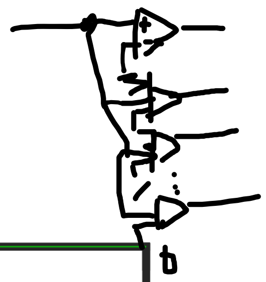
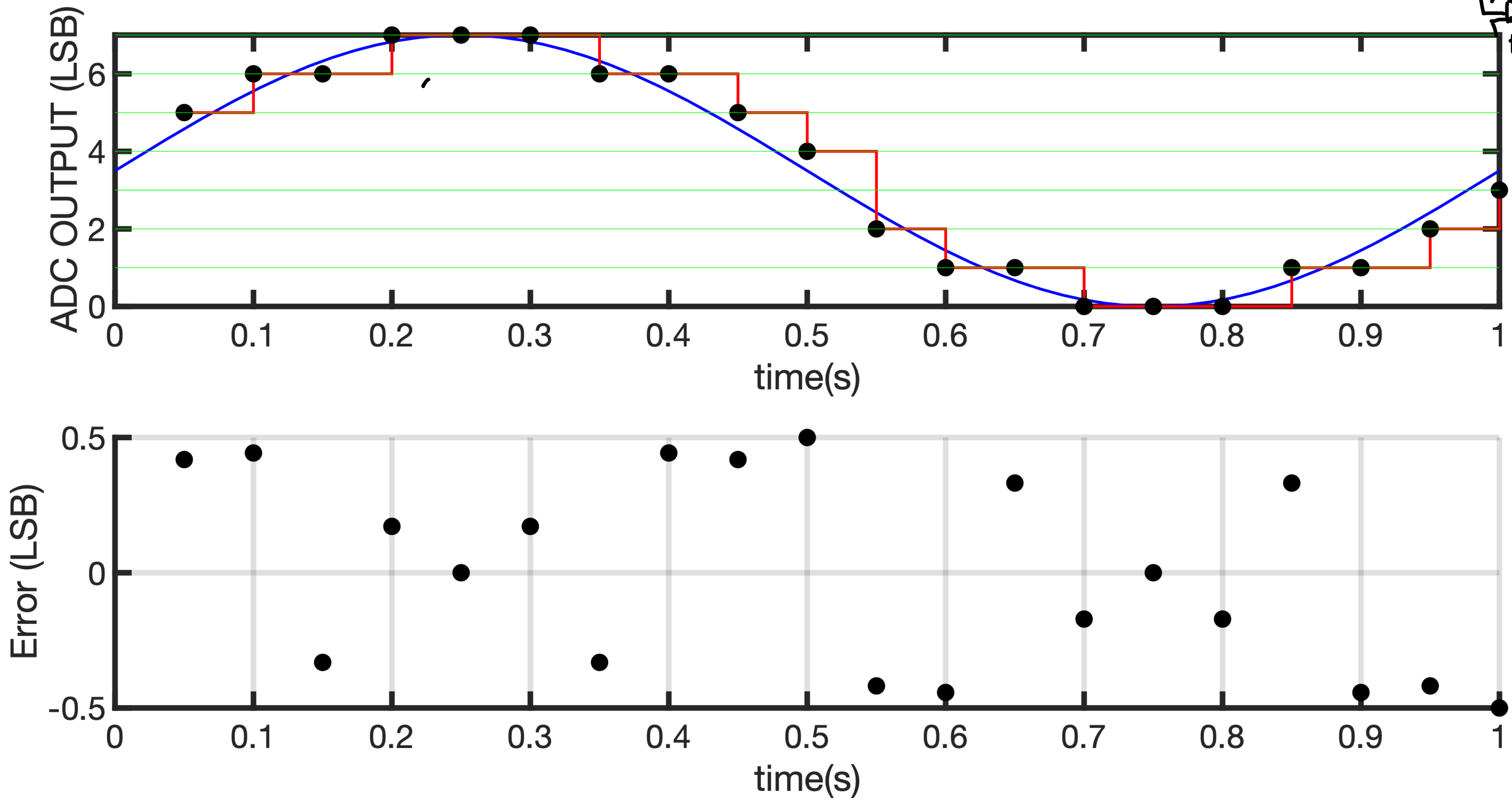
