

What You Hear is What You Get

By Gerry Lemay

It's Saturday afternoon and you've just brought home that new subwoofer. Wires are strewn about everywhere, manuals set unopened in the box (we don't need no stinking manuals), and your previous great purchase, the DVD player, sits patiently on the shelf. You even stopped off to buy the latest Star Wars DVD; the kids ripped it open and put it in the player before you had the sub out of the box. The stage is set for the unveiling. The obligatory FBI warning opens the show with the usual fanfare and the home theater experience commences. Soon rich bass fills the room like never before. Shortly afterward, your wife insists on turning it down and wonders out loud if bass is man's way of compensating for other shortcomings. Quietly, after the hoopla draws down, even you begin to wonder if the obnoxious bass is really everything its cracked up to be.

I hear about these little incidents all the time, and frankly, have had similar experiences myself. So what is a home theater aficionado to do? Why doesn't your cousin's system draw the ire of your wife; she seems to really enjoy his movie parties. It must be the wine or what? Typically, this is where I step in. I spend fully half of my time explaining something that most people seem to know already yet fail to fully understand; it's the room, right? Well, ya it's the room but it's also how the equipment is set-up in the room. Everyone needs to understand that good equipment is only half the battle. The best sound is revealed when the equipment is properly installed and calibrated. The fundamental question is; just why does a system sound so good in some rooms and not so good in others? Its answer is revealed with a reasonable understanding of small room acoustics tempered by a little decorating flair.

Element number one; smooth bass sounds better than boomy bass. We've all been tempted to do it; turn up the bass control one more notch. We've all felt the rush as crushing bass vibrates our stomachs. But somewhere between the last seismic charge and the first star ship crashing to the ground we begin to sense a bit of a fatigue. The splash becomes tiresome and is reserved for those moments when the neighbors stop by to see the new toy or, with the wife out, we play our old Van Halen CDs. Oddly enough good sound is not just about booms and roars. Most movie sound tracks are produced by folks who listen to them non-stop for weeks during post-production. These professionals are just as prone to listening fatigue as the next person, yet they have one big advantage. Besides working in rooms specifically designed for sound reproduction, their systems are calibrated to create good sound. The operative word here is calibration.

A smooth frequency response is not an easy goal for the uninitiated. Many folks understand the process of moving a speaker closer or farther from the wall to change its sound. Yet, besides driving a car blindfolded, no other process seems as random in its results. Ultimately, what is correct? Many again seem drawn to the loudest bass and find themselves less than satisfied after the 20th depth charge or so. For those who seek the home theater nirvana, I recommend seeking out a place to hear good sound in the form of

a well set-up AV Dealer showroom or a THX certified commercial cinema. Hearing correct set-up is the first step toward achieving it yourself. It always pays to identify and understand the nature of your quarry. Once you have a clue about what sound is correct you can begin experimenting. The prime rule is to eliminate the fuzzy and annoying booms, replacing them with smooth yet high impact bass. We remove the pain and are able to increase the gain (sorry). The physics of bass is actually very well understood, and speaker or subwoofer placement is the amateurs' way to equalize their sound. A couple of rules of thumb may be in order here.

First, try placing the sub in the corner or for full range speakers, near the rear wall. The corners always accentuate bass modes yielding the loudest or fullest bass. This the starting point because in many cases we put our systems in open floor-planned rooms without the benefit of a dedicated sealed space to contain the bass. This means we are not only filling our listening room with bass but the entire house as well. The result is a sub or receiver running out of gas while trying to reproduce loud transients of sound. You will also find though, that the corner typically yields the boomiest bass. Ouch!

Step two; try changing your listening position. In a small room moving as little as one foot can drastically change the sound of bass. Poor listening locations include sitting against any wall or in any corner. Here "boom" rules and this is definitely not the place for the wife. Additionally, the center of the room is notorious for poor results. There, the most common complaint is about not enough bass. The best location for you to sit is slightly behind and beside the room center. Here all those bass standing waves tend to become more moderate.

Finally, step three; experiment moving the sub from the corner to one of the following positions; at the center of the front wall or the center of the length wall or at $\frac{1}{4}$ of the rooms length or width. Hey, I'm not here to teach a physics class but these are usually the locations of nodes in the world of standing waves. Placing the sub at one of these points can reduce the strength of a particularly boomy frequency. You just need to find which one is most effective. At the end of our calibration, we will consider ourselves successful if we can reduce the level of boom and reveal more of the true character of the bass.

For those who don't like to take chances there is a scientific method behind the madness. A qualified dealer will employ a device called a Real Time Analyzer (RTA) combined with a lot of experience to locate the proper place for your speakers. Consider that besides smooth bass, speaker position dictates many other elements of character to your sound quality; soundstage, focus, clarity etc. There is no substitute for knowing what you're doing to save time and frustration.

Another very useful element is the inclusion of a parametric equalizer in the bass chain. Many new subwoofers include this technology and those that don't can be augmented by an add-on EQ. The operative word here is parametric versus the old graphic EQs. We will equalize only the specific mode or frequency band that is booming. This approach is infinitely better than using a graphic EQ which lower an entire band just to reduce the

effect of one problem mode. To calibrate a parametric EQ test CDs are used in conjunction with sound pressure meters. Some manufacturers have gone the extra mile to create a simplified calibration kit to set up the EQ; it is well worth taking your time to do it right. A poorly set-up EQ can actually sound worse than none at all. Trust me; setting up a parametric EQ by ear is not an option. For the best results I highly recommend a trained technician with a high resolution (1/12 octave) RTA for the job.

