DIGITAL SURROUND CORRECTION FOR THE AUDIOPHILE

Muhamadiyev Abdivali Shukurovich
Isvandiyarova Madina Beknazarovna
e. mail: abduvalim@mail.ru
madimadi14.10.94@gmail.com

The principles of modern Digital Room Correction (DRC) technologies are often misunderstood. There are many articles on this topic, but there are rarely materials that answer the main question - what problems does DRC solve? How it works? And why should an audiophile care? Let's try to answer these questions.

What problems does digital surround correction solve?

Let's start by trying to understand the task of digital room correction. To understand quickly, you need to listen to how your speakers play low frequencies. Let's figure it out together. You need to find music with a lot of bass. The more different low notes there are, the more frequencies we will test.

I chose the song "Spanish Harlem" from the album "The Raven" by Rebecca Pidgeon. This composition features a nice acoustic bass in G major with the classic “I-IV-V” progression. A little later I will explain what prompted me to choose this particular song. You will choose what you like. Let's continue.

What do you need to hear? So, first turn the volume down to a comfortable level. If you have a sound pressure meter (you can use an SPL meter on your smartphone), adjust the volume so that the sound pressure level at your listening position is 77–83 dB(C).

Sit back, close your eyes and concentrate on the bass line and bass notes. Do all low notes sound at the same level? Perhaps some notes are more pronounced? Do you feel like one of the notes is dominant?

This is not an easy exercise for your ears, since we are already accustomed to uneven reproduction of low frequencies. Perhaps many have never heard a uniform bass line at all, so there is nothing to compare with. In general, you will have to spend time “tuning” your ears and concentrating on the low-frequency part of the musical composition. Among other things, focusing can be difficult due to the sound of different musical instruments and vocals at the same time.

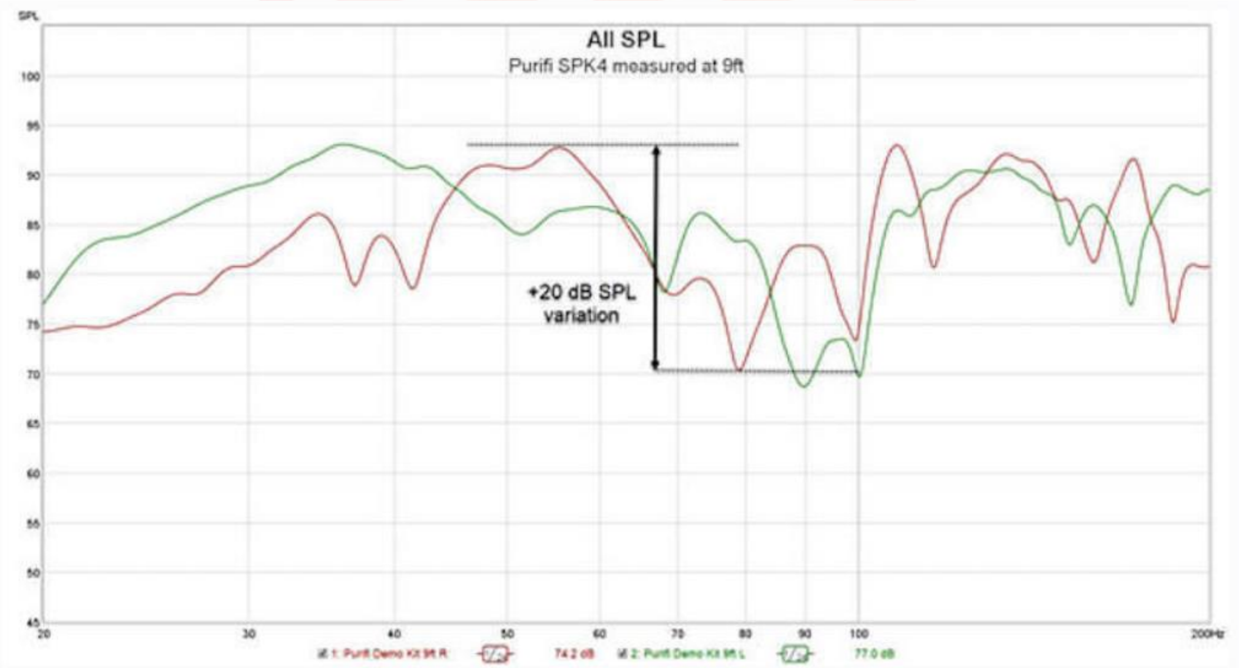
That's why it's better to choose a song that has a clear bass progression with different notes. These notes are easier to hear and understand which ones sound softer or, conversely, sharper and louder. This approach helps not only when you're going to listen to something quiet with a loose bass line (like "Spanish Harlem"), but also if you've chosen a song with richer and louder bass (like Madonna's "The Power of Goodbye")). Once you adjust your hearing, it will become easier to distinguish notes.

