Discrete-Time Fourier Transform Properties

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Abstract

Gives various Fourier transform properties

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	Sequence Domain	**Frequency Domain**
Linearity	$a_1 s_1(n) + a_2 s_2(n)$	$a_1 S_1\left(e^{i2\pi f}\right) + a_2 S_2\left(e^{i2\pi f}\right)$
Conjugate Symmetry	$s(n)$ real	$S\left(e^{i2\pi f}\right) = \overline{S\left(e^{-(i2\pi f)}\right)}$
Even Symmetry	$s(n) = s(-n)$	$S\left(e^{i2\pi f}\right) = S\left(e^{-(i2\pi f)}\right)$
Odd Symmetry	$s(n) = -(s(-n))$	$S\left(e^{i2\pi f}\right) = -\left(S\left(e^{-(i2\pi f)}\right)\right)$
Time Delay	$s(n - n_0)$	$e^{-(i2\pi f n_0)} S\left(e^{i2\pi f}\right)$
Complex Modulation	$e^{i2\pi f_0 n} s(n)$	$S\left(e^{i2\pi(f-f_0)}\right)$
Amplitude Modulation	$s(n)\cos(2\pi f_0 n)$	$\frac{S\left(e^{i2\pi(f-f_0)}\right)+S\left(e^{i2\pi(f+f_0)}\right)}{2}$
	$s(n)\sin(2\pi f_0 n)$	$\frac{S\left(e^{i2\pi(f-f_0)}\right)-S\left(e^{i2\pi(f+f_0)}\right)}{2i}$
Multiplication by n	$ns(n)$	$\frac{1}{-(2i\pi)}\frac{d}{df}\left(S\left(e^{i2\pi f}\right)\right)$
Sum	$\sum_{n=-\infty}^{\infty}(s(n))$	$S\left(e^{i2\pi 0}\right)$
Value at Origin	$s(0)$	$\int_{-\left(\frac{1}{2}\right)}^{\frac{1}{2}} S\left(e^{i2\pi f}\right) df$
Parseval's Theorem	$\sum_{n=-\infty}^{\infty}\left((\lvert s(n)\rvert)^2\right)$	$\int_{-\left(\frac{1}{2}\right)}^{\frac{1}{2}} \left(\lvert S\left(e^{i2\pi f}\right)\rvert\right)^2 df$

Figure 1: Discrete-time Fourier transform properties and relations.