ECE 431 S

ASSIGNMENT (D. Hatzinakos)

Problem Assignment on DFT

1) Compute the DFT of each of the following finite length sequences considered to be of length N.

   a) $x(n) = \delta(n)$
   b) $x(n) = \delta(n-n_o)$, $0 < n_o < N$
   c) $x(n) = a^n$, $0 \le n \le N-1$

2) Analog data are sampled at 10 kHz and the DFT of 1024 samples computed. Determine the frequency spacing between spectral samples.
Justify your answer.

3) Let X(k) denote the N-point DFT of an N-point sequence x(n). X(k) itself is an N-point sequence. If the DFT of X(k) is computed to obtain a sequence $x_1(n)$, determine $x_1(n)$ in terms of x(n).

4) Let $X(\omega)$ be the DTFT of the sequence $x(n) = (1/2)^n u(n)$

Let $y(n) \neq 0$, $n = 0,1,\ldots, 9$ otherwise equal to zero. The 10-point DFT of y(n), denoted by Y(k), corresponds to 10 equally spaced samples of $X(\omega)$, *i.e.*, $Y(k) = X\left(\omega = \frac{2\pi k}{10}\right)$

Determine y(n).

5) Consider a finite duration sequence x(n) of length N so that $x(n) = 0$ for $n < 0$ and $n > N-1$. We want to compute samples of its DTFT $X(\omega)$ at M equally spaced points in the range $0 \le \omega \le 2\pi$ One of the samples is to be at $\omega = 0$. The number of samples M is less than the duration of the sequence N; i.e., M<N. Determine and justify a procedure for obtaining the M samples of $X(\omega)$ by computing only once the M-point DFT of an M-point sequence obtained from x(n).

6) Consider two finite duration sequences x(n) and y(n) where both are zero for $n < 0$ and

$$x(n) = 0 \qquad n \ge 8$$
$$y(n) = 0 \qquad n \ge 20$$

The 20 point DFTs of each of the sequences are multiplied and the inverse 20 point DFT is computed. Let r(n) denote the inverse DFT. Specify which points in r(n) correspond to points that would be obtained in a linear convolution of x(n) and y(n)