Let's return to "Spanish Harlem". Here is the sequence of frequencies of the main notes on which the bass line is built (the melody is based on the aforementioned “I-IV-V” progression): 49-62-73; 65-82-98; 73-93-110.

This is the starting point where we have specific data and values that will help us understand what problem DRC solves. In short, digital surround correction is designed to equalize low frequencies so that all bass notes are heard equally clearly. Modern DRC algorithms take into account different listening areas (points) to ensure constant phase and frequency characteristics.

Why, in fact, do you need to think about uneven bass sound? We'll get an answer soon. Since we already know the frequencies of the lower notes in the song “Spanish Harlem,” we can correlate those bass notes with actual acoustic measurements of the bass response of the speakers in the room. For my measurements, I used acoustics assembled on the basis of the Purifi SPK4 kit, a special microphone and the REW program in standard mode (500 ms, without smoothing). Subwoofers were not used.

Standard settings included microphone capture of sound directly from the speakers, as well as capture of early and late reflections up to 500 ms in the range from 20 Hz to 200 Hz. All this was grouped and displayed on a diagram. We'll focus on bass frequencies below 200 Hz:



The diagram shows frequency response from 20 Hz to 200 Hz horizontally and sound pressure level (SPL) in 5dB increments vertically. To calibrate the microphone I used an SPL meter and pink noise.

Pay attention to the amplitude. The largest jump between two peak values is greater than 20 dB. To our ears, a difference of 20 dB is perceived as a fourfold increase in volume (or decrease, depending on the specific bass note). Also, there is a difference between the two channels.

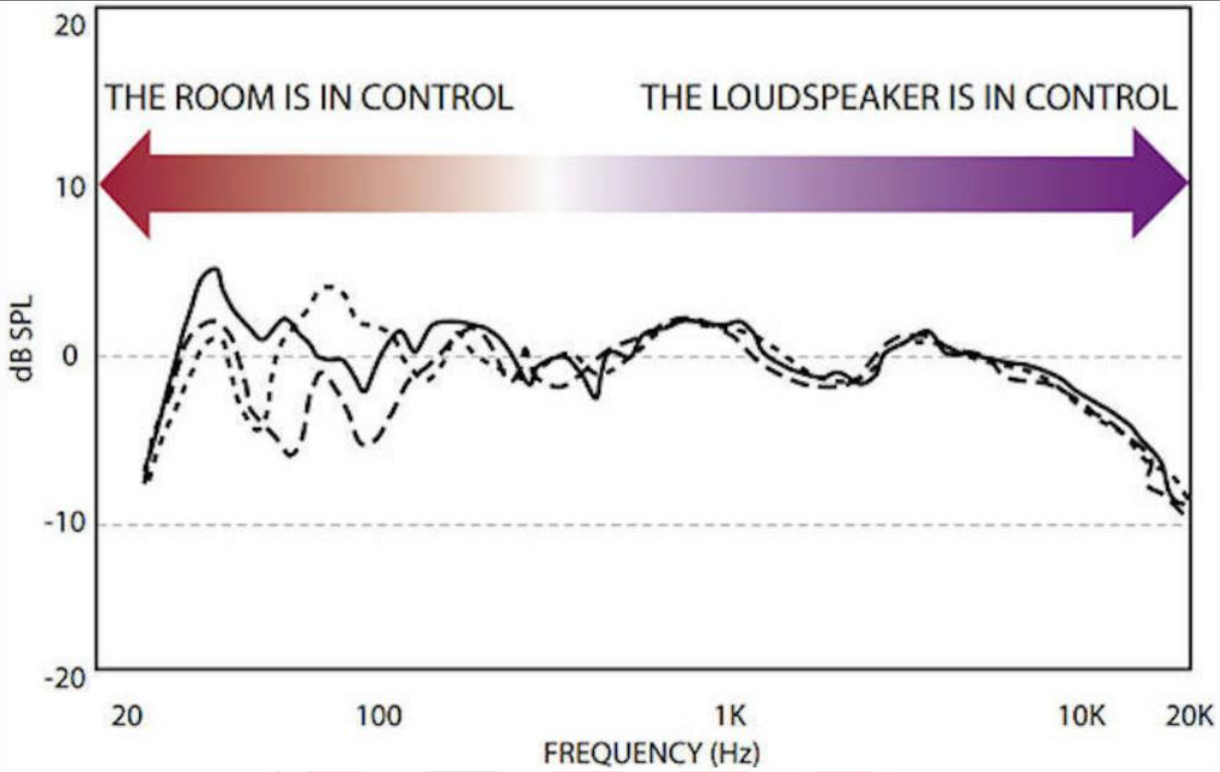
Analyzing the song "Spanish Harlem", we see that the notes between 70 and 100 Hz remained at a low level, and 110 Hz simply resonated in my room. This can also be seen on the graph. Depending on the note, I hear some low-frequency sounds four times louder or quieter. My personal subjective perception corresponds to the objective measurement results showing frequency response in the bass range. We hear the difference in the reproduction of lower register notes - and we see it on the diagram. Why is this the case with low frequencies?

