

TDL® Technology, Inc. – Case Study Number 4

Restoration of a Poorly Recorded CD

Written: 14 November 2005

Recently a friend gave me a copy of a CD that had been recorded in September 2005 of a Chopin [1] concert. I was especially interested because I know the history of the Steinway Grand that was used. So I quickly fired up my sound system and hit the play button. I was shocked by what I heard coming from my speakers – the music was awful. This was not a “bootleg” CD made from a cassette tape recorded by a member of the audience. It was made by someone authorized by the organization which sponsored the concert.

The music was strident and “raw” and I heard evidence of quite a bit of peak clipping. I “ripped” [2] the CD to a hard drive and started *Sound Forge 8 (SF8)* [3] which contains a clipped peak detector. Some tracks had only a few clips while others had thousands. *SF8* inserts a marker at each clip it detects but doesn’t give a count of them.

Noise Reduction 2.0 (part of the *SF8* bundle) contains a Clipped Peak Restoration utility which automatically repairs them. It also reduces the amplitude enough so the repair doesn’t cause a new clip. With the Attenuation slider set to 0 dB and checks in both the Enable post-limiter and Crossfade edges boxes, I ran this utility on all eleven tracks. It turned out this was a mistake, but more on that later.

I listened to the “worked on” track 1. It was better but still very “raw” sounding. It seemed to be all mid frequencies with very little bass. A spectrum analysis using *Spectrogram* [4] confirmed this and a “before” sample is shown in Figure 1. It was clear that I had to equalize the wav files to boost the bass and “tame down” the mids.

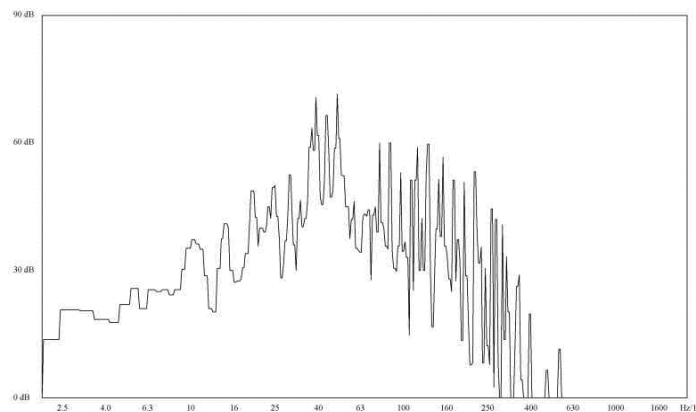


Figure 1 – Spectrogram of original track 1

An equalizer, whether it’s hardware or a computer program, is a very dangerous thing. Yes, they do let you adjust the amplitude in different frequency ranges but they also add phase distortion at each

filter band edge. Phase distortion is heard as non-linear time delay distortion and it can be rather bad. If you must use an equalizer, use as few bands as possible. In general, I would never use a 1/3 octave band equalizer – there are just too many band edges. I decided to try the 10-band (1 octave bands) equalizer in *SF8*.

With the following settings, I ran the equalizer on track 1. So now you are wondering, how did I pick these settings? I suppose you would call it a guess based on experience and I could easily run it again with other settings if I didn't like the results. I could see from Figure 1 that I needed to boost the bass and reduce the mids but a piano doesn't have a "flat" spectrum so these numbers seemed a good place to start.

Frequency = 28 Hz	+12 dB	900 Hz	- 6 dB
56 Hz	+12 dB	1800 Hz	0 dB
112 Hz	+ 6 dB	3600 Hz	0 dB
225 Hz	- 6 dB	7200 Hz	0 dB
450 Hz	- 12 dB	15000 Hz	0 dB

Overall gain = 0 dB

I listened to the resulting file and it sounded very good so I looked at it with *Spectrogram* and got the sample shown in Figure 2 (from about the same place in the file as Figure 1).

