UNIVERSITY OF CALIFORNIA, BERKELEY

EE-120: Lecture 14

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1 REVIEW OF THE SAMPLING THEOREM

Setup:
We take samples of a continuous-time signal x every 2 seconds:

$$\omega_s = \frac{2\pi}{T} \tag{1.1}$$

We can reconstruct $x(t)$ from the samples $\{x(nT)\}_{n\in\mathbb{Z}}$ if it is the case that for $\omega \notin (-\omega,\omega)$: $X(\omega) = 0$ and that the sampling frequency $\omega_s > 2\omega_M$ then x_r defined as follows is equal to x

$$x_r(t) = \sum_{n=-\infty}^{\infty} x(nT)\text{sinc}(\frac{t-nT}{T}) \tag{1.2}$$

2 FOURIER TRANSFORM OF THE SAMPLED SIGNAL

We can define $x_d[n] = x(nT)$ which as we can see is a discrete-valued time signal. We can relate the DTFT to the CTFT as follows:

$$X_d(e^{j\Omega})|_{\Omega=\omega T} = X_p(\omega) \tag{2.1}$$

Note: because X_p and X_d are defined as follows

$$X_P(\omega) = sum_{n=-\infty}^{\infty} x_d[n]e^{-j\omega Tn} \tag{2.2}$$

$$X_d(e^{j\Omega}) = \sum_{n=-\infty}^{\infty} x_d e^{-j\Omega n} \tag{2.3}$$

We can see that X_d is equal to the following:

$$X_d(e^{j\Omega}) = \frac{1}{T}\sum_{k=-\infty}^{\infty} X(\omega T - 2\pi k) \tag{2.4}$$