Solutions

Examination in Integrated A/D and D/A Converters, ETI220

14.00-19.00, Friday, August 27, 2010

I. Basic questions about converters

a) Sampling frequency: $f_s = \frac{2^{15}}{10^{-2}} \approx 3.28 MHz$

Highest frequency: $f_{Nyq} = \frac{f_s}{2} \approx 1.64 MHz$

b) See textbook and lectures.

c) Quantization noise, kT/C noise, jitter.

d) Mapping of s-domain to z-domain for $z = e^{sT}$

e) If the amplitude of the suspected distortion is much higher than the noise floor, it is distortion. Otherwise, increasing the number of samples yields a decrease of the noise floor (if done correctly), while the amplitude of a distortion signal is not affected.

f) A Delta-Sigma converter

II. Specific questions about converters

a) See textbook and lectures.

b) A capacitive DAC with capacitive attenuator (see textbook and lectures).

c) See textbook and lectures.

d) Calculations:

$$U - V\left[\left(\frac{1}{z-1}\right)^2 + \frac{2}{z-1}\right] + U + E = V$$

$$V = U + \left(1 - z^{-1}\right)^2 E \;\rightarrow\; 2^{\text{nd}} \text{ order}$$

$$X_2 = U - V\left(\frac{1}{z-1}\right)^2 = -z^{-2}E$$

e) A folding converter. See textbook and lectures.

f) See lecture.

g) The negative part of the wave is quantized in exactly the same way as the positive part. This means that the q-noise samples in the negative part is perfectly correlated to the q-noise in the positive part. More specifically, for each q-error sample in the positive part there is the same q-error sample (with inverted sign) in the negative part. Thus, all even bins are empty, and the q-noise is found only in the odd bins.