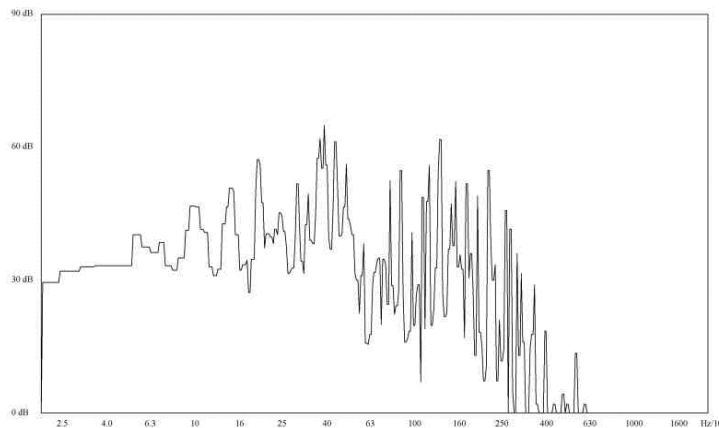


Figure 2 – Spectrogram of restored track 1

Since the piano was the same for all tracks as was the microphone placement (as far as I knew) and the room acoustics, it seemed safe to use the same equalization on all tracks. This took, at most, a minute or two per track. Then I listened to the whole restored concert and most tracks were fine. Tracks 7, 8, 9, 10 and 11 still had problems. They were noisy with odd, low-level clicks and pops and "swishing." Wondering if this was in the original tracks, I played them and listened closely. They were quiet so apparently I had introduced the noise with the restoration.

Tracks 7 and 8 had no peak clipping so all they needed was equalization. Tracks 9, 10 and 11 had

very loud portions (0 dB) alternating with very quiet sections. After a little experimentation, I learned that I had introduced the noise by running the Clipped Peak Restoration on the whole track. So I selected just the loud (and clipped) portions of the original tracks and ran Clipped Peak Restoration on just the selected portions. I equalized the resulting files and gave them a listen. They were quiet. I didn't experience this problem on any of the other tracks, apparently because the others didn't have such a large dynamic range. (*The Noise Reduction 2.0* User Manual has a Note that cautions: "The Clipped Peak Restoration should only be used for material in which clipping is minimal. Heavily distorted material where most peaks are clipped is often not salvageable.") After reading this Note, I wasn't sure that I could restore the heavily clipped tracks. Since they restored fine, apparently "thousands of clips" is still acceptable.

Rather than repeating details on making the restored CD, please see Chapter 8 and Case Study 2.

SF8 contains a spectrum analyzer which I could have used so this could have been a total *SF8* restoration. But *Noise Reduction 2.0* is a group of Direct-X plug-ins which will run under any of the programs which support Direct-X (see Chapter 7) so using *SF8* wasn't essential. However, the "street" price for the whole *SF8* bundle is less than *Sony* charges for *Noise Reduction 2.0* alone so it makes better sense to just buy *SF8*. I am impressed with its power and easy of use. If I had to settle for just one audio restoration program, I think it would be the *SF8* bundle.

The purpose of this Case Study is to show that post-processing is a very powerful tool. Even if the original recording is less than expected, there is a lot that can be done to fix it.

REFERENCES

1. Frederic Chopin, Polish composer and pianist, 1810 - 1849. Lived and worked in France after 1831.
2. "Ripping" is the common term for copying a playable music CD and converting its cda files to wav files on your hard drive.
3. *Sound Forge 8* is available from <http://www.sony.com/mediasoftware>. It is also available from other vendors at a lower "street" price than from *Sony*. Please see Chapter 7 on Restoration Software.
4. *Spectrogram* is available from <http://www.visualizationsoftware.com/gram.htm>. I'm using version 8.5. The current version (Nov 2005) is 12.3 and the registration fee is \$49.95 USD.

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TDL® Technology, Inc.
Las Cruces, New Mexico USA

