6.003: Signals and Systems

CT Fourier Transform

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CT Fourier Transform

Representing signals by their frequency content.

$$X(j\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt \qquad \text{("analysis" equation)}$$

$$x(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(j\omega) e^{j\omega t} d\omega \qquad \text{("synthesis" equation)}$$

- generalizes Fourier series to represent aperiodic signals.
- equals Laplace transform $X(s)|_{s=j\omega}$ if ROC includes $j\omega$ axis.
  $\rightarrow$ inherits properties of Laplace transform.
- complex-valued function of **real** domain ω.
- simple "inverse" relation
  $\rightarrow$ more general than table-lookup method for inverse Laplace.
  $\rightarrow$ "duality."
- **filtering**.
- **applications in physics**.

Filtering

Notion of a filter.

LTI systems

- cannot create new frequencies.
- can only scale magnitudes and shift phases of existing components.

Example: Low-Pass Filtering with an RC circuit