Electric Bass & Kick Drum Mixing in *Doo Wop (That Thing)*
will bosworth 6/14/2010

Let's all agree that Lauryn Hill's *Doo Wop (That Thing)*[1] is a Total Banger. One important aspect of the song is how punchy the lower end of the mix is -- the kick drum and bass both fill up space well, seemingly without competing with each other or dominating the entire mix. This post looks at the amplitude/frequency make up of the kick drum and electric bass sound in the mix and identifies how these instruments interact in the lower frequencies of the track.

Most of the figures in this paper show spectral analysis of small snippets of the song. These graphs take a small instant (milliseconds) and show which frequencies have high and low amplitudes (volume). The x-axis of these figures is log(Hz) from 10 Hz to 20 kHz which is the extreme range of most audio formats and of human hearing. The y-axis shows amplitude, from ~-72 dB to ~0 dB, where -72 dB is virtually inaudible and 0 dB is the volume ceiling. There must be a decent explanation for spectral analysis somewhere, but i can't find it =(

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Figure 1 shows the complete stereo track in total amplitude vs. time (x axis is time, ~4 minutes; y axis is amplitude, normalized). This song was definitely made in the late nineties or later, as can be noted by all of the 0db peaks [http://en.wikipedia.org/wiki/Loudness_war]. Though, the limiting isn't too extreme, as the truly dense regions are less than 25% of the song. (exercise to reader: can you pick out different sections of the song based on total amplitude? Identify which instruments are responsible for various peaks?)

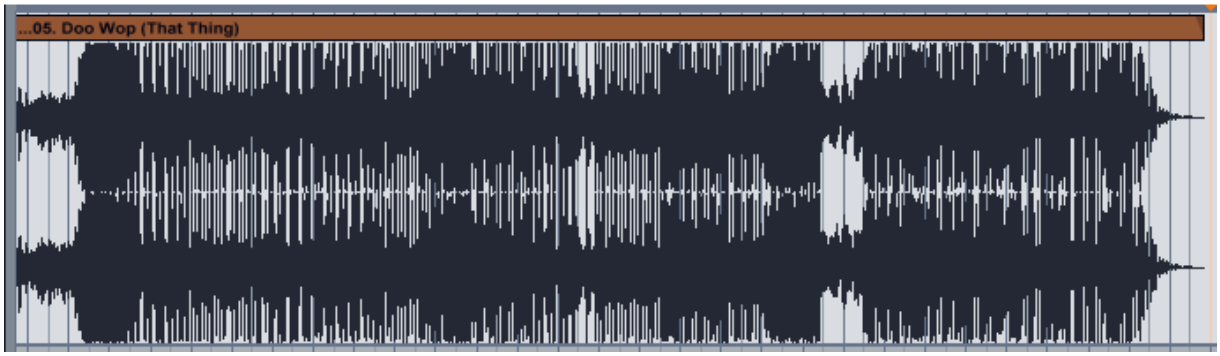


Figure 1: Doo Wop (That Thing) 's wave form

Figure 2 shows spectral analysis of the loudest part of the song. The horns are blaring, the Lauryn Hill Choir is going 'yeah!', and all the percussion & rhythm instruments/samples are thumpin (the darker colored line, which shows the cumulative amplitudes of the previous few milliseconds is the important one here). Note that there is a lot of energy throughout the spectrum – there is significant energy from 30 Hz to 10+ kHz.

[1] http://www.youtube.com/watch?v=dE6Qcc6VDo8

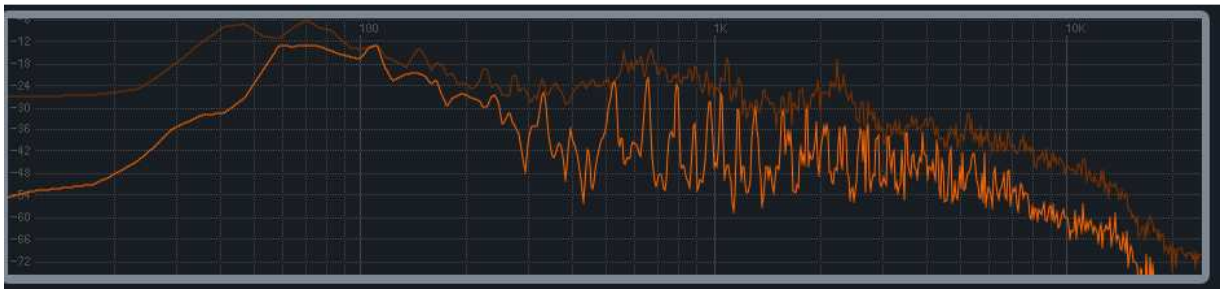


Figure 2: Loudest part of song

Figures 3 and 4 show two parts of the song where a bass note is played while the kick drum is not played (other higher frequency instruments are still happening). In Figure 3, the bass note center is the peak at ~120 Hz (@ -12dB), with maybe a secondary peak at 220 Hz. Figure 4's bass note is slightly lower in pitch, centered at 75 Hz, with a second prominent peak at 150 Hz. (Octaves are doublings of Hz. I assume these peaks are octave fundamentals, though it's hard to tell with great precision in these graphs)

Anyways, the real thing we're going to see that the real *rumbling bass* in this mix is not coming from the bass instrument, it's coming from the kick drum and or other percussion sounds (there's this one sample used in the song that really fills the 30 Hz area), while the bass sits in the low-mids (or is it the high-lows?). Note the darker orange/red line that traces the last few milliseconds of the mix to see the lower frequency shadows.

