EEE 360 Communications Systems I

Lecture Presentation 16

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☞ Evaluation of Power: *Section 4.4*

The total average normalized power of a bandpass waveform $v(t)$ is

$$P_v = \langle v^2(t) \rangle = \int_{-\infty}^{\infty} \mathcal{P}_v(f) df = R_v(0) = \frac{1}{2} \langle |g(t)|^2 \rangle \tag{1}$$

The Peak envelope power (PEP) is the average power that would be obtained if $|g(t)|$ were to be held constant at its peak value.

$$P_v = \frac{1}{2} [\max |g(t)|^2] \tag{2}$$

******* Look at example 4.1 ******

☞ Evaluation of the magnitude spectrum of an amplitude-modulated (AM) signal

The complex envelope is given by

$$g(t) = A_c[1 + m(t)] \tag{3}$$

The spectrum of the complex envelope is

$$G(f) = A_c[\delta(f) + M(f)] \tag{4}$$

The AM waveform

$$s(t) = A_c[1 + m(t)] \cos\ \omega_c(t) \tag{5}$$

AM waveform spectrum are given by

$$S(f) = \frac{1}{2}A_c[\delta(f - f_c) + M(f - f_c) + \delta(f + f_c) + M(f + f_c)] \tag{6}$$

The total average signal power is given by

$$P_s = \frac{1}{2}A_c^2\langle|1 + m(t)|^2\rangle = \frac{1}{2}A_c^2[1 + 2\langle m(t)\rangle + \langle m^2(t)\rangle] \tag{7}$$

where

- $\langle m(t)\rangle$ is the d.c power
- $P_m = \langle m^2(t)\rangle$ is the power in the modulation $m(t)$
- $\frac{1}{2}A_c^2$ is the carrier power
- $\frac{1}{2}A_c^2 P_m$ is the power in the sidebands of $s(t)$.