Processamento Digital de Sinais

Prof. Carlos Speranza

Lista de exercícios 2 – Amostragem e Reconstrução de Sinais Contínuos

P3.19 An analog signal $x_a(t) = \sin(1000\pi t)$ is sampled using the following sampling intervals. In each case, plot the spectrum of the resulting discrete-time signal.

1. $T_s = 0.1$ ms
2. $T_s = 1$ ms
3. $T_s = 0.01$ sec

Atenção: usar $x_a(t) = sin(1000\pi t + \pi/4)$

P3.20 We implement the following analog filter using a discrete filter.

$$x_a(t) \longrightarrow \boxed{\text{A/D}} \xrightarrow{x(n)} \boxed{h(n)} \xrightarrow{y(n)} \boxed{\text{D/A}} \longrightarrow y_a(t)$$

The sampling rate in the A/D and D/A is 8000 sam/sec, and the impulse response is $h(n) = (-0.9)^n u(n)$.

1. What is the digital frequency in $x(n)$ if $x_a(t) = 10\cos(10,000\pi t)$?
2. Determine the steady-state output $y_a(t)$ if $x_a(t) = 10\cos(10,000\pi t)$.
3. Determine the steady-state output $y_a(t)$ if $x_a(t) = 5\sin(8,000\pi t)$.
4. Find two other analog signals $x_a(t)$, with different analog frequencies, that will give the same steady-state output $y_a(t)$ when $x_a(t) = 10\cos(10,000\pi t)$ is applied.
5. To prevent aliasing, a prefilter would be required to process $x_a(t)$ before it passes to the A/D converter. What type of filter should be used, and what should be the largest cutoff frequency that would work for the given configuration?

P3.21 Consider an analog signal $x_a(t) = \cos(20\pi t)$, $0 \le t \le 1$. It is sampled at $T_s = 0.01$, 0.05, and 0.1 sec intervals to obtain $x(n)$.

1. For each T_s plot $x(n)$.
2. Reconstruct the analog signal $y_a(t)$ from the samples $x(n)$ using the sinc interpolation (use $\Delta t = 0.001$) and determine the frequency in $y_a(t)$ from your plot. (Ignore the end effects.)
3. Reconstruct the analog signal $y_a(t)$ from the samples $x(n)$ using the cubic spline interpolation, and determine the frequency in $y_a(t)$ from your plot. (Again, ignore the end effects.)
4. Comment on your results.

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