Fourier Series 'Properties

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Properties of the FT

Property	Given FT pair : $x(t) \leftrightarrow X(j\omega)$	Remarks
Linearity	$\sum_k a_k x_k(t) \longleftrightarrow \sum_k a_k X_k(j\omega)$	
Time shift	$x(t-\tau) \longleftrightarrow X(j\omega)e^{-j\omega\tau}$	
Time scaling	$x(at) \longleftrightarrow \frac{1}{\lvert a\rvert} X\left(\frac{j\omega}{a}\right)$	$a \neq 0$ real
Frequency shift	$x(t)e^{j\omega_0 t} \longleftrightarrow X(j(\omega-\omega_0))$	ω_0 real
Derivative in time $\frac{d}{dt}$	$\frac{dx(t)}{dt} \longleftrightarrow j\omega X(j\omega)$	
Conjugate symmetry	$x^*(t) \longleftrightarrow X^*(-j\omega)$	
Derivative in frequency	$t x(t) \longleftrightarrow j\frac{dX(j\omega)}{d\omega}$	
Convolution in time	$x(t) * y(t) \longleftrightarrow X(j\omega)Y(j\omega)$	卷积
Duality	$X(jt) \longleftrightarrow 2\pi x(-\omega)$	
Multiplication in time	$x(t)y(t) \longleftrightarrow \frac{1}{2\pi} X(j\omega) * Y(j\omega)$	
Intergation in time	$\int_{-\infty}^{t} x(\tau)d\tau \longleftrightarrow \frac{1}{j\omega}X(j\omega) + \pi X(j0)\delta(\omega)$	
Parseval Theorem	$\int_{-\infty}^{+\infty} x(t)y(t)dt = \frac{1}{2\pi}\int_{-\infty}^{+\infty} X(j\xi)Y(j\xi)d\xi$	

$$x[n-n_0] \leftrightarrow X(e^{j\Omega})e^{-j\Omega n_0}$$

$$e^{j\Omega_0 n}x[n] \leftrightarrow X(e^{j(\Omega-\Omega_0)})$$

$$-jnx[n] \leftrightarrow \frac{dX(e^{j\Omega})}{d\Omega}$$

$$x[-n] \leftrightarrow X(e^{-j\Omega})$$

$$x[n] * y[n] \leftrightarrow X(e^{j\Omega})Y(e^{j\Omega})$$

$$x[n]y[n] \leftrightarrow \frac{1}{2\pi}\int_{-\pi}^{\pi} X(e^{j\xi})Y(e^{j(\Omega-\xi)})d\xi$$

$$x^*[n] \leftrightarrow X^*(e^{-j\Omega})$$