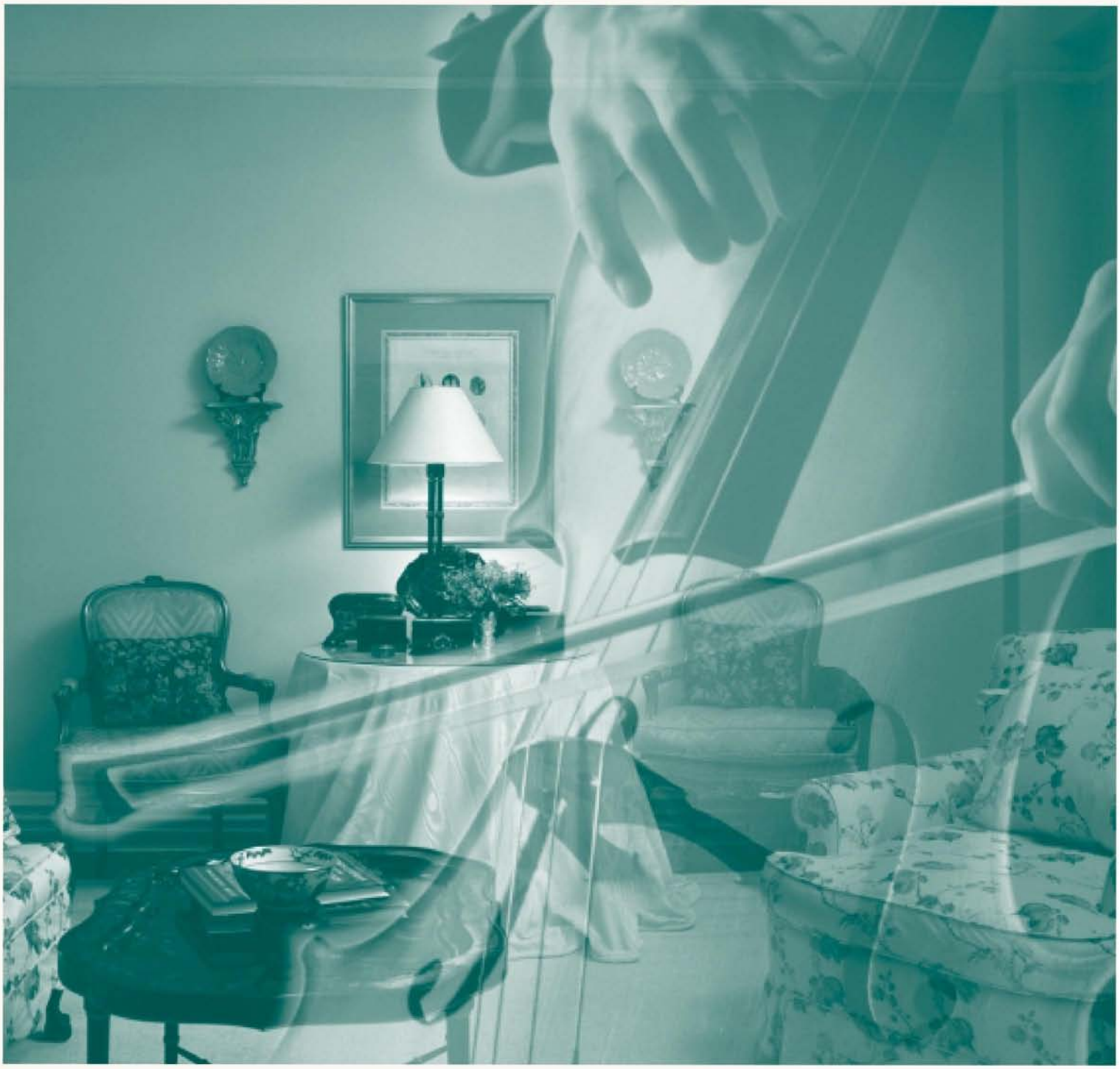
BASS OPTIMIZATION SYSTEM™

Infinity®

TECHNOLOGY•PERFORMANCE•DESIGN



Matching the Loudspeaker to the Room – "Room Friendly" Loudspeakers and the Bass Optimization System

By Floyd E. Toole

Introduction

One of the many complicating factors in the world of audio, for both consumer and manufacturer, is that the listening room has such a powerful influence on what is heard. For the consumer, it means that opinions formed about a loudspeaker in one room may not translate to another. For manufacturers, it means that the performance of their loudspeakers will be significantly changed, for better or for worse, by the choice of listening room.

Over the years, many have attempted to control this powerful influence so that the listening experience is both better and more consistent (as we move from room to room and from system to system). It was once thought that this could be done simply by setting up a microphone, measuring a "room curve" and, with a handy-dandy equalizer, adjusting the frequency response curve until it looked "right." Not so easy. For every system that was improved by such exercises, there were many that were adversely affected because:

1. A simple "room curve" is not a reliable correlate of perceived sound quality at every frequency.
2. Equalization can only "fix" certain kinds of loudspeaker room problems; it is essential to know what can and cannot be equalized.
3. The kinds of measurements and equalizers that have been used have not always been the ones that were needed to evaluate or to solve the problems.
4. Some problems can only be solved with a better loudspeaker.

