

Stereo Made Whole – Do You Need It?

Ambiophonics and the path to immersive reality

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Ambiophonics positions two speakers close together in front and uses crosstalk cancellation for 120°-wide, undistorted music, movies, & games (stereo-compatible). *PanAmbio* adds speakers in back for 360° surround (5.1-compatible).

You can quickly determine whether it might be worth your time to study and try Ambiophonics audio technology by considering these three situations:

1. I don't have a lot of money, but would like a more realistic, immersive experience from my stereo, laptop audio, or home theater – and my ears work;
2. I have a lot of money and would do anything to get back the spark I once felt from my CD/vinyl collection – and the performance of my system;
3. I am a scientist/engineer, moderately skilled DIY-er (do-it-yourselfer), or open-minded audiophile who enjoys experimenting – and good results.

If you identify with two of the above, you'll risk little to read on and discover Ambiophonics. (On the other hand if you're totally satisfied with mp3 quality, Ambiophonics will still work, but might not mean enough for you to venture beyond your iPod®, old wives-like conventions, or brand name suppliers.) The reward will be the enjoyment of realistic sound.

Cost? Implementing Ambiophonics ranges from free (except for your efforts) to the cost of a high end preamp/processor that features it. You probably have most of what you need: Your library of music, movies, and games in stereo or 5.1 surround; your audio system with at least two good speakers (plus subwoofer); and working ears and brain. You also have the need not to be bored, nor to suffer acoustically-based distortions that wreck listening quality, nor to be missing quality

that has been captured in your recorded collection, nor to have lost the value you've invested in your gear.

What's missing is some way of reversing these losses. How? Understand what the distortions are and how to reduce them. Then modify your setup using Ambiophonics so that most every stereo or surround recording makes it to your brain with far less spatial distortion, raspy comb-filtering, muddied transients, and lack of "air" that are caused simply by using two speakers angled 60°, as in conventional stereo. The inventors of stereo were aware of these issues, but they were the least of the problems with the technology available in 1933. Today we can do much better.

In brief, Ambiophonics completes human binaural hearing. It is in fact *speaker-binaural*. Ambiophonics works like "virtual headphones" not for just correcting, but for avoiding in the first place the derailing acoustic distortions above that are unavoidable with speaker-stereo. Of course you could use ideal headphones, but these would not allow the tiny head movements we use unconsciously to localize sounds, to be comfortable, or to allow at least one other person to listen. Restoring binaural hearing preserves the listener's individual head-related transfer function (HRTF), which limits listening to a "sweet spot" by one or two persons.¹

¹ Ambiophonics is for critical personal listening or professional monitoring by one or two persons located on the line bisecting the angle between speakers. With an imprecise layout, or listening off-axis, Ambio processing will not cancel as intended at the listeners' ears and cause audible artifacts.

Ambiophonics is not new. It's an amalgam of existing technologies that are largely in the public domain. Ralph Glasgal, Angelo Farina, Robin Miller, and other researchers on the "team" might just wait until a big manufacturer "invents" it, but meanwhile are making it available through enlightened suppliers of audio hardware and software, and with free DIY tools on the Ambiophonics Institute website.

For a quick experiment: temporarily position two speakers and try the pre-processed music excerpts at www.ambiophonics.org/audiofiles/. If you hear no difference, something's wrong. If you hear a game-changing difference, welcome to the cognoscenti.

To summarize the advantages that will apply to most stereo and 5.1 recordings (music, movies, games, broadcasts) of Ambiophonics implemented on stereos & home theaters, PCs & laptops:

- Undistorted tone color (timbre) of important center sounds (soloists, dialogue) by eliminating stereo's raspy comb-filtering of phantom images;
- Increased clarity by eliminated stereo's crosstalk that muddies transients, and results in lack of air.
- Spatial distortion ("hole-in-the-middle") reduced so that instead of attention being called to stereo's two speakers, speakers and front wall disappear;
- Spatial expansion of perceived image width from stereo's 60° between speakers increased to 120°, equal to the recording angle as captured;
- Imaging accuracy, localization, and therefore tone-color (localizing early reflections) are all significantly improved over conventional stereo.
- Full 360° surround sound (5.1-compatible) by adding another speaker pair in back. Imaging and tone color are improved over conventional 5.1.