Why does the bass sound uneven?

The answer lies in the size and proportions of the room. Building materials and acoustic preparation also play a role, but in the case of long waves, the most important thing is the proportions of the room. To analyze a room, you can use an online acoustic calculator. For example, AMROC Room Mode Calculator is suitable. By entering the room dimensions into the calculator, you will receive a complete modal analysis of the room.

It's great if you can output audio from your web browser to your sound system. This way you can select any room modes (you just need to hover your mouse) and hear exactly how they sound in the room (don't forget to turn down the volume). This is a good way to experience everything with your own ears. Try it - nothing compares to real auditory perception. It also makes sense to move around the room while listening to a mod: the mods may seem less pronounced in some places, while a buzzing effect may appear in other places.

The harsh truth is that few of us have properly proportioned music listening rooms. In short, our music rooms are more likely to have the wrong modal density. At some frequencies all the room resonances come together. Sometimes this happens at the most “inappropriate” frequency. For example, at a subwoofer cutoff frequency of 80 Hz. It is the low frequencies below the transition frequency (also called the “Schröder frequency”) that form modes, as well as standing waves and resonances. All this leads to the fact that the room is dominated by bass echoes, but not by speaker systems. Re-read and delve into this paragraph - it contains the essence and meaning of using digital surround sound correction. Here's an example of measurements taken in a typical music listening room. The measuring microphone was always at the same listening point, and the speakers changed their position three times, without increasing or decreasing the radius by more than 60 cm:



