Column by Renzo van Riemsdijk (Masterenzo):

To LUFS and beyond, Part two

I promised that I would thoroughly discuss dynamics in this month's column. I lied, how shameful. My editor pointed me to the use of images to make the technical subject of LUFS easier to understand. So, images! Taken from the internet, just like that.

Let's start with an image explaining how a true-peak measurement works:

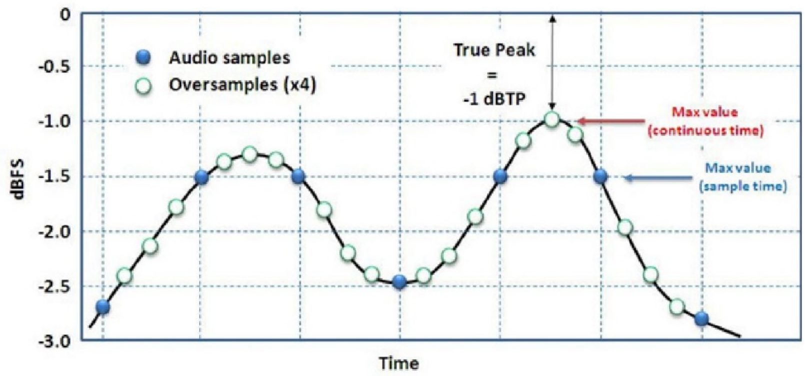

Image 1: True-peak versus sample-peak.

In image 1 we see a magnificent musical waveform. The blue dots show us what a regular peak meter will tell us. The white dots represent the inter-sample peaks (true-peak: the peaks between the peaks). Another aspect we see in the image is the use of *oversamples (x4)*. Without making this read too complex, oversampling means that the sample rate of the original signal is being multiplied by the meter. By doing so, the measurement of that signal is four times as accurate, which we see as the white dots in the image.

Okay, measuring true-peaks is a lot more in the clear now, isn't it?

And now for the LUFS themselves. I must confess: I've forgotten to mention something in last month's column. Before the signal is being measured by the LUFS meter, a filter is being applied to that signal. The filter used is quite important for an honest measurement.

Before telling what the filter is about, I need to explain something about how our ears work. Our hearing is far from linear. This means that our ears are not equally sensitive to different frequencies. Our ears tend to be more sensitive in the midrange than in other frequency areas. Think about the middy sound of a telephone, made for speech.
Of course this sensitivity differs from person to person.

In the thirties of the previous century two American scientists (Fletcher and Munson) have done intensive research on the sensitivity of the human hearing at various frequencies. Their research led to a schematic diagram, also known as the *Fletcher-Munson curves*:

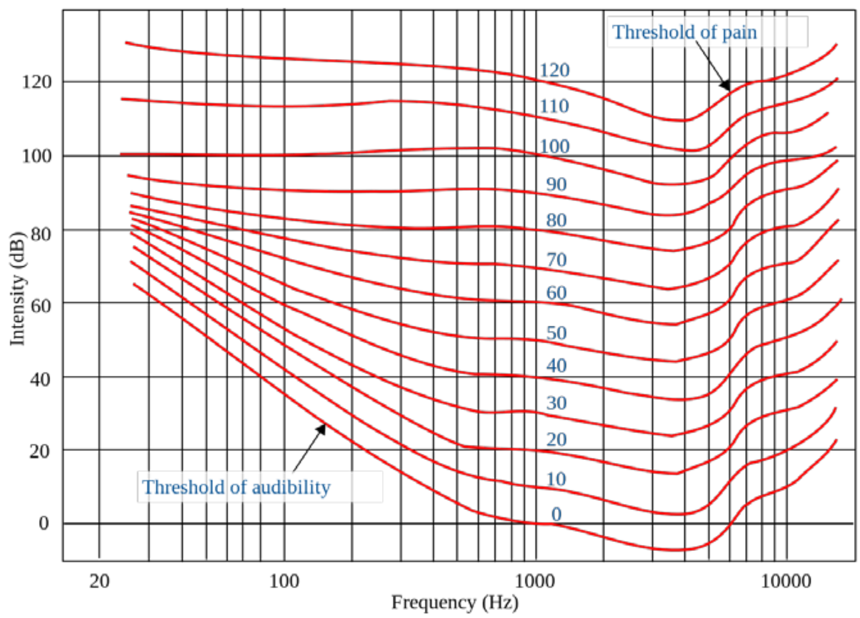

Image 2: Fletcher-Munson loudness curves.

In the second image we see the *Fletcher-Munson curves*. First we notice the *threshold of audibility* (the softest sound we can hear) and the *threshold of pain* (well, you can guess that one).
The second we notice is that the lines in the graph are far from straight. If our hearing would be linear, the lines would be straight. The diagram shows us that our hearing is more or less sensitive at different frequencies.

Okay, now that we know all this. Nice, but what's the connection to LUFS?

As mentioned earlier, a filter is applied to the signal before it's being measured. The filter compensates for the lack of linearity of our hearing. This results in a far more accurate measurement of loudness, as our ears actually hear it!

Here's the graph of the filter:

Image 3: K-Weighting filter correction.

In this third image we see the K-Weighting filter correction for loudness compensation and proper LUFS measurement.

Why the letter K is used for this weighting remains a little mystery to me.

Well, in this column and in the previous one I've revealed some of the secrets behind LUFS measurements combined with true-peak. Although these measurements are primarily used in the mastering stage, it's valuable for mix engineers and producers to know how these measurements work.
Should you have any questions about LUFS or true-peak, let me know!

Next month: *dynamics*, really!

Renzo

Renzo (Masterenzo) is a Rotterdam based Dutch mastering engineer. He has worked for Gery Mendes (GMB), Charlie Dée and Phil Bee's Freedom. More info about mastering and about Masterenzo can be found on his website.