Performance Media Industries, Ltd.

Go Horns!
2/2006

by A. Grimani

Contrary to what some of you may be thinking (or hoping), I haven't decided to go off topic to discuss college football – although I did watch the Longhorns dethrone the reigning champion Trojans in beautiful high-definition. No; I'm afraid what's on my mind is a little more mundane, but perhaps more practical than reveling in the glory of our collegiate national pastime.

You've probably noticed at recent CES and CEDIA trade shows that a number of horn-loaded speakers are popping up. It may come as a surprise, too, because horns are typically considered (at least in the US) to be fodder for Lo-Fi professional applications where the primary goal is volume and lots of it. Unfortunately, that stereotype has led many people to overlook horns as a very legitimate and beneficial element of speaker design.

To a certain degree, horns deserve their bad reputation. Back in the middle of last century, horns *were* used to increase the output capability of sound systems at a time when amplifier power was limited. Those horns also happened to sound pretty bad, but not because the *theory* was bad. They were simply *bad horns*. These days, horns are much improved, thanks to significant technological advancements over the last fifty years. That's not to say there aren't still bad ones. You can find bad implementation of any technology if you look hard enough!

Now that horns are suddenly all the rage, you should know some of the benefits they provide. First, obviously, is higher sensitivity and increased output through the processes of *compression* and *impedance-matching*. The horn acts as an impedance transformer, improving energy transfer between the driver's diaphragm and the air molecules. Given the same amount of power, a horn-loaded speaker will, therefore, play louder than a similar speaker without horns. Since today's power amplifiers are titans compared to their ancestors, horns may no longer appear to be required for adequate output levels in many applications. I'm sure, for example, that you can find a plethora of non-horn-loaded speakers that play plenty loud in your living room. However, for larger home theaters, like 30' x 20' rooms, you will find that high output

Performance Media Industries, Ltd.
9A Mono Avenue. • Fairfax • CA 94930 • USA
(415) 454 2087 • (415) 454 2171 Fax • info@pmiltd.com

designs become necessary if you want to reproduce all the impact of action films. You need speakers with sensitivity ratings in excess of 94dB, and a horn-loaded design is definitely the easiest way to get there.

Second, horns shape the dispersion pattern of a speaker. They capture all of the sound energy produced by the transducers and aim it – as opposed to letting it randomly propagate out according to the inherent dispersion character of the individual transducers. Most of the time you want a speaker to cover the entire audience but not spray the room at large with stray sound energy. It's virtually impossible to accomplish this without a horn or waveguide to focus the speaker's dispersion. Left to their own devices, transducers in a baffle – called a speaker cabinet – radiate bass frequencies spherically and mids and highs hemispherically. (For the engineers among you, the actual dispersion pattern of the speaker will be narrowed somewhat by the arrangement and diameter of the transducers.) Unless the audience is on both the ceiling and the floor, 180-degree horizontal *and* vertical dispersion is a bit too broad. Interestingly, horns do not always *narrow* the dispersion of a speaker. For example, compared to a ¾" tweeter, a 2" tweeter will produce an extremely narrow beam of sound at very high frequencies. However, if the right kind of horn with a ¾" throat is placed in front of the 2" tweeter, its high frequency dispersion suddenly becomes like that of a ¾"! The additional output capability of the 2" driver is harnessed without sacrificing the ideal dispersion character of the smaller transducer.

Third, horns can provide constant directivity, which is a fancy way of saying that the dispersion does not vary with frequency. The dispersion at 5 kHz is the same as the dispersion at 15 kHz. Notice I said *can*. Horns are not always constant directivity. In fact, the older horns that sounded like megaphones were not. They were, rather, collapsing directivity, meaning that the dispersion pattern narrowed, or collapsed, at higher frequencies. A collapsing directivity horn has laser-like dispersion at high frequencies, which makes it unsuitable for any listener who is off-axis. The sound power response (a measure of total sound energy radiated in all directions) of a speaker with a collapsing directivity horn is severely tilted toward low and mid frequencies, causing the speaker to sound honky when it's placed in a room. But modern horns are constant directivity. Their response is smooth and consistent both on- and off-axis. Listeners spread across a room all hear a similar response, and the reflected sound energy has the proper balance of lows, mids, and highs. Research has proven that constant directivity is one characteristic shared by all speakers that sound good to a wide range of listeners in a variety of rooms.
Understand that speakers with constant directivity can have *different* dispersion patterns. Some have narrow patterns while others are wide. In the professional world, you can tell whether a speaker is narrow or wide by looking at its Directivity Index

specification. Sadly, the Directivity Index, like many professional audio innovations, has never caught on in the consumer market.

Horns aren't a panacea, but they make it easier to get good sound in certain applications – such as large and/or high-performance systems. Speakers without horns are more easily stressed at high output levels, and their dispersion is much too broad for large rooms. If you use horns properly, you can tailor the coverage pattern of each speaker to match the audience even in a large home theater. The pattern must be wide enough to include listeners on the extreme edges, but not so wide that strong reflections from surrounding wall and ceiling surfaces degrade imaging and frequency response. Horns also come in handy for non-dedicated media spaces that may be open to other parts of the house, lack an effective means of acoustic treatment, or require extremely broad horizontal dispersion. Again, horns will focus the speakers' sound energy into a smooth response across the audience and eliminate unwanted reflections.

As I said earlier, it's becoming easy to find high-quality, horn-loaded speakers. JBL's Synthesis line has been around for a while, and they recently released the new Array series. Custom installation giant Triad also makes a couple of speakers, the Platinum and Classic Gold LCR, with what they call "dispersion control lenses." You will also find horns in Paul Hales' Professional Home Cinema (PHC) line. Klipsch, one of the worldwide leaders in horns for commercial cinemas, uses horns in all of their speakers, including the relatively new THX Ultra2-certified models. These are just a few of the brands that are implementing horn technology in their speakers to improve the sound quality of home audio systems. Give them a try!

This article is based on a column published by A. Grimani in Residential Systems magazine February 2006. Chase Walton contributed to this article.

Performance Media Industries, Ltd.
9A Mono Avenue. • Fairfax • CA 94930 • USA
(415) 454 2087 • (415) 454 2171 Fax • info@pmiltd.com