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soundInnovations: the manufacturer's view

Blue Sky: Evolution and the Art of Speaker Design

by Pascal Sijen and Rich Walborn

Through the ages, science and art have always been closely linked. These days, people have forgotten how much individual artistic talent goes into truly magnificently engineered products. An example of a product that requires a considerable amount of technical and artistic talent is an accurate studio monitor. This article will show how a new technology, known as BOO, can bring artistic vision and ideal acoustic performance to the marketplace more quickly and take out much of the guesswork.

Designing a modern loudspeaker involves many factors, including: output requirements, room acoustics, directivity requirements, psychoacoustics (how people perceive sound), and design philosophy. Design philosophy can also be interpreted as the artistic vision for a product. Artistic vision/design philosophy is typically made up of the factors that a company or engineer has found through research and experience makes a speaker sound "good." For Blue Sky International, these factors usually include such things as smooth on- and off-axis frequency response, flat on-axis response, a certain output requirement and a wide listening window.

Unfortunately, the process of getting from a set of components and the necessary cabinet to a "good"-sounding speaker is typically hit or miss at best. Prior to starting the design of a loudspeaker, a manufacturer will typically take the performance data of the drivers,

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Roger Charlesworth

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It's Playback Time

Big consoles are not yet obsolete. In film, television, and music production, large-format recording, mixing and on-air consoles currently remain unmatched in the complexity of mix paths, the sophistication of control surfaces, the scope and scalability of I/O and mix structures, and the ability to operate in real time. In the long term, our concepts of console and workstation will converge, which we see beginning as more consoles begin to accept plug-ins or support dedicated reverb and delay effects.

While the knob-encrusted behemoths may hold their own for some time, they are falling behind in one fundamental area that gives workstations a big advantage. Consoles don't record and playback audio. While this was an enormous technological hurdle a few years ago, today it's a piece of cake. By integrating audio recording and playback capabilities with other console functions and by cross-referencing multitrack audio data and console metadata within one environment, console manufactures could greatly enhance the current and future viability of their products. Based on recent developments in disk recording and taking advantage of the modularity of modern console

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BURBANK, CA—Royer Labs has released a new demonstration CD intended as an introduction to the company's modern ribbon microphones, and as a tool for Royer owners to learn new recording methods and expanded uses of Royer ribbon mics (for more on the mics, see page 66). The CD contains a wide variety of recordings, mostly short excerpts (20 to 80 seconds) of tracks ranging from Grammy-winning, major-label productions to home recordings made with literally one mic and small hard-drive systems.

John Jennings of Royer says, "I've had hundreds of tracks show up on my desk that were cut on our mics, and I've always thought that people needed to hear this stuff. So much of it sounds so damn good!"

Dialog throughout the CD tells which mics were used on each excerpt of music and, on some pieces, gives information on how the microphones were placed. The CD's booklet has technical notes on the recordings. The CD ends with five tracks of microphone comparisons made by Steve Albini at his Chicago studio, Electrical Audio. Royer also maintains a demo CD page on its website that lists the tracks and shows descriptive photos of some of the recording sessions.

The CD's dialog was cut on a Royer R-121 and gives an idea of how the microphone can perform in voiceover and broadcast applications. The Royer Labs demonstration CD is free ($3.50 S&H charge in the U.S.) and can be ordered by contacting Royer Labs.

Royer Labs
Voicelink: 818-760-8472
Weblink: www.royerlabs.com

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design a box and then start the process of modeling a crossover and EQ. Typically, a software program is used that takes into account some of the driver parameters and the box parameters and then creates a "rough" equalization and crossover design. The problem with this simulated crossover network is that the software rarely considers on- and off-axis frequency response, electrical response and the many ways to get to the same point.

Additionally, the real-world measurement data rarely correlates with the predicted acoustic response and always requires many tweaks. These tweaks can take a huge amount of time and are akin to a painter having to try hundreds of mixtures of paint, then paint the entire canvas and then start over again because it doesn't look right. This process is wasteful and time-consuming, plus it distracts the engineer from getting to the "artistic vision" and acoustic performance criteria that are important to him or her.

To deal with this problem, Audio Design Labs created a software program called BOO, which is an acronym for Binary Organic Optimization. BOO combines a high-powered electro-acoustic simulator with an optimizer based on a genetic mathematical algorithm called differential evolution. Genetic algorithms are simplified mathematical models of the biological processes that organisms like bacteria use to mutate and evolve. You can apply the same strategy to optimize electro-acoustical circuits. In this case, the speaker is the organism, the crossover the DNA, and the components are the genes.

The program is given a target response curve, which is the goal of the evolution process. The program then creates a population of organisms (speakers) with genes (component values). Then parents are selected out of the gene pool and combined with a randomized vector (mutation) to create children. The children that match the target better than their parents survive (evolve). The ones that are inferior to their parents die (don't survive). Thereby, a new population of organisms is created, and the process repeats until the process can evolve no more (the crossover is the best it will be).

BOO has now created an optimal crossover design, which takes into account the many complex characteristics of the drivers and the enclosure. Multiple parameters can now be evaluated, including the electrical signal that will be sent to each driver, the on- and off-axis frequency response and how close the system performance will get to the design goal. If the system doesn't perform as desired, changes can be made (new tweeter, woofer, different box, new crossover topology, etc.) and BOO can rerun the evolutionary process until the system is performing as desired.

At this point, it is time to build a real-world crossover and speaker system, measure the performance of the product, compare it to the predicted results and move on to the next step of the design process—listening tests. It must be said, that it is extremely rare for BOO's predicted performance to be off by any great degree (if any). In fact, real-world measurement errors have been discovered using BOO's predictions.

BOO is a proprietary technology first used in the development of Blue Sky International's Sky System One, made up of SAT 6.5 and SUB 12. The Sky System One conforms to THX's rigorous standards and has been approved for use in THX pm3 Certified Studios. The SAT 6.5 biamplified satellite speakers feature a cast-aluminum frame, 6.5-inch hemispherical driver, and a 1-inch, dual-concentric, diaphragm tweeter with integral wave guide for superior off-axis response.

The SAT 6.5 is powered by two custom-designed, 100-watt amplifiers with an optimized electronic crossover. The Blue Sky SUB 12 was specifically designed to complement the SAT 6.5, and features a cast-aluminum frame, 12-inch forward-firing driver with 2-inch voice coil, and a dedicated 200-watt amplifier. In addition, the SUB 12 has a built-in 2.1 bass-management system with a fourth-order, 80 Hz Linkwitz-Riley low-pass filter and second order 80 Hz high-pass filter for the satellite.

Later this year, a white paper will be made available on the Blue Sky and Audio Design Labs websites (www.abluesky.com; www.audiodesignlabs.com) laying out in greater detail the technology behind BOO. As a side note, no embryos were destroyed in the development of BOO, but we may have lost a mouse or two.

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