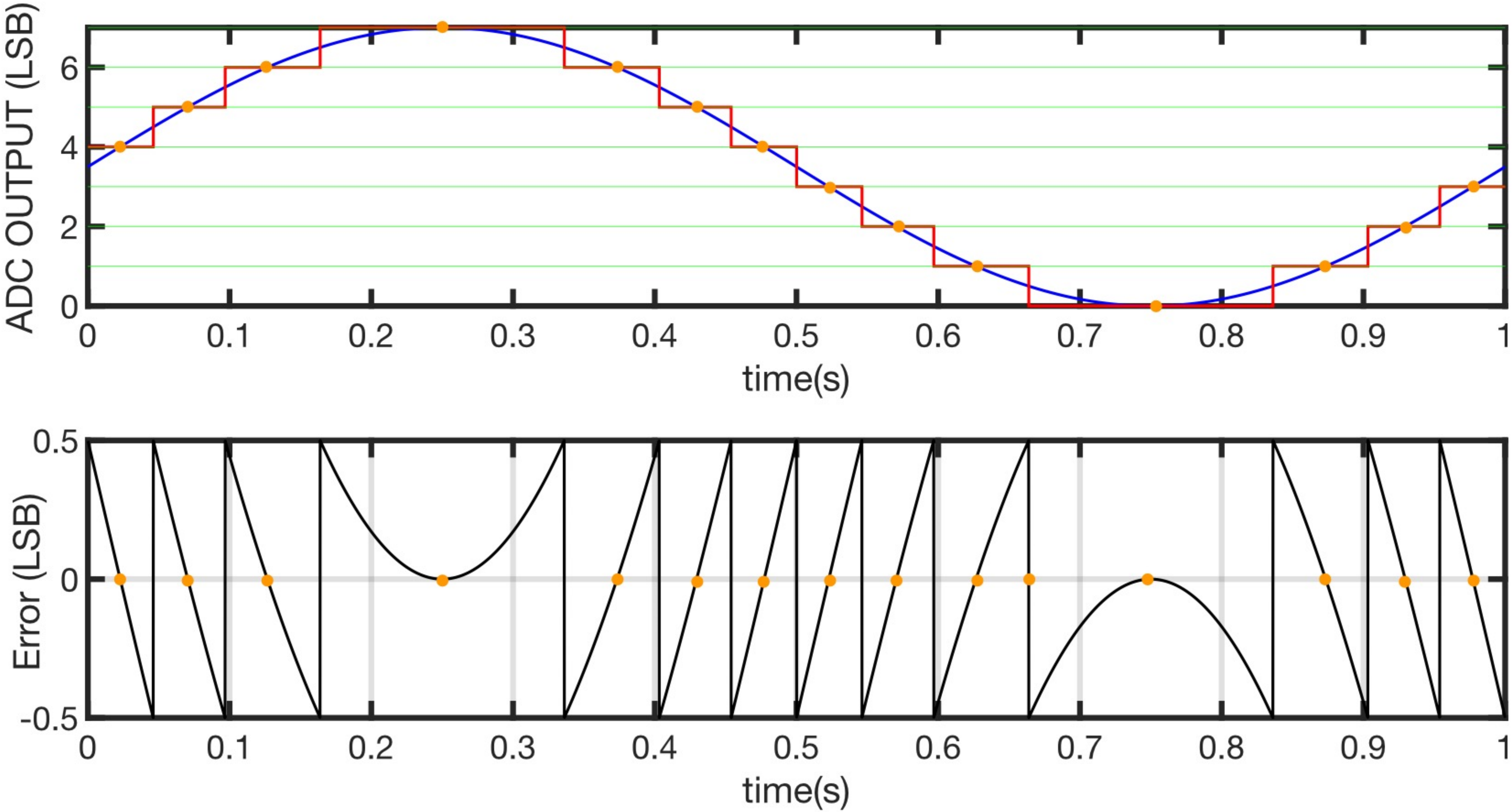
Uniform Sampling:

