What to expect to hear with Ambiophonics

observations of an audio engineer that anyone can appreciate

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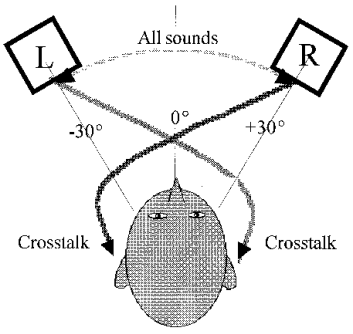
What this long-time audio engineer hears with Ambiophonics cf. stereophonics is a big step closer to realism and WHAT WE ALL WANT TO HEAR, namely: A) correct tone color (timbre), B) immersive spatiality, and C) temporal clarity. However, audio reproduction of life-like tone color, spatiality, and clarity is the perceptual destination of a tortuous journey, beginning with performers and their instruments plus recording engineers and their microphones in the recording space, and ending with listeners and their ear-brains in the listening space.

All other things being equal (low distortion, flat frequency response, good acoustics and dispersion, etc.), **realistic tone color and spatiality** both result from more encompassing and near-1:1-corresponding *localization*, where perception of each auditory arrival matches the original position of the sound, whether direct or reflected. Note that, in the best seat in the hall, usually beyond the acoustical *critical radius*, reflected sound energy exceeds direct sound energy and its direction is critical to tone color.

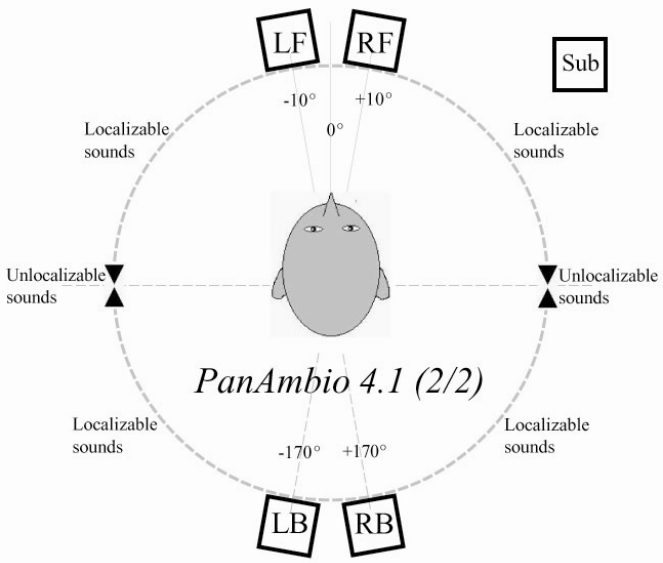
Encompassing localization implies capability greater than conventional stereo, where images are confined to the 60° angle between speakers. (Ultimately we must be immersed in "full-sphere" 3D, as in natural hearing, or at least enveloped 360° for 2D surround.) It is important because replicating arrival direction, not only of direct sources but also of the reflections they spawn – "coded" for interpreting direction by our individual head-related transfer function (HRTF), including filtering by our *pinna* (outer ear) – enables our brain to integrate these cues over time-of-arrival, and thus to perceive tone color as heard live. Ambiophonics replay encompasses 120°; *PanAmbio* envelops 360° as with 5.1/6.1/7.1 surround.

Additionally with conventional stereo, each speaker is heard by not just one, but by both ears – called *crosstalk.* By the time they travel to the opposite ear, these delayed signals masquerade as "reflections" that distort human hearing of tone color and spatiality, smear transients, blur each sonic event, and call attention to the speakers, because these rogue "early reflections" are identified by the brain as belonging to a speaker, not anything recorded. Therefore, fortunately, most recordings benefit greatly by using Ambiophonic *crosstalk cancellation*.



Stereo (2/0)

Crosstalk is inevitable using speakers. Delay artifacts, when sounds travel farther to the opposite ear, destroy clarity, and distort center voice timbre with comb-filtering.



Ambiophonics positions two speakers closely in front and uses crosstalk-cancellation DSP. *PanAmbio* adds a second pair in back for 360° surround (5.1-compatible).

