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Digital Audio Processing
E85.2600, Prof. K. Peacock

ASSIGNMENTS

I. Definition of Aliasing

Since I have already described aliasing in previous reports, I will try to be brief with my current definition. Aliasing is the folding over of frequencies higher than the Nyquist frequency (one-half the sampling frequency) back into the audible spectrum. If the Nyquist frequency is considered to be the modulo, one can easily calculate the frequencies at which higher tones will alias. Thus, in a 44.1 kHz system, the Nyquist frequency is 22.05 kHz above which tones will foldback down under the Nyquist frequency. A 30 kHz tone, therefore will alias to (30-22.05) 7.95 kHz; similarly, a 44.1 kHz tone will alias to (44.1-22.05-22.05) 0 Hz. To prevent aliasing, filters must be introduced before sampling to bandlimit the incoming analog waveform at somewhere below the Nyquist frequency.

II. Summary of J. Watkinson article, "When Digital is Analogue"

Apparently, Ben Duncan has published some flawed D-A designs in Studio Sound. According to Watkinson's article, these designs are similar to Figure 1.5(a) in Watkinson's text, "The Art of Digital Audio", pg. 9. With this type of converter, no method is built in to reject jitter noise at the receiver. Therefore, the quality of data input to the receiver determines the quality of sound output by the converter. Better cabling and higher grade connectors will thus noticeably improve the performance of the device. It is the main tenet of digital audio, however, that sound quality is irrespective of the transmission and storage medium (Watkinson, pg. 7), given that errors introduced in the analog domain do not exceed the error handling capabilities of the digital system. A D-A converter which is affected by the quality of its cabling or connectors, therefore, is not a true D-A converter since it is not irrespective of the transmission medium. Watkinson's main point in his article is thus that a pure or ideal digital system, provided there are no parity errors, should be immune to any differences in the method by which data is received by the D-A converter.

III. Commentary on K. Peacock article, "Computer Analysis of Clarinet Multiphonics"

The article on clarinet multiphonics exposed me to a few basic concepts: 1) a natural clarinet tone is composed of strong odd harmonics that decrease in strength as partial numbers increase, as well as a few faint even harmonics that increase in strength with rising frequency; 2) a clarinet multiphonic has a more complicated frequency response than the natural clarinet tone; and 3) this complicated frequency response in multiphonics is a result of the cancellation of unrelated partials. I found most of the information disseminated in the article to be straightforward. The main point of the article seems to be that, yes indeed, clarinet multiphonics do in fact contain a different frequency spectrum than traditional clarinet tones. I doubt, however, that this difference was ever questioned in the minds of even the most scientifically untrained of musicians. The article does dig a little deeper by graphically explaining how these differences are sonically represented, but these graphs and scientific analyses

only serve to elucidate the "why" of multiphonics, i.e. why do they sound different?

What hasn't been fully addressed in the article (at least for my taste) is the "how" of these clarinet multiphonics. A couple lines allude to the methods by which multiphonics actually arise: "this is caused by the influence of many 'unrelated' partials in the complex sound which tend periodically to reinforce or cancel each other out," (pg. 16) and "their complexity is due to the presence of many unrelated partials which interact in unpredictable ways." (pg. 17) It is all well and good to soncially analyze clarinet multiphonics, but if it is, as the author states, "the irregularity of all parameters of the sound which makes synthetic duplication so difficult," (pg. 15) then why isn't this irregularity the real item under inspection? For example, a list of Fibonnaci numbers may seem complex at first sight but is truly a simple concept once reduced to a formula. What I would like to see out of computer analyses of instrumental sounds is a formula for the sound, not just a picture or series of pictures. The pictures are only the series of numbers; these sonic pictures, like a series of numbers, are meaningless unless connected in some way through a defined relationship (or formula). To comment that odd partials appear with decreasing strength as frequency increases is a good observation, but like any observation about a series of numbers, it is a qualification and thus just a first step for the true quantification of those numbers.

N.B.: I happened to notice that this article contained an unnaturally high use of quotation marks. In fact, neglecting the one instance where quotation marks actually appeared around a quote, I counted 38 uses of quotations around a single word or phrase. To me, 38 uses of quotations marks is unduly high for a four-page article (of which three pages are pretty much each half a page due to large graphics). In comparison, John Watkinson's article used a single word quote only once, appearing around the word "digital" in the pre-article banner. Watkinson's use seems rather standard considering his whole article is an exposition of the misunderstandings of the word "digital" and thus an attempt to more clearly define this specific word. In the clarinet article, which is at least 10 to 15 times more dense with quotation marks, the reasons for usage seem more random and unpredictable. For example, the phrase "multiple sonorities" appears without quotes in the first paragraph yet quoted in the second. On the other hand, the term "multiphonics" appears quoted in the first two paragraphs but never again. I wonder why "multiphonics" wasn't put in quotes in the article's title? Luckily for the ink supplier, the word "snapshots" appears five times in this article, always surrounded by those chicken scratches (should I have put "chicken scratches" in quotes?) In conclusion, I found myself slightly distracted while reading this article by the overuse of quotations marks and began to wonder whether I "understood" any of the "article" since so much of "writing" was embedded with this "double-meaning."