3bit 2^3 12 2^R



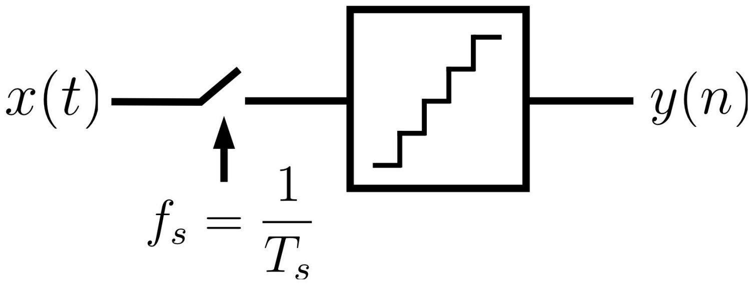


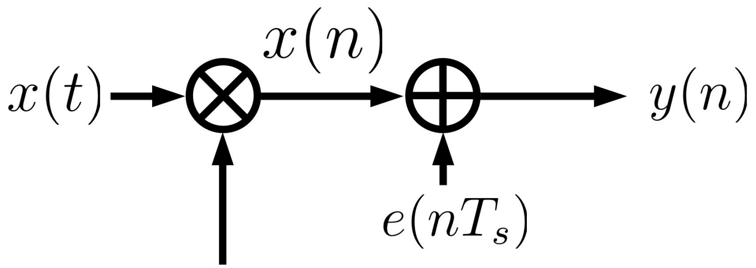
Non-Uniform Sampling:



Uniform vs Non-Uniform Model:

Uniform



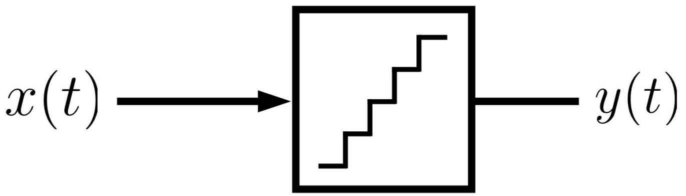


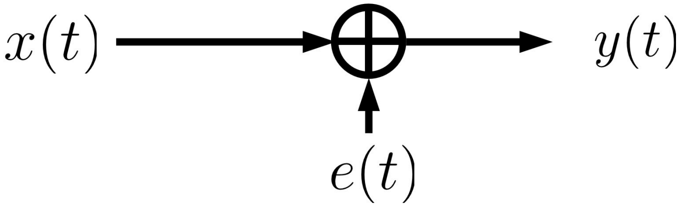
$$f_t(t) = \begin{cases} 1, (t = kT_s, k = \ldots -1, 0, 1 \ldots) \\ 0, otherwise \end{cases}$$

