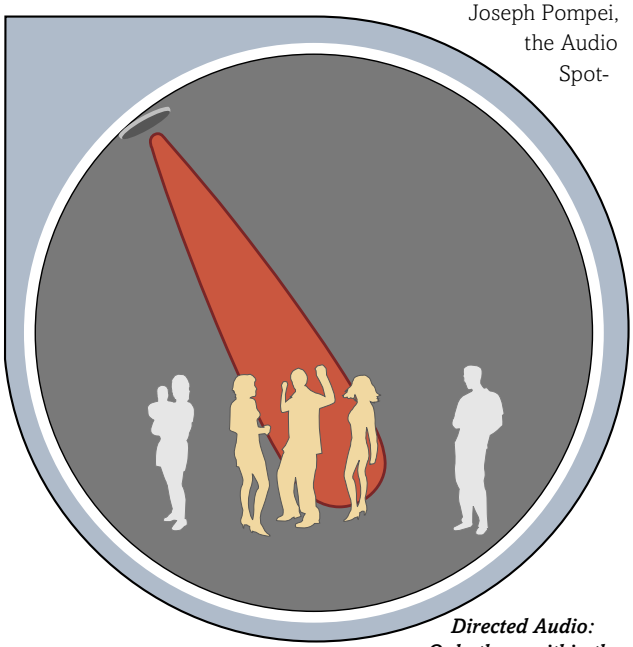
Holosonics Audio Spotlight

In an age where every speaker manufacturer is trying to gain a competitive edge with another patent-pending three-letter acronym, it is interesting to reflect that the fundamental design of virtually all speakers hasn't changed in nearly 80 years. Sure, this moving coil design has become ever more efficient as we've attempted to more accurately reproduce the full frequency spectrum with a coherent phase response. We've seen direct radiators, divided-range systems, horn loading, dual-concentric designs and, more recently, constant Q and a return to the concept of the line array with specialised wave guides and enclosure/crossover topologies… all seeking to address the phase and frequency compromises associated with multiple drivers in a single enclosure. In the end, all our endeavours have been to somehow circumvent one over-riding limitation, namely that the moving coil transducer is essentially omni-directional in nature. But what happens if we start from a different paradigm? Enter the Holosonics Audio Spotlight… "The Audio Spotlight is to sound what the spotlight and laser are to light." It is a grandiose claim, so does it really work?

The answer is, a guarded, 'yes' but with several caveats. The pattern control of the Audio Spotlight's flat transducer disc is undoubtedly impressive. It produces a coherent beam of sound roughly equal to the disc diameter. The Audio Spotlight doesn't actually emit audible sound *per se*. The beam it generates is inaudible ultrasound (in the order of 60kHz). It is, in fact, the interaction of the ultrasound and air that produces a 'virtual source' in the audible frequency range. So is the 'spotlight' analogy valid? Dr. Joseph Pompei, the Audio Spotlight's designer certainly thinks so: "The traditional loudspeaker is much like a lamp-sound that is created spreads everywhere, filling the room with sound. The Audio Spotlight is more like a spotlight, or laser, directing sound to a specific place, much as is done with modern lighting. It controls *where* sound goes."



Directed Audio: Only those within the beam can hear the sound.

The essence of the effect relies on the non-linearity of the air around us. What's 'non-linear'? By definition, a non-linear response introduces new frequencies that were not originally present. The basis of the non-linearity of air relies on the fact that the speed of sound in air is locally pressure-dependent. That is, the peaks of the wave travel at a slightly different speed to the valleys. This changes the shape of the wave, and introduces new frequencies not in the original signal. In traditional loudspeaker design, the non-linear effect is present, but is generally ignored. Dr. Pompei's stroke of genius was to work backwards from the audible input to synthesize the appropriate ultrasonic signal which generates the desired audio signal. Needless to say there is some serious mathematics involved here and much of the development of Audio Spotlight was undertaken as part of Dr. Pompei's PhD at MIT.

So what does it really sound like? To dig a little deeper than the hype I needed to have a really good critical listen and perform a few empirical tests. EAV (which is distributing this product in Australia) kindly sent out a demo unit. The Audio Spotlight is a flat disc (I had the 24-inch disc but there is a smaller version as well) and the kit comes complete with the transducer disc, all cables and a proprietary amplifier/processor which has drive, high/low shelving and signal lights. I listened to a range of program material, made FFT frequency/phase response traces with pink noise and measured SPL at various distances. It is significant to note that accurate measurements were difficult to make. I was measuring an extended low frequency response as well as a modulation of the measurement signal level. I put this down to the AM (amplitude modulation) used in the processing stage along with possible radiation pressure from the ultrasound. Microphones, even a good one like the B&K 4007 I used, can be fooled. Radiation pressure can change at an audio rate and may deflect a microphone diaphragm at lower frequencies showing what appears to be much more extended low frequency bandwidth than is audibly perceived. The tests were performed in a rehearsal room and outside (free field) in a public space. The first and most striking factor is that outside the beam soundfield you can hear virtually nothing. This is less true in a room, as reflections add the beam audio to the ambient noise of the room (still a reduction of 30-40dBA was impressive with as little as 15 degrees off-axis). Standing on-axis, the Audio Spotlight sound feels as if it is 'inside your head', you don't get a sense of localisation that you would with a conventional speaker. This effect is caused in two ways. Firstly, the sound is quite literally being created right next to your ears, and secondly, the lack of room reverberation

in the beam path causes it to appear as sounding very close to you – there's nothing to tell your ears that it is far away. Inherent in the conversion from ultrasound to audio is a natural 12dB per octave slope. Less ultrasound is needed to create higher frequencies than low frequencies. A tradeoff exists between maximum output level and low frequency reproduction. The high/low shelving knobs on the processor/amp unit assist in setting the gain versus bandwidth of the unit. The bandwidth is not quite so impressive – a little better than a telephone call (about 400Hz to 4kHz). It would be fine for spoken voice and background music but do not expect hi-fi. The technology is still in its infancy and it may be some time before we see high quality reproduction of music.

This technology is not going to rock the world as we know it; at least not in the foreseeable future. The main market for the Audio Spotlight will undoubtedly be museums, galleries and other public spaces where reducing background noise is desired. It is interesting to note that Holosonics is in negotiations with several interested parties. Most notable of these is Chrysler (which is interested in the concept of multiple discrete sources for automobiles) and U2 (who are interested in the technology for moving sound – think moving light, but with sound). In the longer term it is quite possible that this technology will represent a seminal moment in the relationship between humanity and sound. The invention of the phonograph forever changed our relationship to sound. So too did headphones and the telephone.

The Audio Spotlight's inventor, Dr Joseph Pompei.

In the public domain, however, we are constantly immersed in sounds that are a shared experience. The roar of the crowd at a football match lets you know a goal has been scored, even if you're under the stand buying a beer. We can hear the bottom end of dance party rockin' from a kilometre away. What are we to make of a world of discrete soundfields where sound can appear inside the head of your companion but not yourself? Food for thought. – *Hugh Covill*

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