

EE 110B - Signals and Systems

Spring 2017

Lab 3

Compute, plot, and discuss the discrete-time Fourier transform (DTFT)

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

of each of the following sequences. For each $X(e^{j\omega})$, plot the amplitude spectrum:

$$|X(e^{j\omega})| \text{ versus } \omega,$$

and the phase spectrum:

$$\angle X(e^{j\omega}) \text{ versus } \omega,$$

for $-\pi \leq \omega \leq \pi$. You will need to discretize ω . Try discretizing at increasing precision until you do not see a noticeable difference in the plot. For example, evaluating $X(e^{j\omega})$ only at $\omega = -\pi, -\frac{\pi}{2}, 0, \frac{\pi}{2}, \pi$ will probably not be sufficient, and evaluating $X(e^{j\omega})$ at all integer multiples of 0.001 will probably be too much.

Also, it is fine to truncate the summation in DTFT and set the lower and upper limits to -100 and 100, respectively.

Here are the sequences:

- (a) $x_1[n] = 0.9^n \cos\left(\frac{\pi}{5}n\right)u[n];$
- (b) $x_2[n] = 0.9^n \cos\left(\frac{\pi}{5}n\right)u[n] + j0.9^n \sin\left(\frac{\pi}{5}n\right)u[n]$
- (c) $x_3[n] = 0.9^n \cos\left(\frac{\pi}{5}n\right)u[n] + j0.7^n \sin\left(\frac{\pi}{5}n\right)u[n]$
- (d) $x_4[n] = 0.9^n \cos\left(\frac{\pi}{5}n\right)u[n] + j0.7^n \sin\left(\frac{\pi}{7}n\right)u[n]$
- (e) $x_5[n] = x_4[n-2]$
- (f) $x_6[n] = x_4[-n]$
- (g) $x_7[n] = x_4[n]\exp(j2\pi 0.1n)$
- (h) $x_8[n] = x_1[n] * x_4[n]$
- (i) $x_9[n] = x_1[n]x_4[n]$