EE-125 Homework – Lecture 5

Due 9/25/2017

Problem 1:

Suppose that the output from an A/D converter is $x(n) = \cos(0.2\,\pi\, n)$, and the sampling rate used to acquire the signal was fs = 8000 samples/sec. Determine a formula for the continuous-time input signal x(t), assuming there is no aliasing.

Problem 2:

The sampled signal x(n) = xa(nT) is reconstructed using an idealized low-pass reconstruction filter, which takes the value A for |F|< Fc and zero otherwise. The reconstruction results in a continuous-time signal xr(t).

a) a) If the original signal xa(t) satisfies the condition Xa(F)=0 for |F|> B, find the maximum value of T, and the values of Fc and A such that xr(t) = xa(t).
b) b) Consider a second case, where xa(t) = x1(t) x2(t), where X1(F)=0 for |F|>B, and X2(F)=0 for |F|>2B. Find the maximum value of T, and the values of Fc and A such that xr(t) = xa(t).

(see hint below)

HW hint – problem 2

- In problem 2, I ask a question about ideal reconstruction and ask you to pick the gain 'A' of the reconstruction filter. What is that about?
- There is a scale factor of 1/T in the board notes on sampling (Lecture 4, scanned in hand-written board notes – see below). This gives a scaling on the sampled amplitude in the frequency domain. You can see this, for example, in Fig. 6.1.3b) of the textbook
- During reconstruction, we can "undo" this scaling by multiplying by T

3 $D(t) = \sum_{n=-\infty}^{\infty} \delta(t-nT) \Leftrightarrow D(F) = \frac{1}{T}\sum_{n=-\infty}^{\infty} \delta(F-nF_s)$