Importantly, the problems that Ambiophonics fixes are not inherent in well-made recordings themselves – clear, timbrally correct, spatial accurate hearing cues are locked away in your CD/vinyl collection awaiting proper replay. Problems are caused simply by using speakers angled 60°, as in conventional speaker-stereo. To make your recordings whole again, Ambiophonics uses speakers angled 10~20° and crosstalk cancellation DSP to effect speaker-binaural reproduction that is, while surprising, well worth implementing.

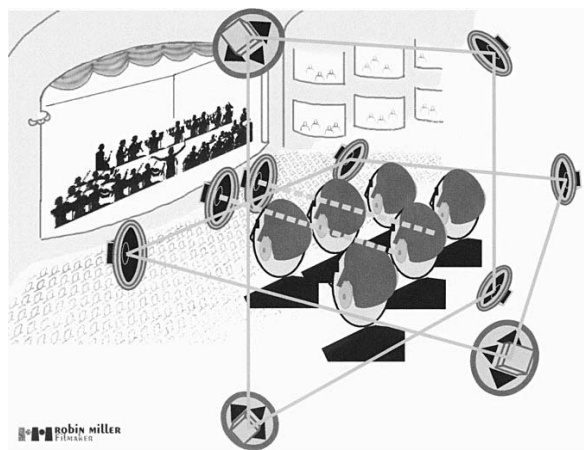
Appendix – Essence of hearing and recreating "reality"

Since the mid 1950s when stereo took off, consumers and recording engineers alike thought of it in visual terms, assuming it was only important to reproduce sounds coming

from where we would see musicians on a flat stage, within an aperture 60° wide and with no height. Surround sound (360° horizontal circle) has had a tough slog against this belief, despite the enjoyment people experience from sitting in the best seat in a concert hall, where the reflected sound energy from around, above, and even below is greater than the sound energy from the stage. In life, we hear a sphere.

Our hearing system has evolved so that the *differences* between sound signals developed in our ears cue our brain as to direction (e.g. localizing a tiger approaching from behind) and spatiality/ambience (e.g. the size of our cave from wall reflections). Direct sounds and early reflections arriving from any spherical angle are filtered by our individual HRTF including pinnae (outer ears), head, & torso for the brain to interpret by associations learned from childhood to discern front from back, up v. down. Beyond a sound's *locatedness*, it is *reflections arriving over time*, each "colored" differently by angle per our HRTF, that are integrated into the holy grail of auditory enjoyment, live or recorded, tone color or *timbre*.

True, we're better at left v. right in front (accuracy of about ±1°), but stereo's meager 60° aperture ignores most sound cues and energy developed in acoustic spaces, and so can't achieve "real." Any direction a sound comes from around the entire sphere our ears are immersed within contributes to life-like quality if it is recorded or synthesized and reproduced by an audio system. After 5.1/6.1/7.1 will come full-sphere 3D technology – and immersive reality!



Next? High Sonic Definition 3D (Pat.) captures, encodes in 5.1-compatible form, and decodes full-sphere 3D to 10 or more speakers (demonstrated at Filmmaker Technology).

An internationally recognized engineering consultant and Peabody award-winning film producer, Robin Miller has presented advanced 2D and 3D audio solutions worldwide to the Audio Engineering Society, Society of Motion Picture & Television Engineers, Acoustical Society of America, Canadian Acoustical Association, and German Tonmeisters. As an invited panelist at the AES 2007 Italia conference in Parma, he demonstrated using original recordings Ambiophonics, 5.1-compatible PanAmbio 2D surround, and full-sphere 3D. His company, Filmmaker Technology, engages in applied research, systems design & integration, and has a patent for a system of full-sphere 3D recording & reproduction. See www.filmmaker.com.