Laboratory 4: Sampling/Reconstruction

OBJECTIVE

The purpose of this lab is to

a) Study the relationship between a continuous signal and its sampled version through periodic sampling.
b) We will also explore how to perform upsampling.

Sampling and Reconstruction

A continuous signal $y(t) = 2\sin(2\pi 2t + \pi/4)$ is being sampled at 1000Hz and 100Hz.

i) Study the Matlab program (Lab4_Matlab_Implement.m) to display the two sampled sampled version of the signal, namely y1000[n] and y100[n] respectively, for time = 0 to 1 seconds.

ii) Study the program to upsample and interpolate y100[n] (Fs=100Hz) to 1000Hz sampling rate. Plot the smooth upsampled signal and compared it with the y[n]. Comment on the similarity and difference between the two signals.

Reference

Sanjit K. Mitra, *Digital Signal Processing Laboratory using Matlab*, McGraw Hill International Edition, 2000

QUIZ

Q: Study how y(n) and t(n) is created in the Matlab code. y1000(n) is the sampled version of the continuous signal y(t) = 2sin(2pi2t + pi/4) with the sampled frequency of 1000Hz. t1000(n) is the corresponding sampled time. What is the signal frequency of y(t) in Hz?

Ans: 2Hz

Q: What is the possible value of the cut-off frequency of the lowpass filter. Freq_Fn? Briefly illustrate the reason.
Ans: 1000Hz sampling frequency, Nyquist is 500Hz, cutoff at 0.1 so is 50Hz

Q: When y100[n] is upsampled to 1000Hz to result in y1000[n], and y1000[n] passes through an ideal lowpass filter with a gain of 1, what is the amplitude of the resultant signal y1000[n] after the lowpass filter?

Ans: y100[n] has amplitude of 2/Ts = 200. Upsampling will not change the amplitude and unity gain opamp also will not change the amplitude.

Q: When sampling continuous signal y(t)=sin(40 pi*t), the minimum sampling frequency is ?? Hz to avoid aliasing.

Ans: F = 20Hz so at least sample at 40