EEE328
Digital Signal Processing

Ankara University

Faculty of Engineering

Electrical and Electronics Engineering Department

Sampling of Continuous-Time Signals

EEE328 Digital Signal Processing

Lecture 9

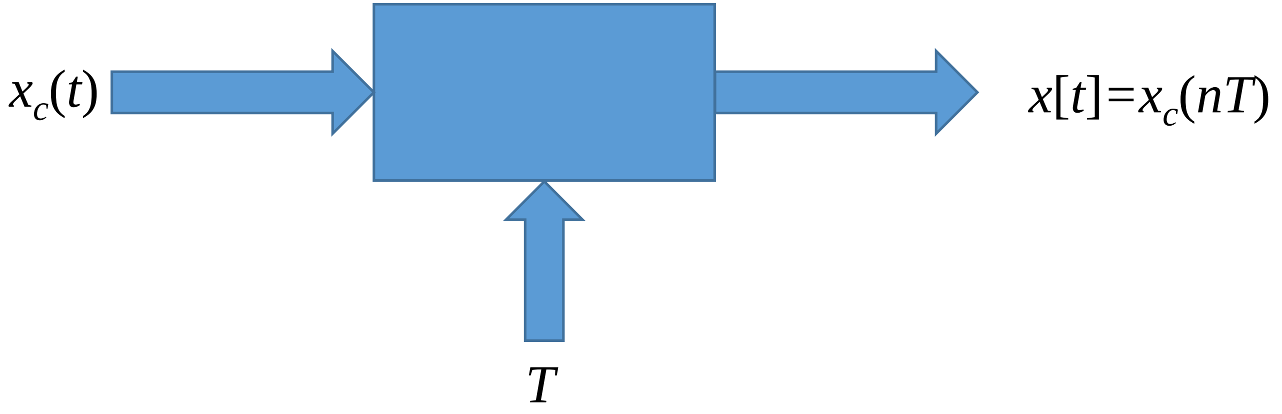
Agenda

- Sampling
- Continuous-Time to Discrete-Time (C/D) Converter

Periodic Sampling

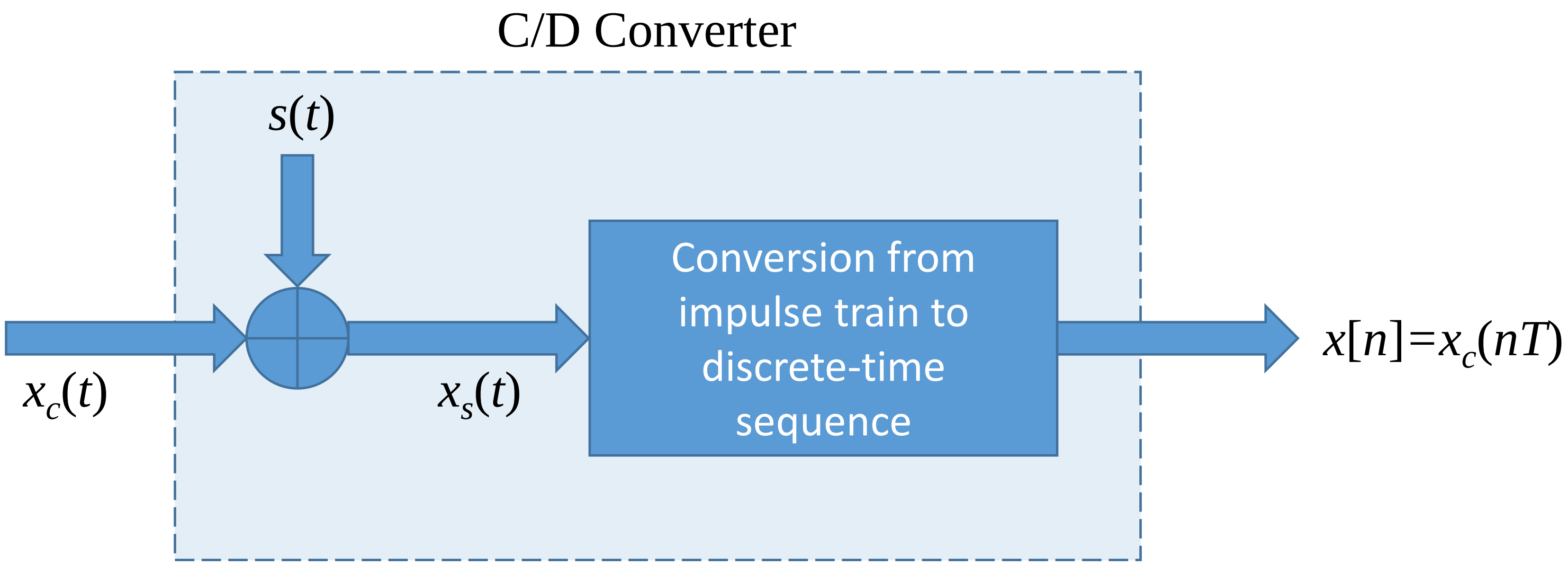
$$x[n] = x_c(nT), \qquad -\infty < n < \infty$$