WHAT DO WE HEAR with 2.0 Ambiophonics? A wider stage up to 120° (measured) – twice that of conventional 60° stereo – and with imaging much more linear across that angle, not bunched at the speakers, thus creating a *hole-in-the middle.* With Ambiophonics, localization is more continuous and natural for frontal sources and their largely frontal, but differently-angled, early reflections. For a listener positioned on the median between speakers, Ambiophonics' 120° range doubles stereo's span of

perception (now equal to the recorded arrival angles), with near 1:1 linearity, so the listener perceives more realistic localization. The result for most all stereo recordings with Ambiophonically-improved imaging is that the speakers and front wall "disappear."

The **restored clarity** heard with Ambiophonics can be described as "separation" – in a sense like photographic separation in rendering highlight and shadow details: definition among many sonic events produced by sounding instruments (highlight detail), plus separately defined details within the near-silences between (shadow detail). Compare this ideal with conventional stereo, which cramps the auditory scene into a 60° pie-shape, masks details with delay artifacts, and bunches images at either speaker, effectively calling attention to the speakers themselves rather than a pure, speaker-less illusion. Separation is lost. Stereo also distorts the timbre of important central voices due to comb filtering at each ear (when the signal from the near speaker mixes with the delayed crosstalk of the same signal arriving from the far speaker).

Why does clarity suffer with stereo v. Ambio replay? Speakers angled 60° muddy the sound with crosstalk that copies and delays transients and smears those artifacts into the "air" between sonic events – analogous to astigmatism in vision that blurs edges by adding a second impulse response to the eye's optical transfer function. Wear glasses to correct vision? – then why not use Ambiophonics to correct stereo! When the recording adds just a few voices, let alone a symphony or layered gaming scene, this cramping and muddying masks so many subtle cues to tone color, localizing, and spatial qualities that we are deprived of the nuances we so enjoy when hearing live.

Beyond Ambiophonics 2.0's still largely frontal presentation, 4.0 PanAmbio surround preserves the provenance of direct and reflected sounds around 360°, resulting in even more realistic tone color and spatiality. (This writer has published curves showing perception of a "Walkabout" recording which, when reproduced in PanAmbio using four speakers, results in ±5° accuracy in the horizontal plane.) What listeners hear with PanAmbio recordings made by the writer is a more compellingly believable spatiality around 360°, where *all* the listening room's walls disappear. They perceive that they are enveloped in the recording space, and are treated again to the clarity of the original, naturally-focused sound, accompanied by a life-like recreation of the tone colors intended by the musicians and the recording engineer.

From the point of view of my fellow content providers and recording engineers: With less need (and cost) for spot-microphones to artificially bolster individual voices lost under stereo replay conditions, recording using the *Ambiophone* allows listeners to relish the transparency of a pure main-microphone, acting as surrogate for our head-and-ears, located in the best seat of the concert hall. Individual auditory events comprising the entire auditory scene journey unscathed by the artifacts generated by conventional speaker-stereo reproduction – getting us closer to the actual experience recorded. The writer uses the *PanAmbiophone* for capture and Ambiophonics for monitoring for recordings and broadcasts, even though the end use by the audience may be conventional stereo, because Ambiophonics supports mixing decisions that produce better results. By design, these recordings are totally compatible and uncompromised with 5.1 surround and iPod ® listening.

It should be acknowledged that there is a risk of DSP artifacts due to the crosstalk cancellation signals inserted by the RACE (Recursive Ambiophonic Crosstalk Elimination) algorithm not themselves being cancelled at the listener's ears, either due to imprecise speakers/setup, or to imperfection in the algorithm itself, which is undergoing continual refinement at Filmaker Technology, where new RACE versions are being demonstrated pending release.

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*An internationally recognized engineering consultant and Peabody award-winning 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 Ambiophonics, 5.1-compatible PanAmbio 2D surround, and full-sphere 3D using ten speakers using his original recordings. His company, Filmaker Technology, engages in applied research, systems design & integration, and has a patent for a system of full-sphere 3D recording & reproduction. See www.filmaker.com.*

At AES2007 Italia in Parma, Angelo Farina (left) introduces invited panelist Robin Miller (third from left), who also demonstrated full-sphere 3D recordings.