$$x(n) = x(t) \times \sum_{n=-\infty}^{+\infty} \delta(t - nT_s)$$

$$y(n) = x(t) \times \sum_{n=-\infty}^{+\infty} \delta(t - nT_s) + e(nT_s)$$

nonUniform





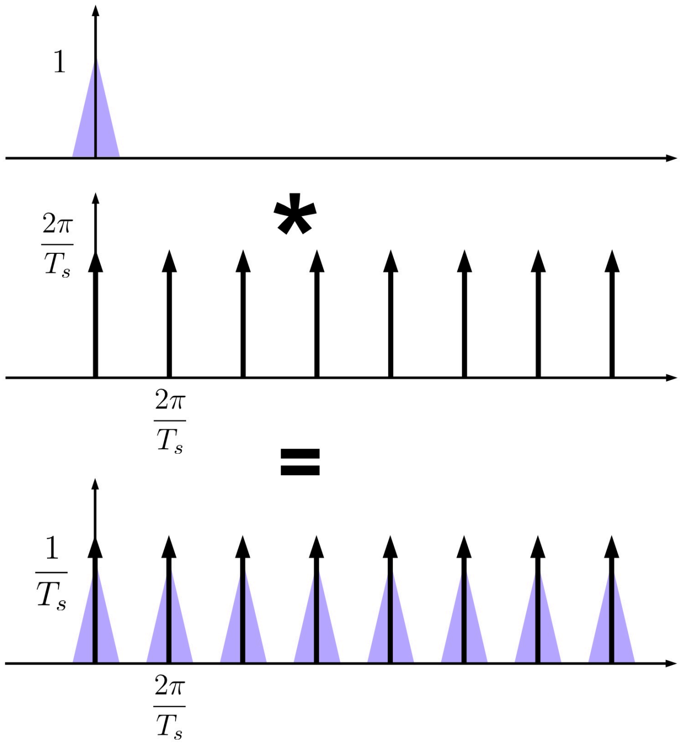
$$y(t) = x(t) + e(t)$$

Uniform vs Non-Uniform QN Model:

Uniform

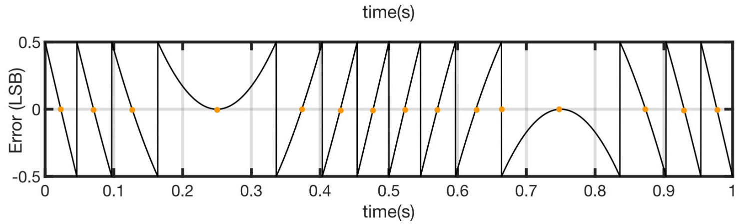
$$x(n) = x(t) \times \sum_{n=-\infty}^{+\infty} \delta(t - nT_s)$$

$$\frac{1}{2\pi} X(jw) * \sum_{n=-\infty}^{+\infty} \delta(jw - njw_s) \; w_s = \frac{2 \times \pi}{T_s}$$



nonUniform

$$y(t) = x(t) + e(t)$$



$$x(t) = Asin(2\pi f_0 t)$$

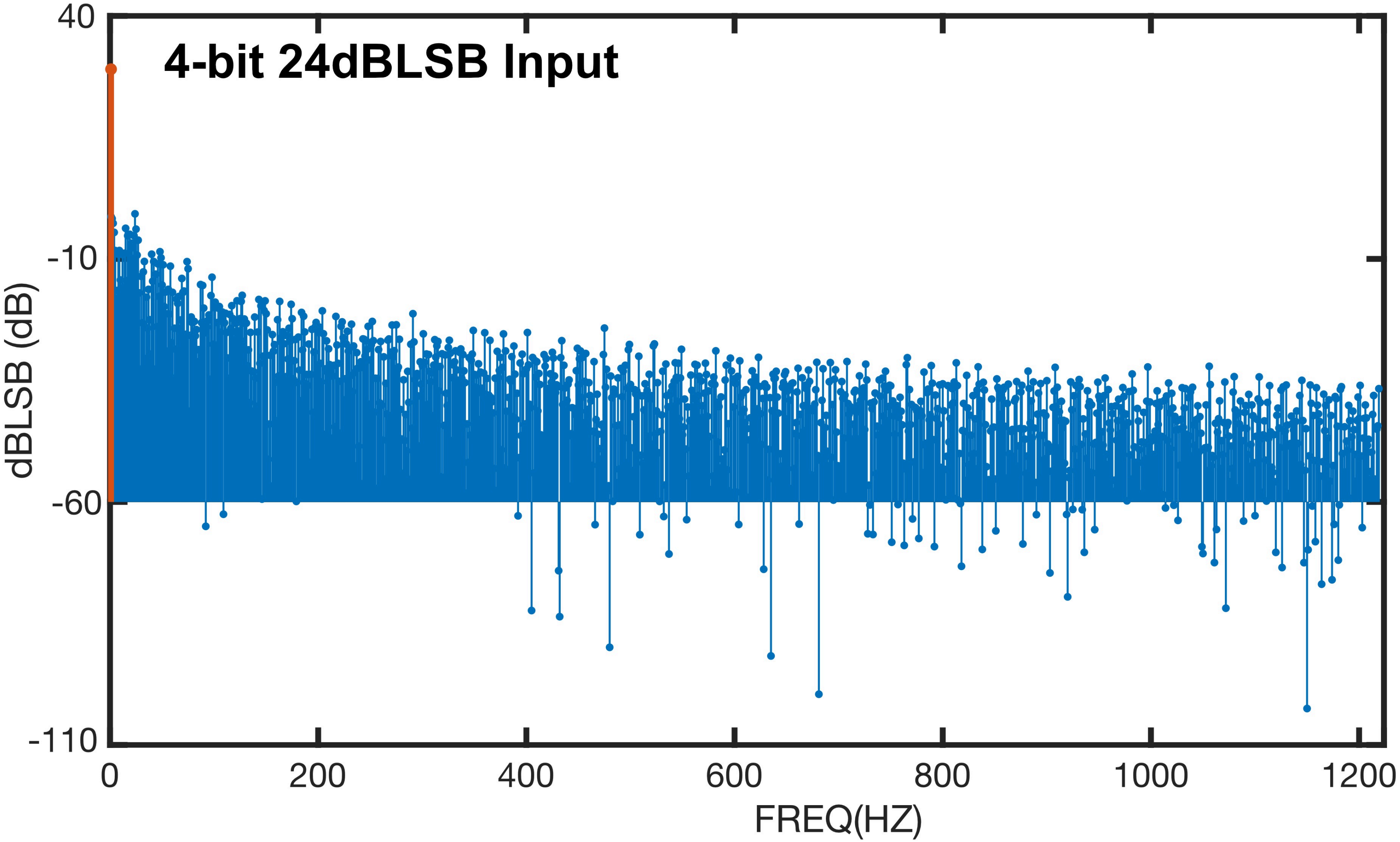
$$e(t) = -\sum_{k=1}^{+\infty} \frac{sin(2\pi k x(t))}{\pi k}$$

