Decibels

Comparison of power and reference power: $P_{dB} = 10log_{10}\frac{P}{P_r}$

Comparison of 2 amplitudes of rms values: $P_{dB} = 10log_{10}(\frac{A}{A_r})^2 = 20log_{10}\frac{A}{A_r}$

Signal energy and power

Instantaneous power: $P(t) = x^2(t)$

Energy: $E = \int_0^T x^2(t)dt$

Average power: $P = \frac{1}{T}\int_0^T x^2(t)dt$

Periodic signals

$\forall x(t+T) = x(t)$ $T > 0$ is a period

Fourier Transform

$$X(f) = F[x(t)] = \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt$$

Inverse Fourier Transform

$$x(t) = F^{-1}[X(f)] = \int_{-\infty}^{\infty} X(f)e^{j2\pi ft}df$$

Shift theorem

$$F[x(t-t_0)] = e^{-2\pi ft_0}X(f)$$

Inv Fourier Transform Calculation

$X(f) = rect_{2B}(f)$

$$x(t) = F^{-1}[X(f)] = \int_{-\infty}^{\infty} X(f)e^{j2\pi ft}df = 2B\frac{sin(2\pi Bt)}{2\pi Bt}$$

Z transform

A series of samples {xn}, ideal sampling: $x_s(t) = \sum_n x_n\delta(t-nT)$

$$X_s(f) = \sum x_n F[\delta(t-nT)] = \sum x_n e^{-j2\pi fnT}$$

substitute $z = e^{j2\pi fT}$

f	z
0	1
$\frac{1}{4T}$	j
$\frac{1}{2T}$	-1
$\frac{3}{4T}$	-j
$\frac{1}{T}$	1

Z Transform: $X(z) = Z[\{x_n\}] = \sum_n x_n z^{-n}$ defined for any complex variable z.

Properties

$Z[\{ax_n + by_n\}] = aX(z) + bY(z)$

$Z[\{x_{n+k}\}] = z^k X(z)$

$F[x(t) * y(t)] = F[x(t)]F[y(t)] = X(f)Y(f)$ $F^{-1}[x(t)y(t)] = X(f) * Y(f)$