Independent University Bangladesh (IUB)
School of Engineering, Technology and Sciences (SETS)
Department of Electrical and Electronic Engineering
Autumn 2020 EEE 321LAB

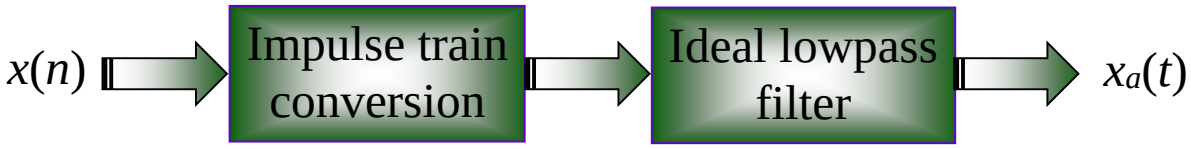
Lab 7: Study on signal sampling, reconstruction and aliasing

Objectives:

1. To understand the sampling and reconstruction of signal.

Theory for signal sampling & reconstruction:

- If we sample band-limited $x_a(t)$ above its Nyquist rate, then we can reconstruct $x_a(t)$ from its samples $x(n)$. The reconstruction follows two steps:



- The above two-step procedure can be described mathematically using an interpolation formula

$$x_a(t) = \sum_{n=-\infty}^{\infty} x(n) \frac{\sin[\pi(t-nT)/T]}{[\pi(t-nT)/T]}$$
$$= \sum_{n=-\infty}^{\infty} x(n)\,\mathrm{sinc}[(t-nT)/T] = \sum_{n=-\infty}^{\infty} x(n)\,\mathrm{sinc}[F_s(t-nT)]$$

- The *sinc* function can be used to implement the above interpolation formula in MATLAB. If {x(n), $n_1 \le n \le n_2$} is given and if we want to interpolate $x_a(t)$ on a very fine grid interval Δt, then the above equation

$$x_a(m\Delta t) \approx \sum_{n=n_1}^{n_2} x(n)\,\mathrm{sinc}[F_s(m\Delta t - nT_s)], \qquad t_1 \le m\Delta t \le t_2$$

- If $x_a(t)$ [and hence $x_G(m)$] is of finite duration, the above equation is similar to discrete Fourier transform of the form

$$\mathbf{X} = \mathbf{W}\mathbf{x}$$

Labwork:

1. Let $x_a(t) = e^{-1000|t|}$. Sample $x_a(t)$ at F_s = 5000 sample/sec to obtain $x(n)$. Determine and plot $X(j\omega)$.
2. Let $x_a(t) = e^{-1000|t|}$. Sample $x_a(t)$ at F_s = 5000 sample/sec to obtain $x(n)$. Reconstruct the original signal and plot it.
3. Let $x_a(t) = \cos(20\pi t + \theta)$ sampled $x_a(t)$ at T_s = 0.005 sec intervals to obtain $x(n)$. Reconstruct the original signal using the *sinc function* and plot it.

Lab Assignment-7

Develop a MATLAB function to perform the sampling and reconstruction of a signal.