Principles of Communications

ECS 332

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4.2 Energy and Power

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Review: Energy and Power

- Consider a signal $g(t)$.
- Total (normalized) **energy**:

Parseval's Theorem [2.43]

[Defn. 4.13]
$$E_g = \int_{-\infty}^{\infty} |g(t)|^2 dt = \lim_{T\to\infty} \int_{-T}^{T} |g(t)|^2 dt = \int_{-\infty}^{\infty} |G(f)|^2 df.$$

- Average (normalized) **power**:

[Defn. 4.15]
$$P_g = \left\langle |g(t)|^2 \right\rangle = \lim_{T\to\infty} \frac{1}{T} \int_{-T/2}^{T/2} |g(t)|^2 dt = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} |g(t)|^2 dt.$$

time-average operator
[Defn. 4.16a]

Power Calculation: Special Cases

	$g(t)$	$P_g = \langle \lvert g(t) \rvert^2 \rangle$
Linear combination of complex exponential functions [4.23]	$\sum_k c_k e^{j2\pi f_k t}$ where the f_k are distinct	$\sum_k \lvert c_k \rvert^2$
Linear combination of sinusoids [4.28]	$\sum_k A_k \cos(2\pi f_k t + \phi_k)$ where the f_k are positive and distinct	$\frac{1}{2}\sum_k \lvert A_k \rvert^2$