Processamento Digital de Sinais
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Lista de exercícios 1A – Sinais e sistemas digitais

P2.1 Generate the following sequences using the basic MATLAB signal functions and the basic MATLAB signal operations discussed in this chapter. Plot signal samples using the `stem` function.

1. $x_1(n) = 3\delta(n+2) + 2\delta(n) - \delta(n-3) + 5\delta(n-7),\ -5 \le n \le 15.$
2. $x_2(n) = \sum_{k=-5}^{5} e^{-|k|}\delta(n-2k),\ -10 \le n \le 10.$
3. $x_3(n) = 10u(n) - 5u(n-5) - 10u(n-10) + 5u(n-15).$
4. $x_4(n) = e^{0.1n}[u(n+20) - u(n-10)].$
5. $x_5(n) = 5[\cos(0.49\pi n) + \cos(0.51\pi n)],\ -200 \le n \le 200.$ Comment on the waveform shape.
6. $x_6(n) = 2\sin(0.01\pi n)\cos(0.5\pi n),\ -200 \le n \le 200.$ Comment on the waveform shape.
7. $x_7(n) = e^{-0.05n}\sin(0.1\pi n + \pi/3),\ 0 \le n \le 100.$ Comment on the waveform shape.
8. $x_8(n) = e^{0.01n}\sin(0.1\pi n),\ 0 \le n \le 100.$ Comment on the waveform shape.

P2.3 Generate the following periodic sequences and plot their samples (using the `stem` function) over the indicated number of periods.

1. $\tilde{x}_1(n) = \{\ldots, -2, -1, \underset{\uparrow}{0}, 1, 2, \ldots\}_{\text{periodic}}$. Plot 5 periods.
2. $\tilde{x}_2(n) = e^{0.1n}[u(n) - u(n-20]_{\text{periodic}}$. Plot 3 periods.
3. $\tilde{x}_3(n) = sin(0.1\pi n)[u(n) - u(n-10)]$. Plot 4 periods.
4. $\tilde{x}_4(n) = \{\ldots, \underset{\uparrow}{1}, 2, 3, \ldots\}_{\text{periodic}} + \{\ldots, \underset{\uparrow}{1}, 2, 3, 4, \ldots\}_{\text{periodic}},\ 0 \le n \le 24.$ What is the period of $\tilde{x}_4(n)$?

P2.4 Let $x(n) = \{2, 4, -3, \underset{\uparrow}{1}, -5, 4, 7\}$. Generate and plot the samples (use the `stem` function) of the following sequences.

1. $x_1(n) = 2x(n-3) + 3x(n+4) - x(n)$
2. $x_2(n) = 4x(4+n) + 5x(n+5) + 2x(n)$
3. $x_3(n) = x(n+3)x(n-2) + x(1-n)x(n+1)$
4. $x_4(n) = 2e^{0.5n}x(n) + \cos(0.1\pi n)\, x(n+2),\ -10 \le n \le 10$

P2.5 The complex exponential sequence $e^{j\omega_0 n}$ or the sinusoidal sequence $\cos(\omega_0 n)$ are periodic if the *normalized* frequency $f_0 \triangleq \dfrac{\omega_0}{2\pi}$ is a rational number; that is, $f_0 = \dfrac{K}{N}$, where K and N are integers.

1. Prove the above result.
2. Generate $\exp(0.1\pi n),\ -100 \le n \le 100$. Plot its real and imaginary parts using the `stem` function. Is this sequence periodic? If it is, what is its fundamental period? From the examination of the plot what interpretation can you give to the integers K and N above?
3. Generate and plot $\cos(0.1n),\ -20 \le n \le 20$. Is this sequence periodic? What do you conclude from the plot? If necessary examine the values of the sequence in MATLAB to arrive at your answer.

ERRATA: em P2.5.2, a função correta é $exp(j0.1\pi n)$
Obs: na P2.3 e P2.4, é interessante obter os gráficos dos sinais intermediários.

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