T: sampling period



Ideal Continuous-Time to Discrete-Time (C/D) Converter

Sampling with Periodic Impulse Train



Frequency Domain Representation of Sampling

$$s(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$$

$$x_s(t) = x_c(t)s(t) = x_c(t) \sum_{n=-\infty}^{\infty} \delta(t - nT)$$

$$x_s(t) = \sum_{n=-\infty}^{\infty} x_c(nT)\delta(t - nT)$$

Frequency Domain Representation of Sampling

$$S(j\Omega) = \frac{2\pi}{T} \sum_{k=-\infty}^{\infty} \delta(\Omega - k\Omega_s)$$

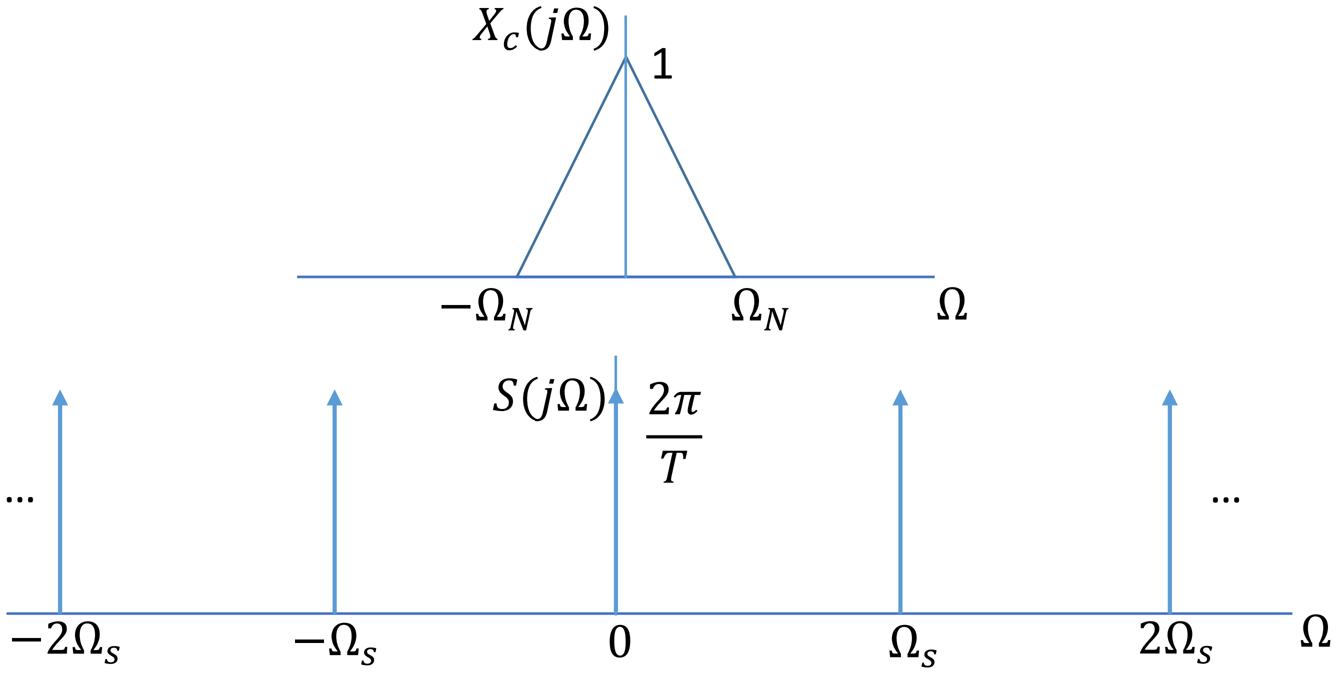
$$X_s(j\Omega) = \frac{1}{2\pi} X_c(j\Omega) * S(j\Omega)$$

