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## Audio Magazine: proposed series Chapter 08 - Stereo Reproduction

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Is there a difference between monaural reproduction and stereo reproduction? Of course there is. Stereo has leftness and rightness. Yes, and what else? Well it seems to give depth to the sound image. Yes, and what else?

About here most of us begin to falter. The idea of lateralization in stereo so overwhelms our thinking that we may overlook some other virtues and faults. Did you ever notice, however, that two not-so-good loudspeakers can have their defects suppressed in glorious stereo while it takes an extremely good loudspeaker to sound good in monaural? If you don't believe it, switch your preamp to a monaural position and turn off one loudspeaker.

Foul! I'll bet you thought I meant just kill the stereo effect and listen to the monaural program through both speakers. Well, listening to two loudspeakers fed from the same program source is not the same thing, from the geometry of sound, as listening to only one loudspeaker, even if it is placed in the center, phantom channel, position.

Now be honest with yourself for a moment. Did you ever have the experience of listening to a reproduction in what you believed to be stereo - only to find out that it was mono? I have, and it is a bit of a kick in the ego. Most of the stereo material is so left-right oriented that it is instantly detectible in mono. But some good, clean, realistically miked material can fool you when you listen through a stereo speaker system.

Let's take another example. In the pre-stereo days there were some excellent, realistic sounding loudspeaker systems which "didn't make it" when stereo came in. Not because you couldn't get two of them into a room,

but because something seemed lacking in the sound. Like the plight of actors when talkies came into motion pictures - some made it, others did not. Why? That bothered a great many people but all agreed that they didn't sound right in stereo.

Conversely there were other loudspeakers which suddenly sounded much better in stereo. One cannot help but wonder if history is about to repeat itself for those who convert from stereo to quad. Chilling thought. Maybe if we can understand some of the reasons for this we will know what actions to take. In any event this mono/stereo business is part of the mystery of audio.

The sound image which we perceive in stereo spends much of its existence in the form of two one-dimensional representations. We normally think of the left channel and right channel as two entities coursing along in time like trains on parallel tracks. However, the sound image also lies dormant in time, but locked into physical deformations on a spiral groove in a vinyl record. Or possibly as magnetic particle orientation on a piece of tape. Time has no meaning on a record until we map the image from that somnolent form into a time representation by physical scanning.

Foolishness? Not at all. But a more general look at the form of the audio image. If your turntable, or tape transport, has speed problems the time coordinate of the reproduced program may be badly warped in a way we call flutter, or wow, or time error depending on the nature of the scanning problem. If the program from one groove or layer of tape can be partially transferred to another groove or layer, there may be

several programs all playing at the same "time". We call this echo or print through. An echo, in the audio image sense, can occur before the apparent program giving rise to it - which is quite contrary to our normal experience.

A nonlinearity can exist in relative time as well as intensity and pitch component. We should not get locked into thinking of nonlinearity in reproduction as only affecting intensity. And nonlinearity can exist in coordinates of spaciousness, which is what I would like to now address.

Let's go back to our considerations of a monaural and a stereo reproduction. The interplay of acoustic cues which give rise to the illusion of phantom image stereo reproduction can be very subtle. In a processing sense this is the "software" of the image. The thing that we seem to associate with spaciousness involves differential time as well as differential intensity and apparent source location. In our natural environment, sounds which come from farther away will arrive later than those from closer sources if both are created simultaneously. Our listening environment enters into the geometry of the sound image. Placing two loudspeakers in a normal stereo configuration can create the subjective illusion of a phantom sound source physically located between the two speakers if they are fed nearly identical material. This phantom image is created from our "software" and does not physically exist as a source of sound. Thus, from the standpoint of the geometry of our sound image, this phantom image is not the same phenomenological thing as removing the stereo speakers and placing one loudspeaker at a spot formerly occupied by the phantom image. Single loudspeaker monaural is not the same thing as multiple-loudspeaker monaural.



