Processamento Digital de Sinais
Prof. Carlos Speranza

Lista de exercícios 1C – Sinais e sistemas digitais (DTFT)

P3.3 Determine analytically the DTFT of each of the following sequences. Plot the magnitude and angle of $X(e^{j\omega})$ over $0 \le \omega \le \pi$.

1. $x(n) = 2\,(0.5)^n\, u(n+2)$.
2. $x(n) = (0.6)^{|n|}\,[u(n+10) - u(n-11)]$.
3. $x(n) = n\,(0.9)^n\, u(n+3)$.
4. $x(n) = (n+3)\,(0.8)^{n-1}\, u(n-2)$.
5. $x(n) = 4\,(-0.7)^n \cos(0.25\pi n) u(n)$.

P3.11 For each of the linear, shift-invariant systems described by the impulse response, determine the frequency response function $H(e^{j\omega})$. Plot the magnitude response $|H(e^{j\omega})|$ and the phase response $\angle H(e^{j\omega})$ over the interval $[-\pi, \pi]$.

1. $h(n) = (0.9)^{|n|}$
2. $h(n) = \text{sinc}(0.2n)[u(n+20) - u(n-20)]$, where $\text{sinc}\,0 = 1$.
3. $h(n) = \text{sinc}(0.2n)[u(n) - u(n-40)]$
4. $h(n) = [(0.5)^n + (0.4)^n]u(n)$
5. $h(n) = (0.5)^{|n|} \cos(0.1\pi n)$

P3.13 Let $x(n) = 3\cos\left(0.5\pi n + 60^\circ\right) + 2\sin\left(0.3\pi n\right)$ be the input to each of the systems described in Problem P3.11. In each case, determine the output sequence $y(n)$.

P3.18 A linear, shift-invariant system is described by the difference equation

$$y(n) = \sum_{m=0}^{3} x\left(n - 2m\right) - \sum_{\ell=1}^{3} (0.81)^{\ell}\, y\left(n - 2\ell\right)$$

Determine the steady-state response of the system to the following inputs:

1. $x(n) = 5 + 10\,(-1)^n$
2. $x(n) = 1 + \cos\left(0.5\pi n + \pi/2\right)$
3. $x(n) = 2\sin\left(\pi n/4\right) + 3\cos\left(3\pi n/4\right)$
4. $x(n) = \sum_{k=0}^{5} (k+1)\cos\left(\pi k n/4\right)$
5. $x(n) = \cos\left(\pi n\right)$

In each case, generate $x(n)$, $0 \le n \le 200$, and process it through the `filter` function to obtain $y(n)$. Compare your $y(n)$ with the steady-state responses in each case.

Fonte: Ingle/Proakis, Digital Signal Processing Using Matlab - 3ª Edição.