta(f + f_c)\right]$$

$$= A_g\tau \frac{\sin \pi f\tau}{\pi f\tau} \cdot \frac{A_c}{2}\delta(f - f_c) + A_g\tau \frac{\sin \pi f}{\pi f\tau} \cdot \frac{A_c}{2}\delta(f + f_c)$$

$$= A_g\tau \frac{\sin \pi (f - f_c)\tau}{\pi (f - f_c)\tau} \cdot \frac{A_c}{2} + A_g\tau \frac{\sin \pi (f + f_c)}{\pi (f + f_c)} \cdot \frac{A_c}{2}$$