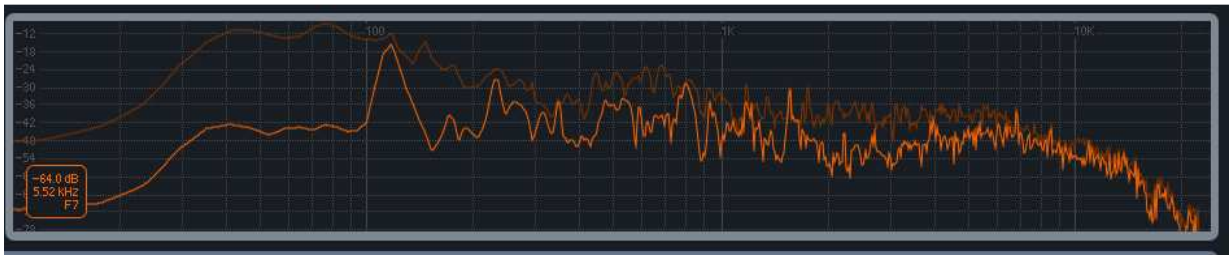


Figure 3: bass only (a higher pitch note)

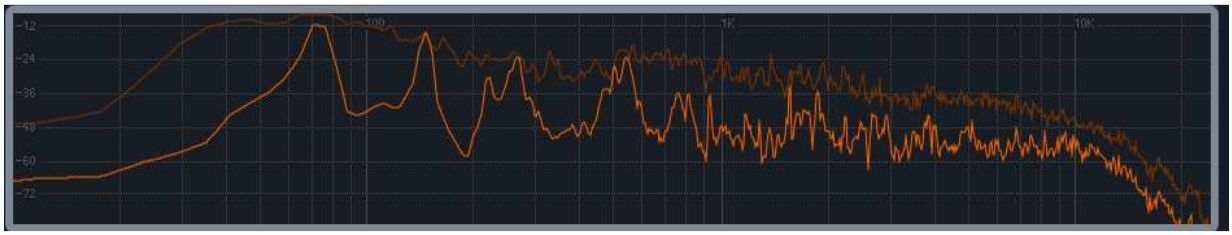


Figure 4: bass only ii (lower)

Figure 5 shows a section of the song with only the kick drum (no bass instrument). Its max amplitude is happening at ~65 Hz, with some action at lower frequencies, and probably a high pass filter starting a bit below 100 Hz. Sometime in the future I'd like to know what parts of the higher frequency the kick drum is taking too, but it will take more digging to separate the vocals, piano, high hats, and snare from the

kick drum. But, anyways, the kick drum takes 40-90 Hz, and the bass instrument dominates the 75-100 Hz region.

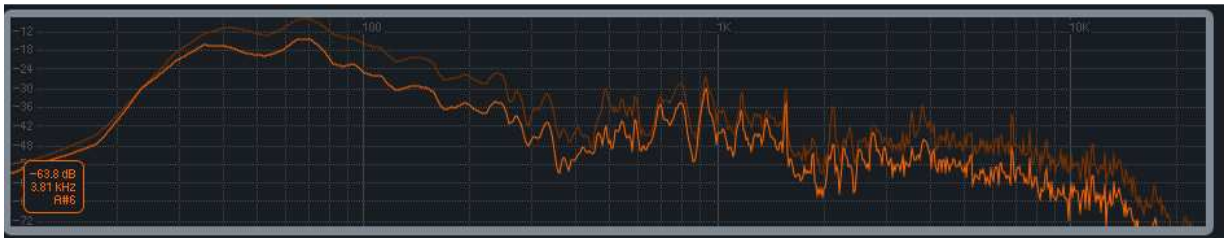


Figure 5: kick drum only

Figure 6 shows the kick and bass hitting simultaneously (by my count, ~80% of the kick drum hits are synced to a bass note; maybe 50% of bass notes are with the kick). Look at how the second peak of the bass note (@ ~150 Hz) got eaten and is now sitting at -18 dB! In Figure 3 and 4, that bass note is pushing -12 dB, but to make space for everything else in the mix, it gets pushed way down in this part of the song.

Did the bassist just play lower volume at different points in the song? Did the mixing engineer ride a fader? Does the bass track have some side-chain compression from the kick drum? Multi-dynamic compression on the master bus?[2] Well, hard to say conclusively from this analysis, though i'm certainly leaning towards a bit of the last three mostly. Regardless, the kick+bass spectrum certainly has more energies covered than the bass alone or the kick alone (duh), and the bass instrument is probably purposely being shaped differently when the kick is or is not present.

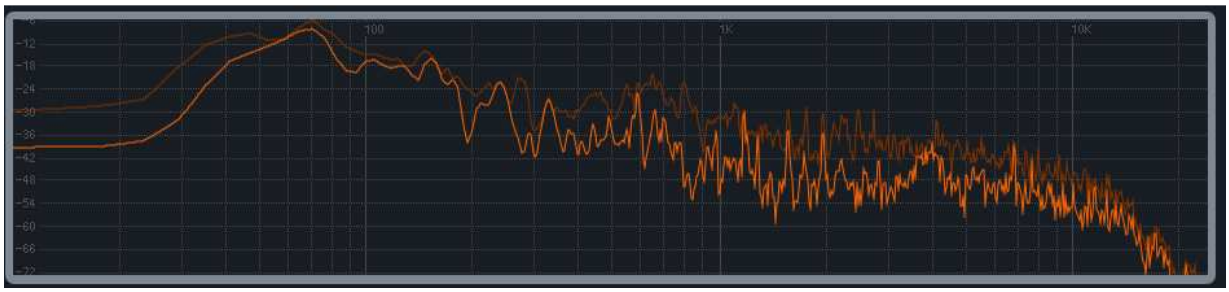


Figure 6: bass & kick

[2] Read up on compression! http://en.wikipedia.org/wiki/Dynamic_range_compression