$$X_s(j\Omega) = \frac{1}{T} \sum_{k=-\infty}^{\infty} X_c(j(\Omega - k\Omega_s))$$

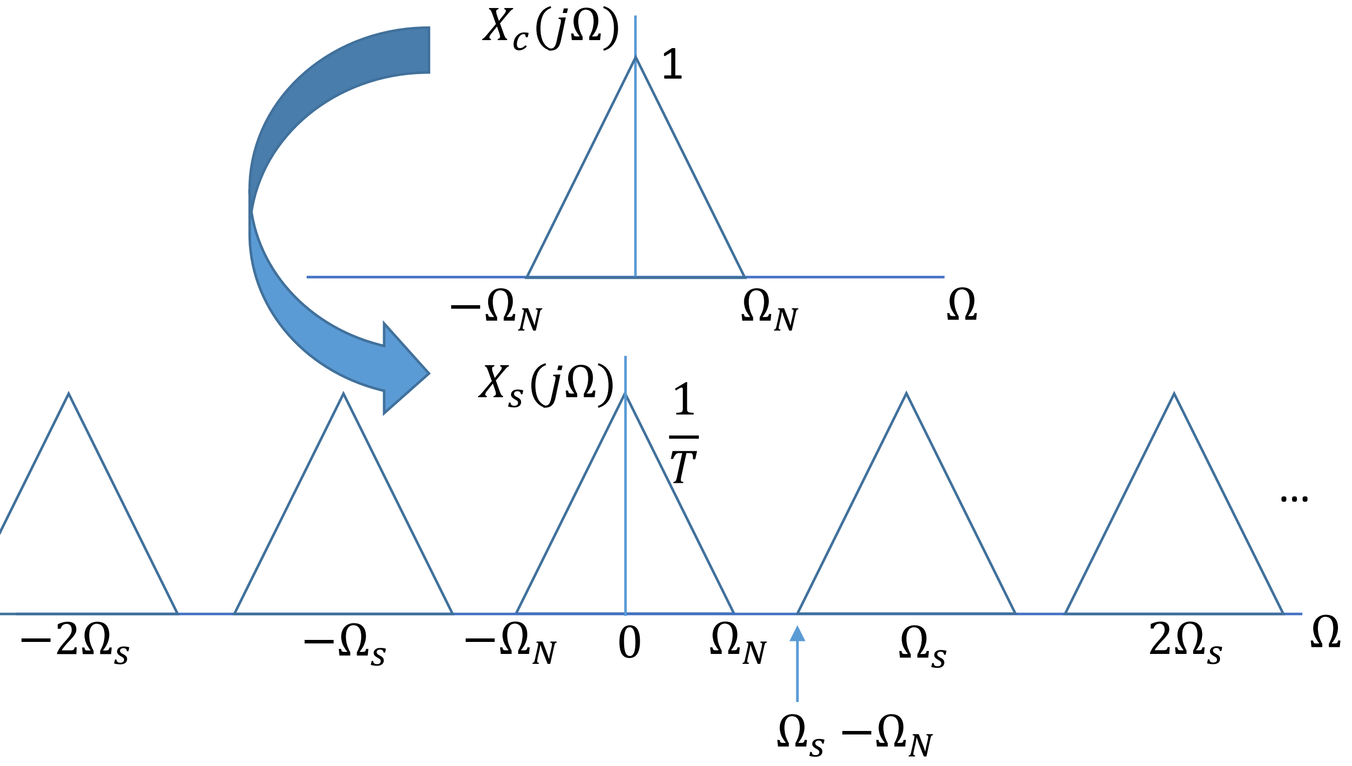
$$\Omega_s - \Omega_N > \Omega_N$$

$$\Rightarrow \Omega_s > 2\Omega_N$$

Frequency Domain Representation of Sampling

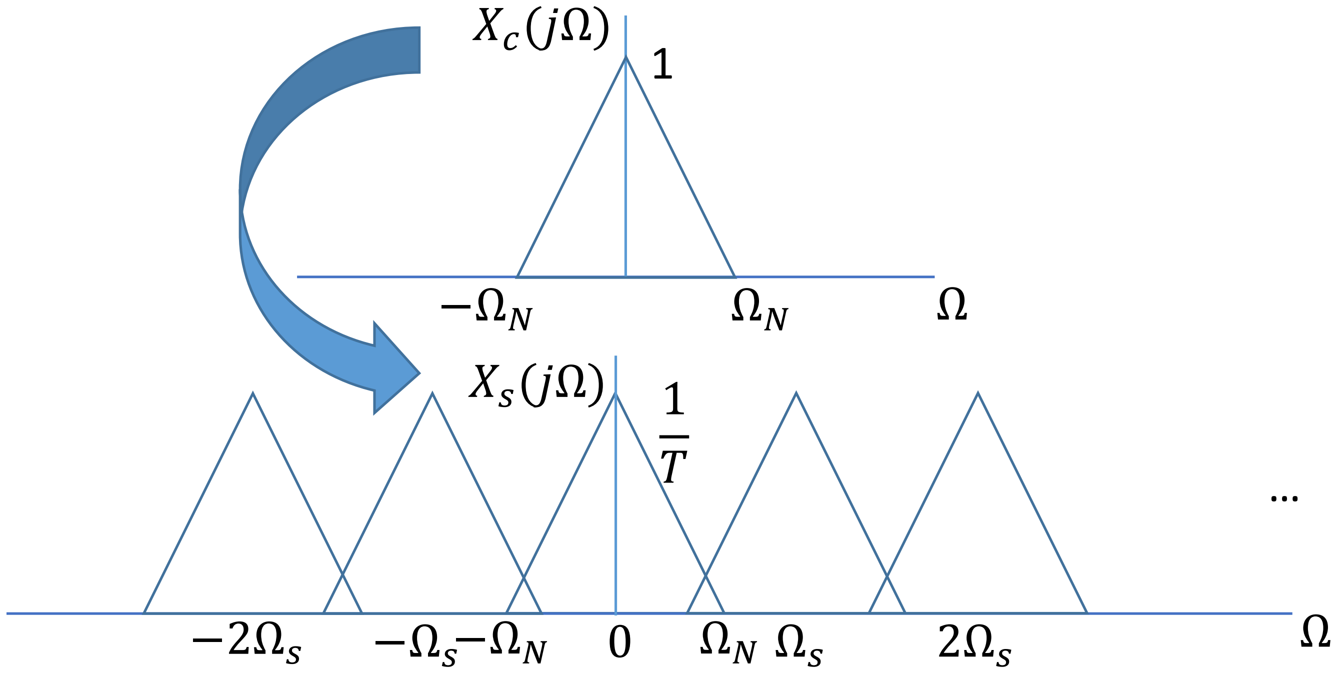


Frequency Domain Representation of Sampling



★ $\Omega_s > 2\Omega_N$

Frequency Domain Representation of Sampling



$\Omega_s \not> 2\Omega_N$ ⇒ Aliasing

References

- Signals & Systems, Second Edition, A. V. Oppenheim, A. S. Willsky with S. H. Nawab, Prentice Hall, 1997
- Discrete-Time Signal Processing, Second Edition, A. V. Oppenheim, R. W. Schafer with J. R. Buck, Prentice Hall, 1999