The loudspeakers and the room together form a system in which what we hear, in terms of sound quality and spatial imaging, is very much a result of a complex combination of the two. In the following analysis of the situation, we will concentrate on frequency range below approximately 100Hz – the bass region.

The Loudspeaker/Room System – Low Frequencies

At low frequencies, the wavelengths are sufficiently long so that acoustical problems are primarily caused by room resonances (also called modes, eigentones and standing waves). Sounds reflecting back and forth, or from surface to surface, can interact at certain frequencies, resulting in acoustic resonances. The specific frequencies at which these resonances occur are determined by the shape and dimensions of the room. The strength of these modes depends on how much low-frequency absorption there is in the room.

If the room is well damped (very absorbent), the modes may not be problematic. At very low frequencies, absorption is not provided by common materials such as fiberglass, acoustic foam sheets or drapery. Instead, it is provided by the walls and windows themselves when they move in response to powerful bass sounds. Sometimes, when building a "special" listening room or home theater, extra effort and expense will be put into making the walls very heavy and stiff. That is good from the point of view of keeping the sound contained within the room – sound isolation – but it is bad from the point of view of damping the room resonances. Such rooms have a tendency to be "boomy." The exact nature of the problem, and its severity, will be determined by how effectively the woofers couple their energy to the room resonances – i.e., the locations of the woofers in the room – and how effectively the resonant energy is coupled to the listener's ears – i.e., the location of the listener in the room.

In the real world, within the constraints of good stereo or multichannel imaging and the demands of appearance, there are severe limitations on where we can put loudspeakers and listeners in a room. Not

In most rooms, the quality of bass that we hear is determined more by

many of us are willing or able to have a custom room designed exclusively for our audio pleasure. So what do we do if we find we have a problem? We equalize!

Infinity's Bass Optimization System

We call our form of equalization Infinity's Bass Optimization System. The difference between this equalization and the kinds that have given equalization a bad name is that here we are not going to allow it to venture into areas that are likely to give us more trouble. Infinity's Bass Optimization System consists of a single parametric filter built into the electronics of the powered subwoofers. As such, it is restricted to addressing only those problems within the range of the subwoofer – up to about 100Hz. It is designed as an attenuation-only filter, so it cannot be used to attempt to fill frequency response dips caused by acoustic cancellations (usually a futile task, resulting only in dynamic limitations and distortion). It is parametric, so that with care it can be tuned to the specific frequency of the most serious problem and adjusted to match the bandwidth of the resonance. Figure 1 is an example of the improvement Infinity's Bass Optimization System can offer.

With detailed listening and some trial and error, the listener can determine the room's most serious bass peak and reduce its negative effect on the rest of the frequency range by adjusting the three Bass Optimization controls, **Frequency, Level** and **Bandwidth.**

While the Bass Optimization System allows the listener to fine-tune the bass response to sound best in a particular room, some listeners don't have the skill or desire to fine-tune their system by ear. In order to facilitate quicker and

the room than by the loudspeaker itself!

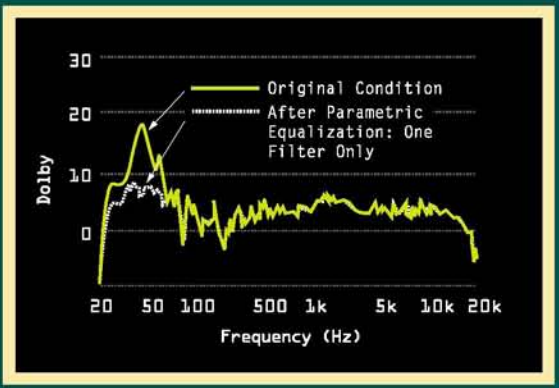


Figure 1. Measurements in a room before and after a single band of parametric equalization was used to attenuate an extremely powerful room resonance. The improvement in sound quality was nothing less than dramatic, with the bass being transformed from boomy, fat and flabby to clean, tight and articulate.

