EXPERIMENT: DISCRETE FOURIER TRANSFORM

OBJECTIVE: To understand the concept of Discrete Fourier transform (DFT) and find the transforms of finite length sequences using Scilab.

PRE-SESSION WORK: Fourier transform gives a frequency domain representation of a time domain signal. However, the obtained spectrum is continuous function of frequency and not convenient for computation. So, we consider the representation of the time domain signal by the samples of its frequency domain representation. Such a frequency domain representation leads to Discrete Fourier Transform (DFT).

The equation for calculating DFT of a finite length sequence x(n) of length L is given by

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{\left(-\frac{j2\pi nk}{N}\right)}$$ Where N>=L

Pre Session Quiz:

1. Properties of DFT

x(n) <---------->X(k)

x*(n)←---------->?

a. X*(k)

b. X(N-k)

c. X*(N-k)

d. X(1/k)

2. DFT is made computationally efficient by

a. Discrete time Fourier transform

b. Fast Fourier transform

c. Z transform

d. Laplace transform

3. For a real sequence x(n),

a. X(k) = X(N-k)

b. X(k) = X(-k)

c. X(k) = X*(-k)

d. X(k) = X*(N-k)

POST SESSION WORK:

1. Find the Discrete Fourier Transform for the following signals and plot the output in the graphic window.

    a. sine wave

    b. square wave

Observe the difference in the output.

2. Find the Fourier transform of a sinc signal. Plot the output and relate it with the duality property of Fourier transform.