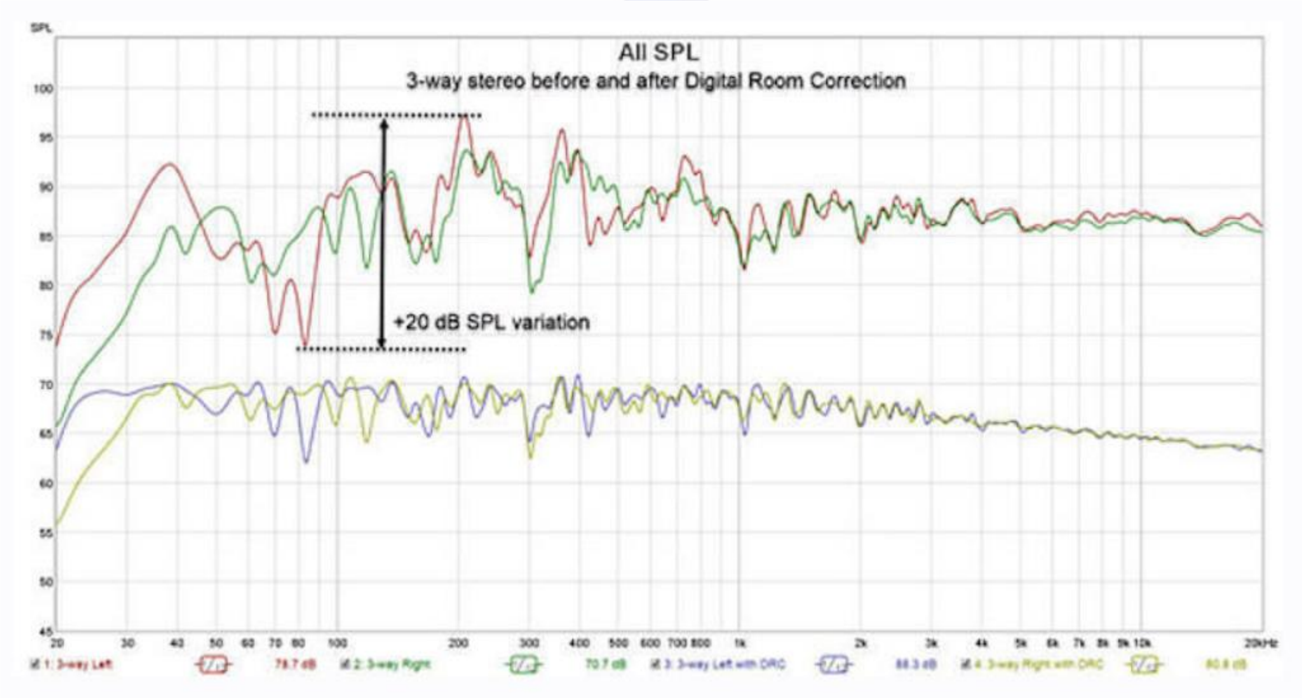
As can be seen from the diagram, the bass response varies greatly, and this depends not only on changes in the location of the speakers - the frequency response is not constant in any situation. The speakers only control the situation above 300 Hz. Sounds from 300 Hz and above are significantly less affected by the room. The correct placement of the speakers and the optimal listening point can change the situation, but most often it turns out that the frequency response changes only in terms of the horizontal distribution of peaks, but the room modes do not go away.

I took the diagram from the works of Canadian acoustics scientist Floyd E. Toole. He claims that over years of research he has come to the following conclusion: about 80% of rooms have a significant impact on the color of sound. According to Floyd, it is the sound of the bass that in 30% of cases is the decisive factor in the subjective assessment of a particular speaker system. Floyd also claims that any speaker can sound better if it uses a bass correction system. The scientist, of course, does not guarantee anything, but suggests trying.

Now that we've heard and measured the "uneven" bass, it's clear that room plays an important role in terms of mod distribution. We also found that the room was largely bass-controlled for sounds below the transient frequency. It's time to learn how DRC systems work.

Bottom line I hope this article was helpful and explained why 80% of music listening rooms are filled with resonances that color the sound of low frequencies. The room is always controlled by low frequencies - and this does not depend on the acoustics used. I hope that your ears will be able to tune in the necessary way to select the right musical material and analyze the sound (this was discussed at the beginning).

Specialized DRC software is able to partially eliminate standing waves, room resonances and modes. To do this, the programs use independent correction of magnitude and excess phase.



Knowing what the ideal speaker response should be, you can use digital equalization to optimize the sound of your system. The right result is clear, collected and intelligible bass. Hearing such low frequency reproduction in your home is a real audiophile pleasure. DRC tools should be viewed as a way to solve problems associated with low-frequency distortion and the correct presentation of direct sound. The software I mentioned can be purchased for $300–400. Add in a $100 USB microphone and you've got a powerful way to improve the sound of your home music system.

In this article we focused on low frequencies, but DRC can be used to create any other filters and time alignment systems. DRC is also suitable for multi-channel setups.