$$PSD_e(f) =$$

$$\frac{2}{\pi^2} \times \sum_{u=1,3,5..}^{+\infty} \left(\sum_{k=1}^{+\infty} \frac{J_u(2\pi k A)}{k}\right)^2 \delta(f - uf_0)$$

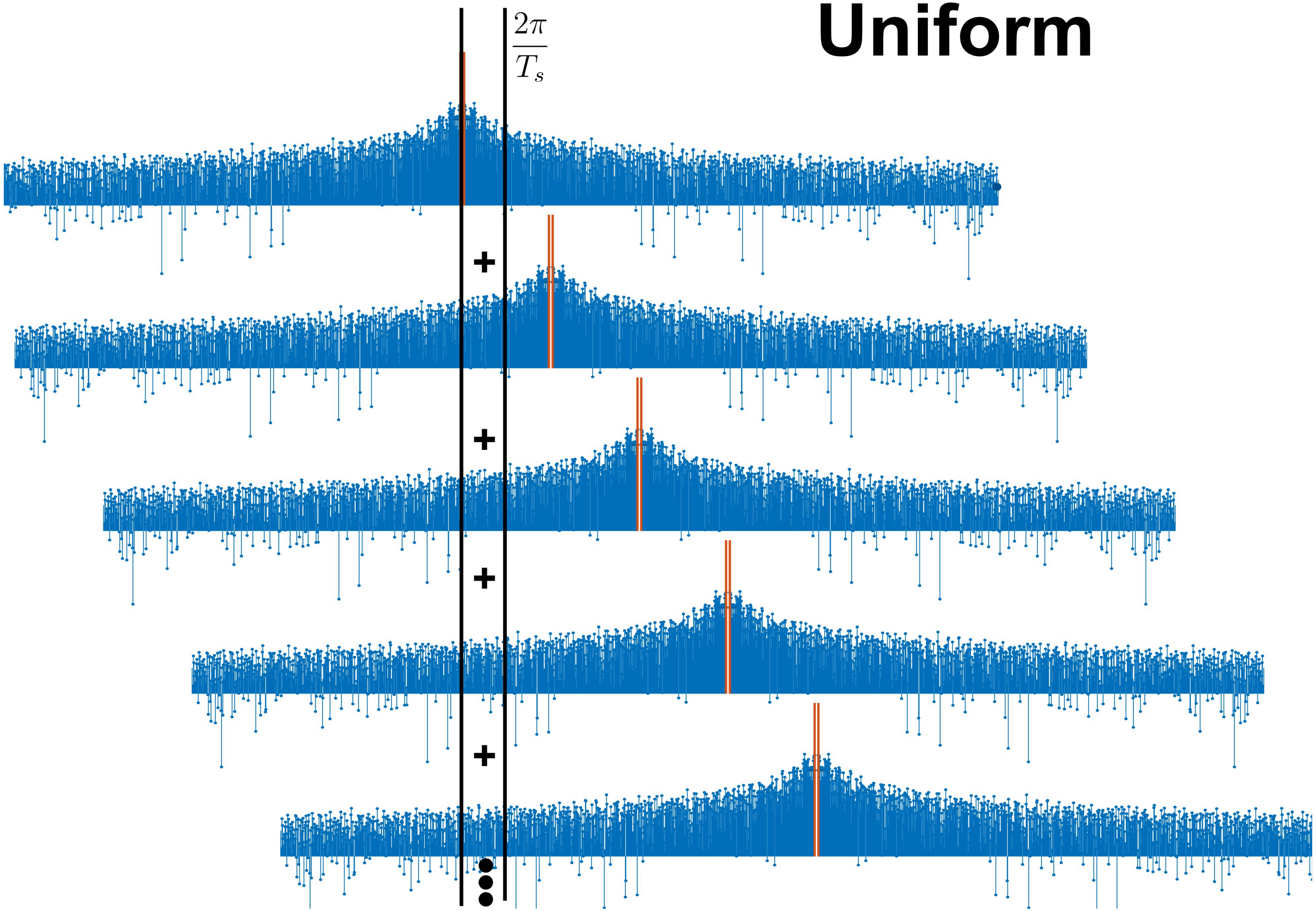
Uniform vs Non-Uniform Spectrum :

