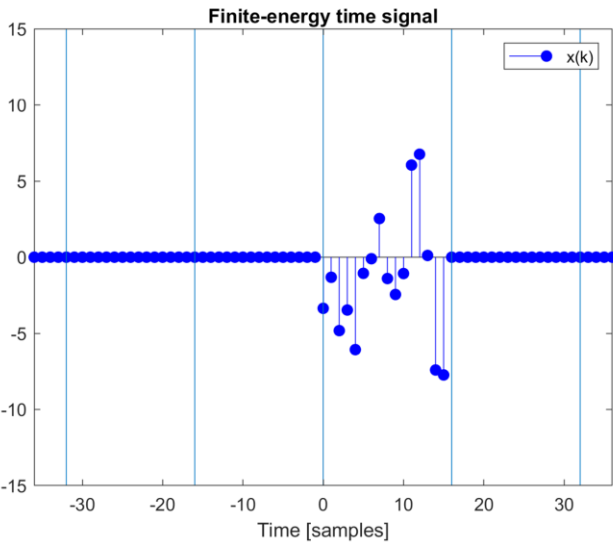


Nonperiodic Time Domain Signal

$$x[n] = \int_0^1 \hat{x}(\theta)e^{2\pi in\theta} d\theta$$

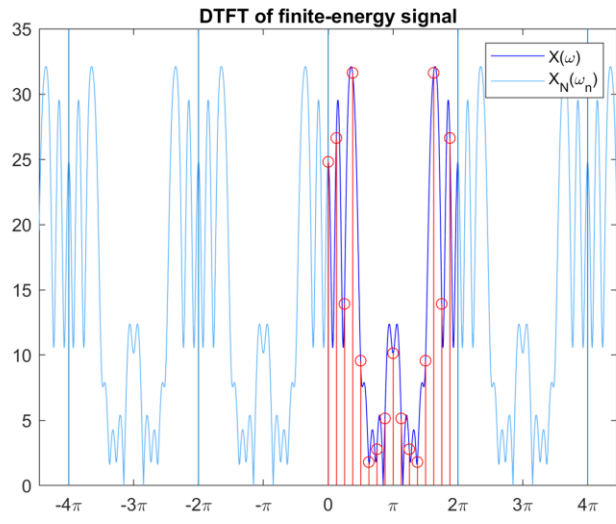
$$x(k) = \frac{1}{2\pi} \int_{-\pi}^{\pi} X(e^{j\omega})e^{j\omega k} d\omega$$



Discrete Time Fourier Transform (DTFT)

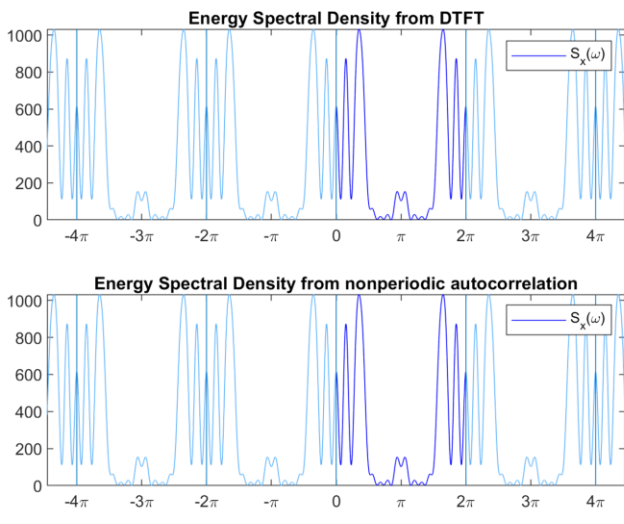
$$\hat{x}(\theta) = \sum_{n=-\infty}^{\infty} x[n]e^{-2\pi in\theta}$$

$$X(\omega) = \sum_{k=-\infty}^{\infty} x(k)e^{-j\omega k}$$



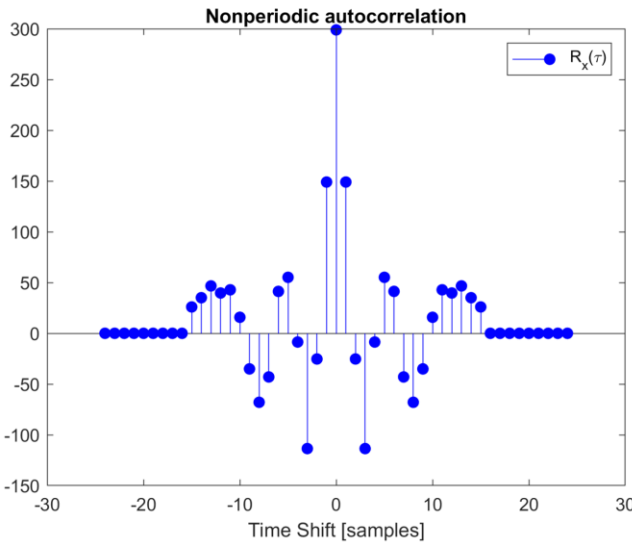
Energy Spectral Density

$$S_x(\omega) = |X(\omega)|^2 = \sum_{\tau=-\infty}^{\infty} R_x(\tau)e^{-j\omega\tau}$$



