DISTRETE FOURIER TRANSFORM

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DFT PRESENTATION 1

Using Harman Chapter 11

$$F_k = F\left(\frac{k}{NT_s}\right) = \sum_{n=0}^{N-1} f(nT_s)e^{-i2\pi nk/N} \qquad (11.5)$$

Definition of DFT and IDFT Assume that a function $f(t)$ is defined at a set of N points, $f(nT_s)$ for $n = 0, \ldots, N-1$ values, as shown in Figure 11.3. The DFT yields the frequency spectrum at N points by the formula

$$F_k = F\left(\frac{k}{NT_s}\right) = \sum_{n=0}^{N-1} f(nT_s)e^{-i2\pi nk/N} \tag{11.5}$$

for $k = 0, \ldots, N-1$. Thus, N sample points of the signal in time lead to N frequency components in the discrete spectrum spaced at intervals $f_s = 1/(NT_s)$. The Inverse DFT (IDFT) is defined as

$$f_n = f(nT_s) = \frac{1}{N}\sum_{k=0}^{N-1} F\left(\frac{k}{NT_s}\right)e^{i2\pi nk/N} \tag{11.6}$$

for $n = 0, \ldots, N-1$. The IDFT is used to re-create the signal from its spectrum.

LECTURE OBJECTIVES

- **D**iscrete **F**ourier **T**ransform

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

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

- DFT from DTFT by **frequency sampling**
- DFT computation (FFT)
- DFT pairs and properties
  - Periodicity in DFT (time & frequency)

DIFFERENCES TLH AND DSPF

$$F_k = F\left(\frac{k}{NT_s}\right) = \sum_{n=0}^{N-1} f(nT_s)e^{-i2\pi nk/N} \qquad (11.5)$$

Ts is the time between samples **S = 1/Ts samples/sec**

Thus, Fk values are frequencies and f values are given at a specific time nTs

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

Here n and k are indices –

NO relation to physical time of frequency

GO OVER :

WEBSITE MATERIAL

- HARMAN CHAPTER 11
- WEB VIDEOS FOR DSP

DFT_FFT_TLH

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DFT&Applications

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