Hardware Tech

Steve Curd
Co-founder and CEO
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I'm about to take you inside the new VSX headphone, part of the Steven Slate Audio VSX room and speaker modeling system. We partnered with Steven Slate Audio to help them achieve the most natural and authentic binaural listening experience possible. We started from scratch, inventing new technologies and using premium materials to deliver unparalleled linearity, bass response, and of course, comfort.

All headphones start with a driver that converts electrical signals into soundwaves. What makes the VSX driver so unique is that it's made of beryllium, an incredibly lightweight and rugged metal commonly used in defense and aerospace. Why beryllium? Because it creates air vibrations that are far more authentic and realistic than typical plastic drivers. This lets you listen to your tracks with extreme clarity and transient detail. A beryllium driver is rugged enough to take the abuse of a high-output console and sensitive enough to work well with low-powered smartphones or portable music players.

To protect the high-performance driver, we utilized an exoskeleton made from aircraft-grade anodized aluminum. This creates a highly predictable and consistent performance yet is lightweight enough to be comfortable for those 10-hour mixing sessions.

We also added custom tuning circuitry to ensure authentic frequency response for a completely blank canvas for the VSX software.

Next, let's talk about the ear cushions. We spent months testing different combinations of materials to ensure that the cushions are not only comfortable for hours, but are also phase accurate and optimized for our beryllium drivers. To test our cushions, we bought the same machine used by NASA to test them, and ensure the VSX headphones will reproduce your mix perfectly.

One of the most revolutionary features is our patent pending APS, which stands for acoustic ported subsonics. APS routes the unused air vibrations from the BACK of the driver through specialized channels in the headphone chassis, essentially turbocharging the ear cushions themselves! This enables VSX to reproduce lows like you've never heard before in a headphone by authentically recreating the sound of massive subwoofers.

We then subjected them to harsh conditions, everything from sweat simulations, drop tests onto concrete, extreme temperatures, and extended high-output listening so that your VSX headphones will be ready to perform right out of the box.

This awesome piece of engineering is only half the story.

When coupled with the VSX plugin, you can produce and mix your music in pro studios, mastering rooms, clubs, cars, boomboxes, and more.

Recreating realistic environments

What are transfer functions?

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Recreating realistic environments - what are transfer functions?

Let's differentiate between Anatomical Transfer Functions (like Head Related Transfer Functions or HRTF) and Scaeva's Spatially Related Transfer Function (or SRTF).

For context - In nature, we always hear in 3D stereo. Both ears are equally engaged, picking up every audible sound from every direction to then integrate our surroundings into a single perception, or mental image in real-time. For example, if I snap my fingers the sound waves travel through the air, striking every surface in this room at every angle, changing as they reflect. Ultimately these waves are joined as they arrive at each of my ears independently. Since they have traversed different paths and have gathered different sets of information about the environment around me, each ear perceives the sound differently.

Our brains use minute differences in phase (timing), reinforcement and cancellation (reverb) and frequency curve shaping (EQ) for each wavefront as they approach our ears. And the way we perceive (and interpret) sound is shaped in two physical ways: First, the shape of our ears, the size and shape of our head, the amount of hair on our head, and even our shoulders uniquely modify the sounds we hear. This is often referred to as the head-related transfer function, or HRTF. But just as importantly, before sound waves approach our head, they are first shaped by the physical environment in which they are heard. Some waves approach us directly, yet others are uniquely modified by reflections and absorptions that occur as they traverse the physical environment. We refer to the way our perceptions are affected by the acoustic environment as the space-related transfer function, or SRTF.

With headphones, we completely impede our brain's natural attempt to piece these sets of complex wavefronts into an integrated audio picture; in other words, there is no meaningful SRTF. The right ear hears only what is emitted from the right headphone driver, unaffected by any external environment, and the left ear hears only what is emitted from the left headphone driver. After considerable testing, it became clear that this lack of spatial influence on the sound was the principal reason traditional headphones are not ideal tools to create professional mixes. Of course every recording engineer, producer and sound designer already intuitively knows this; I believe we now know why.

Ear scans?

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Ear scans?

There’s a lot of chatter out there about ear scanning. I'm going to examine whether we need a physical scan of your ears to accurately reproduce fully immersive spatial audio.

Head-related transfer function, or HRTF, algorithms attempt to shape the sound based on the physical shapes of our ears: “fatter” pinna (the outer flap of cartilage and skin around our ear) absorb more high frequencies, plus each ridge and wrinkle inside of our pinna reflect and absorb sounds at different frequencies in different ways. Of course we can’t remove our pinna when we put on headphones, so why would we re-apply their physical characteristics if they already affect the sounds we hear?

Some advocates of binaural recording believe that recording music using a simulated human head, with simulated ears, can solve both the HRTF and the spatial perception problems by capturing sounds the way a human would. However, again, we already have fully functional ears, complete with (hopefully) intact pinea! Using a binaural recording head is essentially the same as listening to music through your ears, after it has passed through someone else’s ears. None of this makes sense.

