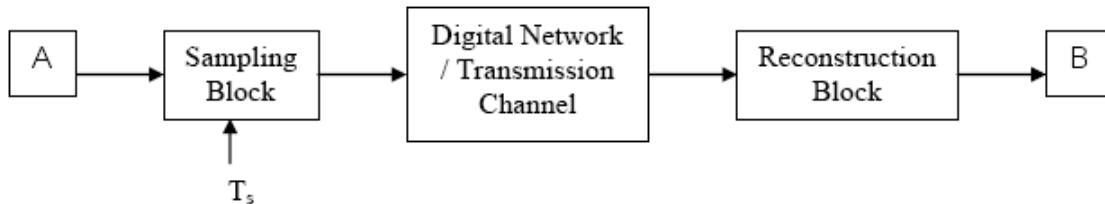


EECS 360 Signal and System Analysis

Lab 9. Sampling and Signal Reconstruction

1. Consider the system below:



- Describe what is taking place in this block diagram.
 - Blocks “A” and “B” represent signals, what is the relationship between these two signals?
 - “ T_s ” is the sampling period. In order for the system to function without aliasing, what relationship must exist between signal “A” and T_s ?
2. Consider an analog signal $x_a(t) = \cos(20\pi t)$, $0 \leq t \leq 1$. Sample this signal at $T_s = 0.01, 0.05, 0.1$ second intervals.
- What is the frequency of $x_a(t)$?
 - Produce a stem plot of all three sampled sequences. Use 3 subplots contained in a single figure.
 - From the stem plots, comment on which sequences are over sampled, under sampled, or ideally sampled.
3. Reconstruct the analog signal $y_a(t)$ using the following techniques. Use the following time vector for all the reconstruction plots, $t_a = [0 : 0.001 : 1]$.
- Reconstruct the signal using rectangular pulses.
Hint: use “rectpuls” function.
 - Reconstruct the signal using triangle pulses.
Hint: use “tripuls” function.
 - Reconstruct the signal using *sinc* interpolation (see example on next page).
 - Reconstruct the signal using *spline* interpolation
 - Plot the three rectangular pulse reconstructed signal (3 subplots)
 - Plot the three triangular pulse reconstructed signal (3 subplots)
 - Plot the three *sinc* interpolation reconstructed signal (3 subplots)
 - Plot the three *spline* interpolation reconstructed signal (3 subplots)
 - Comment on the results, which interpolation works the best? Why?
 - What sampling frequencies reconstructed better than others?

Sinc interpolation example:

$$\text{Formula: } y_a(t) = \sum_{n=-\infty}^{\infty} x_a(nT_s) \frac{\sin[\pi(t - nT_s)/T_s]}{\pi(t - nT_s)/T_s} = \sum_{n=-\infty}^{\infty} x_a(nT_s) \text{sinc}[F_s \pi(t - nT_s)]$$

4. Calculate the mean squared error of all 12 reconstructed signals
 - a. Construct a “bar” graph using the given function “*mseplot.m*”.
Note: reshape the mse vector into a 3x4 matrix before apply.
 - b. Comment on which reconstruction technique produced the least MSE.