Nonperiodic Autocorrelation

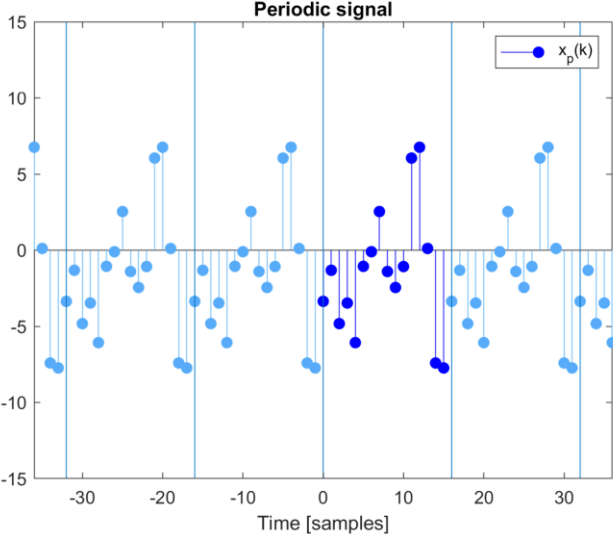
$$R_x(\tau) = \sum_{k=-\infty}^{\infty} x(k)x(k - \tau)$$



Periodic Time Domain Signal

$$x[n] = \frac{1}{N} \sum_{k=0}^{N-1} \hat{x}[k]e^{2\pi in\frac{k}{N}}$$

$$x(k) = \frac{1}{N} \sum_{n=0}^{N-1} X_N(\omega_n)e^{j\omega_n k}, \quad \omega_n = 2\pi \frac{n}{N}$$



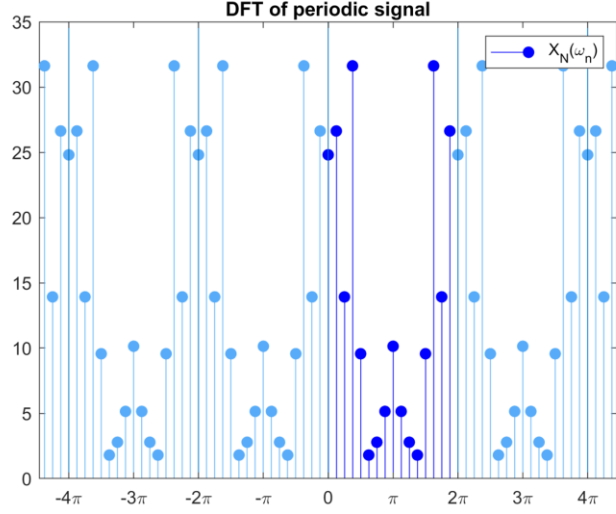
Discrete Fourier Transform (DFT)

$$\hat{x}[k] = \sum_{n=0}^{N-1} x[n]e^{-2\pi ik\frac{n}{N}}$$

$k \in \{0, \dots, N - 1\}$

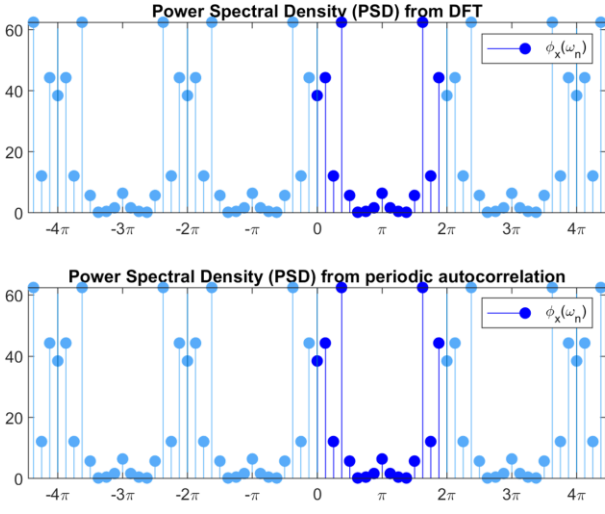
$$X_N(\omega_n) = \sum_{k=0}^{N-1} x(k)e^{-j\omega_n k}, \quad \omega_n = 2\pi \frac{n}{N}$$

$\omega_n \in \left\{0, \dots, 2\pi \left(1 - \frac{1}{N}\right)\right\}$



Power Spectral Density (PSD)

$$\phi_x(\omega_n) = \frac{1}{N} |X_N(\omega_n)|^2 = \sum_{\tau=0}^{N-1} R_x(\tau)e^{-j\omega_n \tau}$$



Periodic Autocorrelation

$$R_x(\tau) = \frac{1}{N} \sum_{k=0}^{N-1} x(k)x(k - \tau)$$

