EE658: VLSI Data Conversion Circuits; HW3

Nagendra Krishnapura (nagendra@iitm.ac.in)

due on 25 Sep. 2006

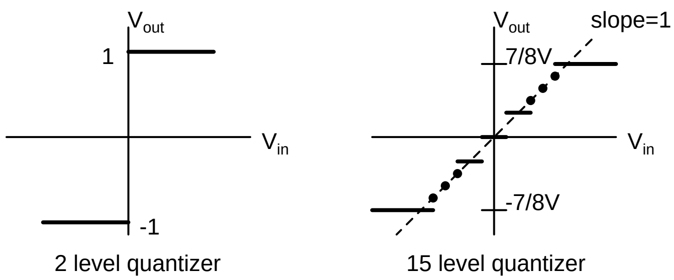

Figure 1:

1. Plot 1024 point FFT magnitudes of a sum of a sinusoid $(\cos(2\pi\nu_{in}n))$ with a unit amplitude and gaussian random noise with $\sigma = 0.001$. Try two cases-with $\nu_{in} = 65/1024$ and $\nu_{in}64.5/1024$. What do you observe?

2. Calculate the theoretical SNR (with a full scale input) and effective number of bits for the following $\Delta\Sigma$ modulators.
   - order=1, Nlevels=2, OSR=64.
   - order=1, Nlevels=15, OSR=64.
   - order=2, Nlevels=2, OSR=64.
   - order=2, Nlevels=15, OSR=64.

3. Simulate the above $\Delta\Sigma$ modulators. Plot the output power spectral density (using a Hann window), and compare the *in band* SNR to the theoretically calculated values. Use quantizers whose characteristics are given above. The input should be a sinusoid near 1/4 the signal bandwidth and peak values of 0.75V and 0.25V. (Please do not use the $\Delta\Sigma$ toolbox. Code the difference equations in MATLAB, Octave, C or whatever). For the power spectral density, average 16 FFTs of length 2048.

   Plot the output power spectral density using a rectangular window and compute the SNR. Compare the numbers to those obtained using a Hann window.

4. Pass the output of the 2nd order $\Delta\Sigma$ modulators above through sinc^3 decimation filters. Compute the output SNR and compare them to theoretical values of in band SNR. Plot the output spectral density.