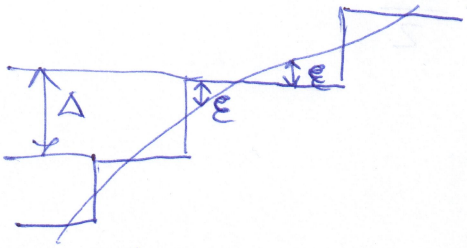
Šum kvantizacije



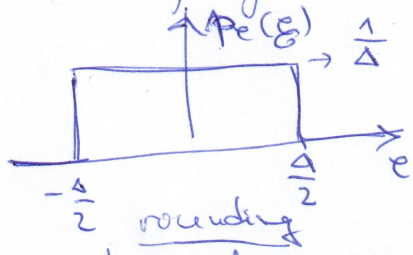
ε - greška kvantizacije, Δ - korak kvantizacije

$\varepsilon \in [-\frac{\Delta}{2}, \frac{\Delta}{2}]$

$x = \hat{x} + \varepsilon$

$\hat{x} \rightarrow Q(x)$ → kvant. f-ja

Funkcija gustine verovatnoće greške kvantizacije:



$$\int_{-\frac{\Delta}{2}}^{\Delta/2} p_\varepsilon(\varepsilon)\,d\varepsilon = 1 \Rightarrow p_\varepsilon(\varepsilon) = \frac{1}{\Delta}$$

- pretpostavka: šum kvantizacije je uniformno raspoređen.

šum kvantizacije tj. greška kvantizacije

ε → neki signal čija je trenutna snaga ε^2, a srednja snaga šuma bita

$$P_{n\varepsilon} = E(\varepsilon^2) = \sigma_\varepsilon^2 = \int_{-\Delta/2}^{\Delta/2} \varepsilon^2 \cdot p(\varepsilon)\,d\varepsilon = \int_{-\frac{\Delta}{2}}^{\frac{\Delta}{2}} \varepsilon^2 \frac{1}{\Delta}\,d\varepsilon =$$

↓ jer je statistički signal

$$= \frac{1}{\Delta} \cdot \frac{1}{3}\varepsilon^3 \Big|_{-\Delta/2}^{\Delta/2} = \frac{1}{3\Delta}\left(\frac{\Delta^3}{8} + \frac{\Delta^3}{8}\right) = \frac{\Delta^2}{12} = \frac{2^2}{12}$$

$\Delta = 2$ u prethodnoj funkciji

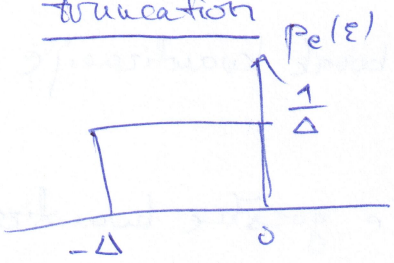
Ako je signal $x[n]$ ~~bez~~ normalizovan tako da je $-1 \leq x[n] < 1$, $\forall n$ onda je $\Delta = \frac{1}{2^B} = 2^{-B}$, gde je B broj bita za predstavu signala $x[n]$.

Tada je $P_{n\varepsilon} = \frac{2^{-2B}}{12}$.

$$SNR\,(dB) = 10 \log \frac{P_x}{P_n} = 10 \log P_x + 10 \log (12 \cdot 2^{2B}) =$$

$$= \left(10 \log P_x + 10 \cdot 8 + 6{,}02\,B\right) dB$$

truncation



$$\rightarrow E(\varepsilon) = -\frac{\Delta}{2} = -\frac{2}{2} = -\frac{2^{-B}}{2}$$

$$\sigma_\varepsilon^2 = \frac{\Delta^2}{12} = \frac{2^2}{12}$$