EE 502 Spring 2003

HW Assignment 3

Assigned: Wednesday, 19 February 2003
CHANGED: Due: Friday, 28 February 2003

From the textbook:

4.52

Simulation Problem

We have a time domain signal described by:

$$x(t) = 0.315 \cdot \cos(310t) + 0.248 \cdot \sin(806t) \text{ volts},$$

where *t* is time in seconds.

I would like you to compare two processing methods via simulation.

Method A:
Sample *x(t)* at a 10kHz rate, using a 14-bit uniform rounding (mid-tread) bipolar linear quantizer that covers the range: -1V = *x* < +1V. Think of a good way to implement the 14-bit quantizer.

The output for Method A is the sequence of quantized sample values.

Method B:
Sample x(t) at a 100kHz rate, using an oversampled noise-shaping converter like Figure 4.61b in the text book. The samples of the input (*x*[*n*]) can be high-precision floating point numbers, but the quantizer output and feedback (*y*[*n*]) must be 14-bit numbers defined by a quantizer like in Method A above. Use a truncated sinc function with ±6 oscillations (see HW #2 Method 4) for the LPF block and perform the decimation (M=10). Note that although *y*[*n*] is a 14-bit number, the LPF coefficients and the filter output will be done in floating point, and you should round the decimated output sequence to be 14 bits per sample.

Please compare the sequences resulting from Method A, Method B, and a "perfect" 10kHz sampling of the input waveform.

Prepare a brief write-up explaining your simulation method and documenting your results. Include the maximum and RMS error between each interpolated sequence and the "perfect" sequence. You should also give some consideration to the amount of computation required for each method, as well as some comments on the theoretical foundation for each approach.