Signals and Systems (BEC 403)

Unit-5

Sampling and Reconstruction of Signals

Atul Kumar Dwivedi©[1]

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

BUNDELKHAND INSTITUTE OF ENGINEERING AND TECHNOLOGY, JHANSI (U. P.), INDIA

Chapter 1

Sampling

1.1 Syllabus:

Sampling,reconstruction

1.2 Signal Reconstruction Using Kth Order Hold

The rectangular function is given by

$$\operatorname{rect}(t) = \begin{cases} 0 & \text{if } |t| > \frac{1}{2} \\ \frac{1}{2} & \text{if } |t| = \frac{1}{2} \\ 1 & \text{if } |t| < \frac{1}{2}. \end{cases} \tag{1.1}$$

The triangular function is defined as

$$\operatorname{tri}(t) = \begin{cases} 1 - |t|, & |t| < 1 \\ 0, & \text{otherwise} \end{cases} \tag{1.2}$$

It is the convolution of two identical unit rectangular functions:

$$\operatorname{tri}(t) = \operatorname{rect}(t) * \operatorname{rect}(t) \quad = \int_{-\infty}^{\infty} \operatorname{rect}(\tau) \cdot \operatorname{rect}(t - \tau)\, d\tau \tag{1.3}$$

Zero-order hold is given by:

$$x_{\mathrm{ZOH}}(t) = \sum_{n=-\infty}^{\infty} x(n)\,\mathrm{rect}\,(t-n) \tag{1.4}$$

for First-order hold

$$x_{\mathrm{FOH}}(t) = \sum_{n=-\infty}^{\infty} x(n)\,\mathrm{tri}\,(t-n) \tag{1.5}$$

for First-order hold. Since $tri(t) = rect(t) * rect(t)$. This can be extended to second order hold as

$$x_{\mathrm{SOH}}(t) = \sum_{n=-\infty}^{\infty} x(n)\,\mathrm{par}\,(t-n) \tag{1.6}$$

where $par(t) = rect(t) * rect(t) * rect(t)$ and third order hold can be given as

$$x_{\mathrm{TOH}}(t) = \sum_{n=-\infty}^{\infty} x(n)\,\mathrm{x_{th}}\,(t-n) \tag{1.7}$$

where $x_{th}(t) = rect(t) * rect(t) * rect(t) * rect(t)$. In this way K_{th} order hold can be written as

$$x_{\mathrm{KOH}}(t) = \sum_{n=-\infty}^{\infty} x(n)\,\mathrm{x_k}\,(t-n) \tag{1.8}$$

where $x_k(t)$ is obtained by

$$x_k(t) = (\mathrm{rect}(t) * \mathrm{rect}(t)) * (\mathrm{rect}(t) * \mathrm{rect}(t)) * \mathrm{rect}(t) \ldots k+1 \quad times. \tag{1.9}$$