Letter to the editor

Marcel van de Gevel writes:

Dear Editor,

Mr. Polak's article "On digital audio formats and the Nyquist-Shannon sampling theorem" in Linear Audio volume 8 confirms the theories about sampling, dither and quantization, and I'm happy it does. Still, there is one thing I don't understand, and that is the only small difference in noise levels between the 50 kHz and 1 MHz sample rate plots in his figure 6.

If the dither is independent and identically distributed, as it normally is, then the dither and quantization noise should be distributed over a 20 times larger bandwidth in the case of 1 MHz sample rate. The noise density then has to be 13 dB smaller. Still, his figure 6 shows almost no difference in noise density. Could he explain the reason for this?

Marcel van de Gevel
Haarlem, The Netherlands

Hans Polak replies:

I agree with Mr. van de Gevel that the quantisation noise will be 13dB lower per FFT filter when going from 50kHz to 1MHz , assuming that the Widrow theorem will be met, meaning that the signal is continuous and large enough in amplitude.

However in the present case and with the used test signal, this condition is not met at all!

The quantisation noise is therefore not white but very much modulated by the signal. As a result, its spectral content lies almost completely in the lower frequency region. You could also argue the other way around: if the noise density is not 13 dB lower when going from 50kHz to 1Mhz, this noise is not white as quantisation noise is supposed to be; see also page 26 in the article.

To prevent this unwanted signal modulated noise, dither is added to the test signal with a Vrms value of 0.5 Q, with Q being the quantisation step. However this dither is present *after* the anti-alias filter, so the dither bandwidth is restricted to the same 25kHz as the test signal, see figure 3 in the article.

So in this case, just as the spectral density of the test signal does not change when changing the sampling rate, neither does the dither spectral density. By keeping everything the same except for the sampling rate, makes it possible to compare the error spectra 1:1, the exact goal of the article.

Hans Polak,
Blaricum, The Netherlands