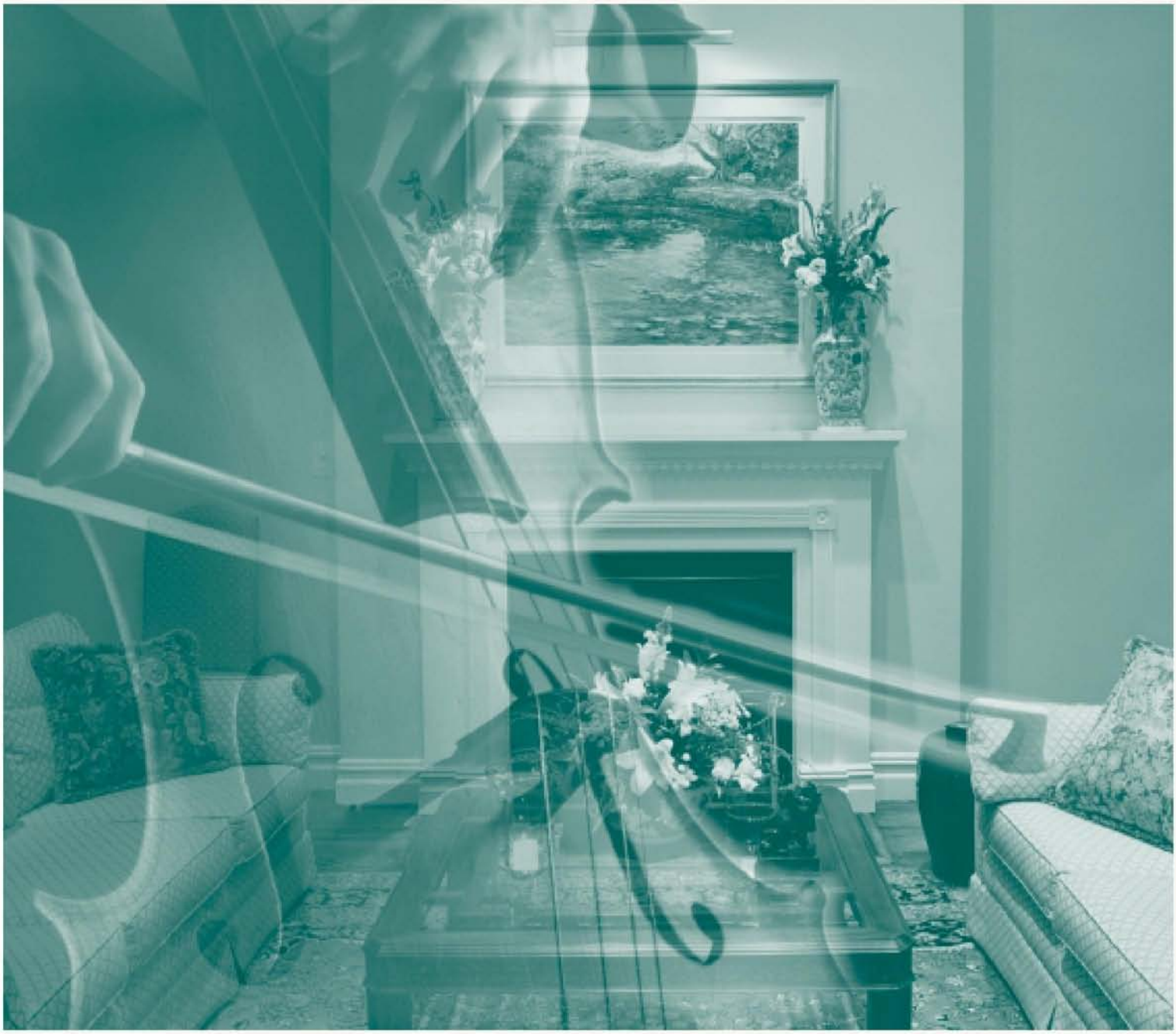
Optional Bass Optimization System Test and Measurement Accessory Kit.

more accurate results, Infinity has developed an optional test and measurement kit that allows the user to perform a series of measurements and aids him or her in properly setting the Bass Optimization System controls. With the addition of this kit, the Bass Optimization System becomes truly room-adaptive. The kit consists of the following: a test CD, a sound-level meter that is specifically calibrated for low frequencies, something we call a "Q-Finder" (a device to help find the width of the measured curve) and, finally, a measurement template. It works as follows. The listener plays the tones from the test CD and records the relative output level of each test tone, using the sound-level meter, on the provided measurement template. After all the tones are complete, the template contains a response curve for the frequencies below 100Hz. The user simply notes the frequency of the largest bass peak, calculates the correct amount of attenuation, and uses the Q-Finder to determine the width of the curve. These three values are dialed into the Bass Optimization System controls located on the speaker. The entire process takes less than twenty minutes.

A reasonable question at this point is whether one parametric filter is enough. In our experience with subwoofers, the majority of installations can benefit from equalization, and the majority of those would achieve most of the potential benefit from a single filter. There are situations in which adding more filters could result in a refinement of performance, but doing so would require many more measurements, as well as an in-depth technical understanding of filters. This implementation of the Bass Optimization System aims to deliver the maximum performance enhancement to the customer, with a minimum of installation difficulty.

Another reasonable question is, if equalization is not recommended, what then **can** be done about major dips in the frequency response? Usually, these result from the specific locations of the listener and/or loudspeakers; dips are **very** position-dependent. Before venturing into the equalization exercise, we therefore suggest that users explore the effects of various small positional changes to see what improvements can be made. Movements of just a few inches often can make huge differences in system performance.

are designed to be listened to *in rooms.*



"Room Friendly" loudspeaker system designs ensure that, regardless of the room, listeners will be treated to the best possible sound quality and spatial imaging. Infinity's Bass Optimization System is the icing on the cake, ensuring that an otherwise elegant listening experience will not be corrupted by a drone of monotonic, "Johnny-one-note" bass and fat, flabby drums. Our job is not done until the listener hears the right sound.

Infinity

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