Element number two; a little echo (also called reverberation) is good, too much is bad. This has been the stuff of acoustical nightmares since the first ping pong ball was heard bouncing from left to right and back (How many wife's thought their husbands truly nuts when they brought home an expensive HiFi to listen to ping pong ball recordings in the 50s). The ping pong sound track was an early demonstration of the stereo soundstage. Stereo in Latin actually means solid, implying three dimensional. A well set up stereo (or home theater including the center channel) creates a 3D sonic image of a recorded event. We can locate musical instruments in the soundstage created by the speakers and point to their perceived location in the listening room.

What is the solution to too much reverberation? The obvious one would be to install lots of acoustical treatment in the form of fiberglass or foam panels. This is a tried and somewhat true method and it is known to remove many of the sonic irritations reverberation can cause, but simultaneously it can remove much of the warmth and three dimensionality of our sound as well. We need a better more scientifically based strategy.

One old technique involves softening the wall behind the speakers and installing a thick carpet on the floor. Often referred to as the Live-End Dead-End or LEDE approach, this too can improve sound but still yields variable results and isn't the best solution either. The right answer depends on understanding the nature of echo in a listening room and how to calibrate it. Calibrate reverberation?

An echo is the result of a sound traveling from the source to the listener in an indirect path reflecting off of an obstacle such as the walls of our listening room. We do not perceive the reflection as an echo in a typical home listening room because it is heard too quickly after the speaker's direct sound. Interestingly, we perceive most very early echoes or reflections as originating from the same location as the direct (original) sound no matter which wall reflected them. We tend to integrate these earliest reflections (those heard within 50 milliseconds of the direct sound) into a single sound fused with the direct sound. This effect, known as the Haas Precedence effect, is responsible for much of the apparent quality upgrade reverberation seems to add to a source. Voices are fuller indoors versus outdoors (no echoes) and audio systems achieve an added richness and warmth when in the right room. This reinforcement of the direct sound with reverberation is not always perceived as a sonic upgrade though. A degrading effect is audible when the echo is too loud compared to the speaker's direct non-reflected sound. Early reflections that are too loud can act like phantom speakers playing from behind the walls in the room. The end result is one of creating a kaleidoscope of phantom speakers playing multiple soundstages interfering with each other and more importantly with the true soundstage.

So what is the better solution than LEDE? If you are looking for a rule of thumb I have good news. If you are looking for a scientific approach I have even better news. The key is in the earliest reflections. Since the correct soundstage is presented by the direct sound from our front speakers, we need to make sure that the direct sound is the strongest signal to our ears. This is reinforced by the fact that the best source of detail and clarity is the direct sound. If we identify the spot on the wall where an echo bounces from, we can place an acoustical panel there to reduce the strength of the offending echo.

These spots on the wall are called mirror points. Finding them is as simple as pretending the wall is a mirror, a sonic mirror that is. The process involves having your wife or friend run a mirror along a wall while you sit in your lazy boy (the listening chair). At the moment you can see one of your speakers in the mirror you've found a mirror point. As you might imagine there are many mirror points in the room. Each wall has one for each speaker and for each listening position. Marking the location of each mirror point with a stick-on dot might end up making the walls and ceiling look like a machine gun target range. That's right, don't forget about the ceiling, floor and rear walls. One saving grace is that you need only focus on the front speakers including the center channel. The rear channels actually seem to work better if you preserve their mirror points.

Element three is actually a corollary of element two: preserve the good reverberation. A professionally installed theater will usually employ a series of acoustical treatments spaced to treat the mirror points yet not so encompassing to over absorb the reverberation. An expensive but very effective alternative to absorbing panels is to employ a diffusion panel. The benefit of diffusion versus absorption is that the sonic energy of a reflection is reduced by scattering it instead of absorbing it. We eliminate the troublesome mirror point but preserve a lower level scattered reverberation; a good thing.

Without diffusion, we treat only the location of the mirror point preserving the remainder of the wall for those good low level reverberations (simulating diffusion). We reduce the strength of early reflections yet preserve the reverberant envelopment. So much for rules of thumb, how can we treat the worst reflections yet know we aren't over treating the room. This where the science kicks in; measure the reverberation.

There is no substitute for using the right tool. A qualified dealer will employ a device called an Energy Time Analyzer or Energy Time Graph (ETG). The resulting data plot will display the series of reverberations or echoes in a room compared to the direct sound. The analysis will reveal how to surgically remove these echoes without destroying the good reverberation. Good results can also be had by simply experimenting with panel positioning, listening for improvements in clarity and the pinpoint focus of your soundstage. Here again seeking the reference of a well set-up theater or sound system will allow you to understand what you are seeking and perhaps more importantly what you are missing.

The beauty of understanding the science of home theater sound is that you can solve many problems by simple speaker or furniture movements. Speaker movements can

eliminate boomy bass or improve soundstage clarity, bookcases make excellent diffusers and surgically placed acoustical panels are not as expensive as treating the whole room. I like to think of elegant solutions before I bring in the sledge hammer. The process boils down to 1) smooth the bass 2) get ride of those mirror points but never forget the third rule 3) preserve the good reverberation. A properly calibrated system is an experience you must hear to appreciate. I have found that many people don't gain that appreciation until they've grown used to poor sound quality in their own theater then have the light suddenly turned on by properly calibrating the same equipment they've been waiting to upgrade. Calibration is cheaper.

If you want to get some assistance to improve your sound, companies like Quest Acoustical Interiors (www.questai.com) are there for acoustical products, professional analysis and design support. For those who need onsite calibration support allow me to suggest selecting one of the Certified Installers of the Home Acoustics Alliance. You can find one near you by going to the HAA website at www.homeacoustics.net.