nonUniform



Uniform vs Non-Uniform Spectrum:

Uniform



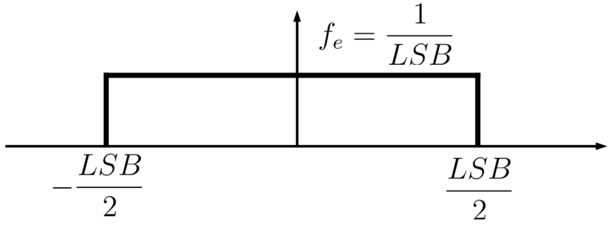
Uniform vs Non-Uniform - SQNR:

Uniform

$$\int_0^{+\infty} PSD_e(f)df =$$

$$\frac{2}{\pi^2} \times \sum_{u=1,3,5..}^{+\infty} (\sum_{k=1}^{+\infty} \frac{J_u(2\pi k A)}{k})^2$$

$$<= LSB^2/12$$



$$V_Q(rms) = \sqrt{\int_{-\infty}^{+\infty} x^2 f_e dx}$$

$$= \sqrt{\frac{1}{LSB} \int_{-LSB/2}^{+LSB/2} x^2 dx}$$

$$= \frac{LSB}{\sqrt{12}}$$

$$SQNR = 20log_{10}(\frac{2^{ENOB} \times LSB/\sqrt{12}}{LSB/\sqrt{12}}) = 6.02ENOB$$

$$SQNR = 20log_{10}(\frac{2^{ENOB} \times LSB/\sqrt{8}}{LSB/\sqrt{12}}) = 6.02ENOB + 1.76$$

nonUniform

$$\int_0^{f_c} PSD_e(f)df =$$

$$\frac{2}{\pi^2} \times \sum_{u=1,3,5..}^{c} (\sum_{k=1}^{+\infty} \frac{J_u(2\pi k A)}{k})^2$$

$$where\ , c = \frac{f_c}{f_0}$$

$$SQNR = 20log_{10}\frac{2^{ENOB}/\sqrt{8}}{\sqrt{\int_0^{f_0} PSD_e(f)df}}$$

$$\cong 9ENOB - 10log_{10}(c-2) - \frac{0.07}{4^n} \times (c^2 + 2c + 4)$$

SNR Improvement: