
Subject: Re: Is 16/44 high enough?

Posted by [SASAudioLabs](#) on Thu, 30 Jul 2009 14:46:57 GMT

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Wayne Parham wrote on Wed, 29 July 2009 15:18

I wonder if it's the untrasonics or possibly the waveshape or distortion. In a way, these are all ways of saying the same thing because harmonics would be shifted up out of the (traditionally recognized 20-20kHz) passband and waveshape modifiers can be expressed as (Fourier series) harmonics.

On the other hand, it could be that the real issue is something like non-linearity, where it may be that the audible thing isn't so much the high frequency harmonics as it is the non-linearity itself - the harmonics are just one way of seeing the non-linearity, a side effect, if you will.

I can see other possibilities as well, such as overall rise time changes? Whatever it is, or combination you and I have pointed out, I would rather be on the safe side.

Here is some more information from Dr. Kunchur's papers.

"The temporal resolution and high-frequency audibility of human hearing are complex issues of both fundamental and practical significance. While the single-tone highfrequency threshold f_{max} for airborne stimuli is around 18 kHz in individuals with good hearing (Pumphrey, 1950; Hall, 2002), a much higher bandwidth and temporal acuity can play a role in the complete perception of the timbre of sound.

Neural processing beyond the cochlea can permit

expected for a linear system. In binaural localization by interaural time difference, it is well known that differences in

1974; Nordmark, 1976). Monoaural experiments involving iterated ripple noise (IRN) and inter-pulse gaps have shown similar thresholds in temporal resolution (Krumbholz, 2003; Leshowitz, 1971).

A similar sensitivity for temporal fine structure can be inferred from the discriminability of the virtual pitch of complex tones (Moore et al., 2006; Gockel et al., 2006).

It also appears that the cochlea may sense ultrasonic stimulation if the latter manages to reach

the cochlea in sufficient intensity, both when presented through the air (Henry and Fast, 1984; Ashihara et al., 2006) but especially when presented through bone conduction (Corso, 1963; Deatherage et al., 1954; Lenhardt et al., 1991; Lenhardt, 1998).

It has also been conjectured that such high level ultrasound may possibly change the perception of timbre when superimposed on audible harmonics (Oohashi et al., 1991; Yoshikawa et al., 1995). Additionally, restricting the bandwidth by low-pass filtering necessarily attenuates all frequencies to some extent, and hence spectral amplitude changes can never be avoided absolutely

timbre will depend on their magnitudes relative to the relevant just noticeable differences. For these reasons it can be expected that limiting the bandwidth of an audio signal by low-pass filtering may produce an audible change, even

well above f_{max} . The present work experimentally confirms this to be true, and at intensity levels and time constants much lower than suspected possible before."

Of all the possibilities both you, me, Dr. Kunchur have presented, I want to play it safe and go beyond the bare minimum.

Take care and thanks.
