

DT Pulse Function Pairs (1B)

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Fourier Transform Types

Discrete Time Fourier Series

DTFS

$$X[k] = \frac{1}{N} \sum_{n=0}^{N-1} x[n] e^{-j(2\pi/N)kn} \iff x[n] = \sum_{k=0}^{N-1} X[k] e^{+j(2\pi/N)kn}$$

Discrete Fourier Transform

DFT

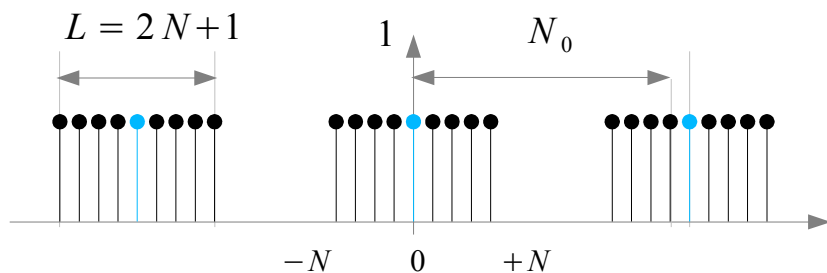
$$X[k] = \sum_{n=0}^{N-1} x[n] e^{-j(2\pi/N)kn} \iff x[n] = \frac{1}{N} \sum_{k=0}^{N-1} X[k] e^{+j(2\pi/N)kn}$$

Discrete Time Fourier Transform

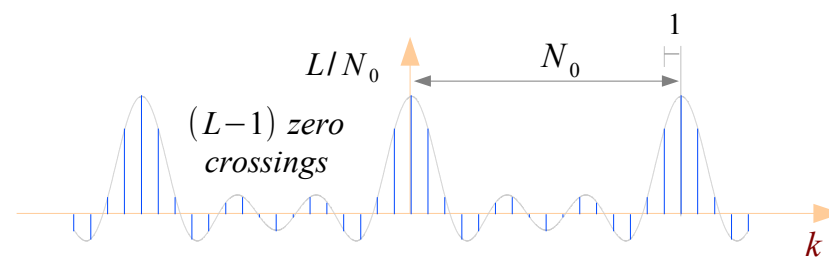
DTFT

$$X(e^{j\hat{\omega}}) = \sum_{n=-\infty}^{+\infty} x[n] e^{-j\hat{\omega}n} \iff x[n] = \frac{1}{2\pi} \int_{-\pi}^{+\pi} X(e^{j\hat{\omega}}) e^{+j\hat{\omega}n}$$

DTFS and DTFT

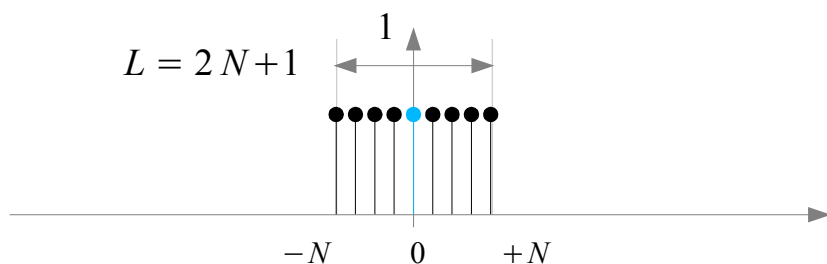


DTFS (Discrete Time Fourier Series)

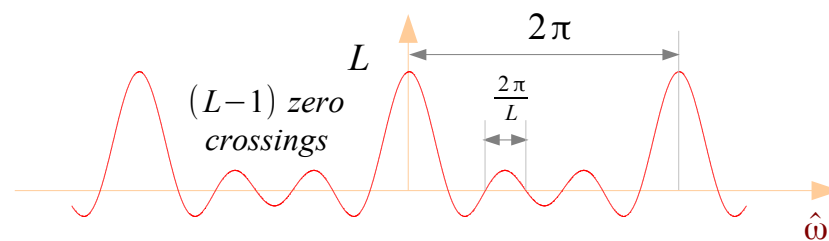


$$X[k] = \frac{1}{N_0} \frac{\sin(\pi L k / N_0)}{\sin(\pi k / N_0)}$$

$$= \frac{L}{N_0} \cdot \text{drcl}(k / N_0, L)$$



DTFT (Discrete Time Fourier Transform)



$$X(e^{j\hat{\omega}}) = \frac{\sin(\hat{\omega} L / 2)}{\sin(\hat{\omega} / 2)} = L D_L(e^{j\hat{\omega}})$$

$$= L \cdot \text{diric}(\hat{\omega}, L)$$

References

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- [5] M. J. Roberts, Fundamentals of Signals and Systems