So we approached the problem from an entirely different perspective. The three hypothesis behind the thinking are as follows:

1, You already have a functioning set of ears, with intact pinna. Any attempts to recreate the effects of our physical biology (e.g. ear shape analysis or HRTF) will not solve the fundamental problem, and in fact will introduce new problems.

2, We never naturally hear sound from only one ear at a time (to test this, hold your hand over one ear for 2 minutes and think about how this affects your perception of sound -- it is completely unnatural and annoying). Yet we do this with headphones all the time. Therefore it is impossible to resolve this challenge without somehow intelligently modifying and combining multi-track sounds to simulate how they would be detected by our two ears.

3, Finally, The physical environments in which we hear sounds are massively important to our perception. Due to the factors I mentioned earlier, the way in which sounds are modified and combined is highly dependent on the acoustic space in which we hear them. (Otherwise, why would recording studios invest hundreds of thousands or even millions of dollars to acoustically treat “perfect” control room spaces?)

To summarize, we discovered how to create the perception of authentic spatially-relevant audio through a combination of high-precision transfer functions, nonlinear processing and high performance reproduction devices. Through our innovative approach of digital and analog processing, which we refer to collectively as SR-Audio, Scaeva has achieved strikingly accurate acoustic 3D emulation.

What is Spatial Audio?

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What is Spacial Audio?

I’m going to share how we create a powerfully immersive experience, built using psycho-acoustic principles to a create a fully dimensional soundscape

Recording in a studio is the equivalent of creating music in a clean room, so artists later add in reverb - a mild environment simulation- to make the listening experience feel more natural. We took this concept further, and created a system to accurately and precisely capture the acoustic properties of real world environments, then enabling playback of any existing track within them. In fact, we have created the most natural and realistic sound reproduction system outside of a large scale studio.

We had to innovate with numerous new approaches to accomplish this.

First, we developed a digital shaping algorithm which we call Quadvolution, to elevate the precision of spatial emulation. By starting with standard impulse response methods, we uncovered and overcame fundamental shortcomings to significantly improve the fidelity of the result. We also tackled what we called “the bass problem.” Speaker systems have the benefit of large physical size, enabling the movement of large volumes of air neces-sary to reproduce low frequency sounds. Through a combination of digital and analog means, we invented new ways to dramatically improve the accuracy of bass reproduction and perception in the absence of a subwoofer. And we integrated these technologies with numerous others to develop what we refer to as InSitu Audio.

To put icing on the cake, we developed a new physical headphone platform which delivers a more organic, precise experience due to improved transient response and bass reproduction. In fact, this is the headphone used in the new Steven Slate Audio VSX room and speaker emulation system.

Discovering Spatial Relevant Audio

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Discovering Spacial Relevant Audio

It has been a lifelong curiosity and journey that led to our first spatial emulation breakthrough. As an early musician, and armed with just enough knowledge of the physics of sound to be dangerous, I have always been baffled by the perceptual differences in how music sounds in headphones versus how the same content sounds coming from loudspeakers in a physical space. For example, I remember saving up to buy a reel-to-reel tape recorder as a teenager so that I could tape touring bands, then duplicate and sell cassette tapes to my fellow students. I would find ways to meet the bands, personally set up microphones before the show, then during the performance while the tape was rolling, I would alternatingly listen bare-eared, then with headphones. Most of these live shows were in gyms or auditoriums, so there was plenty of spatial shaping occurring! Since that time I have never been able to shake the feeling that there was something fundamentally different about how I perceived music when listening to headphones. It seemed to me that I was somehow missing something quite basic. I later took a job as a recording studio runner one summer, spending countless hours moving between the live room and the control room, marveling over how remarkably differently those two spaces shaped the sound coming from the speakers. Fast forwarding a few decades, one musician daughter and four startups later, Wendy Curd, Scaeva Co-Founder, finally convinced me that it was time for me to refocus this nagging curiosity into making a difference in the music industry.

We began with research: by talking with numerous experienced professionals in the sound industry ranging from film sound designers to recording engineers to platinum record producers.From many discussions a universal truth emerged: that the fundamental psychoacoustic differences in how the brain interprets sounds in headphones versus in a physical space was a significant barrier to producing and enjoying content.

At first I believed it was related to the physics behind how the transducers in headphones converted electrical energy into air motion - in other words, the coupling (or transfer function) between electrical energy and air vibrations. I worked with a local inventor who held an interesting patent for a new headphone transducer. However this turned out to be a dead end: unfortunately the problem was much deeper and more complex, **having to do more with how we as humans perceive sound, versus how the sound was being reproduced**.

It was this realization that ultimately resulted in the past 3 years of research, invention and validation, leading to Scaeva's solution to this immense problem of representing spatially-relevant audio in stereo headphones.