Those physical and acoustic properties of a single monaural loudspeaker which can give rise to apparent depth in a sound image are not those possessed by a stereo loudspeaker configuration which uses two separate units. What sort of properties could a center channel mono speaker have which would give great monaural reproduction? For one thing a sense of depth can be created by both a nearly planar wavefront at our listening location as well as the creation of selective room scattering which directs our attention toward a space position behind the loudspeaker. Some of the better sounding monaural speakers were what we would call "multiples" which occupied quite a lateral and vertical spread and had a partial doublet rear radiation. A loudspeaker which had a more nearly point source characteristic might tend to have an "up front" acoustic image since it was more dependent upon program ambiance for depth. Any generalizations here are hazardous but these examples are chosen to try to fit some geometrical considerations of the sound image.

In single speaker monaural reproduction, it is apparent that a substantial part of the sound image is carried by the physical transducer and the listening environment. It might be necessary to fiddle with room placement. And a speaker which sounded great in the store may sound not so great when you get it home.

Another very interesting fact begins to emerge. When we listen to single speaker monaural, we have reduced the dimensions of the sound image by at least one. Lateralization of the sound image, and to some extent elevation, is no longer significant from the "hardware" point of view.

When the image is processed in one-dimensional form, through disc, cartridge, and amplifier, nonlinear distortion cannot foul up left and right. The space dimensionality which would carry the full brunt is that of depth. Now here comes a hypothesis based on the geometry of this. The component in the chain which most greatly affects such monaural spaciousness is the loudspeaker. The types of things which an amplifier can modify in the final sound image is tonal, temporal, and intensity related. The amount of time smear which an amplifier can impart is small potatoes compared to what a loudspeaker can do. If this is so, then loudspeaker imperfections will become more apparent in single speaker reproduction.

Switch now to two-speaker monaural. The software cues of spaciousness are now different than they were in single speaker reproduction. Is this better or worse? With two loudspeakers, the place the sound appears to come from is not occupied by a physical object identifiable as a loudspeaker. This at least tends to keep the visual experience out of the sound illusion. Don't think it isn't important from the standpoint of the sound image. It is. Consider the ventriloquist. We pay him to confuse us into imagining that a sound comes from a place it does not. He can't do it based on sound alone, but by artful visual and associative object cues he can override the acoustic cues and "throw his voice". An allied effect in high quality reproduction is obtained by walking into the next room when material is being reproduced. Then ask yourself if it sounds as though there is an actual voice of instrument playing. This is an excellent test for accuracy in reproduction.

This ability we have to willingly allow ourselves to be confused may account in part for our acceptance of reproduction in a room. We know darn well that a symphony orchestra can't be crammed into our living room and that the acoustics is all wrong for Symphony Hall. But, much to the consternation of those versed in acoustics, we can thoroughly enjoy a good reproduction of a symphony and meaningfully speak of "presence". We experience an acoustic illusion.

In monaural reproduction through stereo speakers the loudspeaker imperfections are generally to be expected to be less significant. Since the sound image may now be allowed a lateral spread as well as depth, there are more apparent geometrical dimensions. Representation distortion may now be shared among more coordinates.

Two things then happen. First, the burden on the loudspeaker is reduced and, second, the one-dimensional processors, such as the amplifier, become more critical. An amplifier which sounded very clean in single speaker monaural may now begin showing some listening problems, if it has a distortion giving rise to a possible spatial spread.

Let's now feed stereo material to those same stereo speakers. Now the sound image assumes a definite lateral extent. We also now become more aware of amplifier problems. Why? because the actual program content is different in each amplifier. If the amplifiers were equally distorted in monaural reproduction, the affect on the sound image would remain centrally located and would show as a depth, intensity, or tonal change. Now in stereo the lateral extent of the image is available to share in this distortion. If, as an example, the amplifiers go into a soft clipping on

program material, then the left channel might be in clipping while the right channel is not, and conversely. This will cause a left-right shift as well as a totally unnatural space spread of distortion fragments.

Because of the greater degrees of freedom available to the stereo sound image, a greater significance attaches to the detail nature of distortion as it might occur in the process of amplification. Magnetic tape overload distortion, which tends to be odd harmonic in nature and with no phase change in those harmonics relative to the fundamental, will have a different affect on the final geometry than slew rate distortion which may have the same harmonic order but altered phase.

It would appear quite natural then that the problems of stereo reproduction are not exactly those of monaural reproduction. The mystery of why some speaker distortion seems less critical in stereo with the inverse true for amplifiers, doesn't seem so mysterious when we look at the geometry of the sound image.