A DISCUSSION OF THE HIGH EMOTION AUDIO APPROACH TO LOUDSPEAKER DESIGN.

History:

High Emotion Audio LLC is a successor company to Nearfield Acoustics, originators of the first successful line-arrays, the PipeDreams loudspeakers. We pioneered the use of multiple drivers in large systems capable of delivering lifelike sound power in the largest rooms. These speakers constitute the benchmark in their category.

Why a new direction?

To embody what we have learned about human auditory perception.

It is important to distinguish and understand the relationship between the content of music and the tools for perceiving it.

Music consists of Rhythm, Melody and Harmony and dynamics.
Perceptual tools are Timing, Pitch and Timbre and Loudness.

So a loudspeaker must address the latter in order to hear the former.

It is also necessary to understand that hearing is a survival sense, like smell. The scent of a predator or the snap of a twig may have been a matter of life or death. Hearing, like smell acts directly on the limbic brain without the necessity of cerebral interpretation. This is probably an atavistic leftover from earlier times.

This also explains why the ear/brain system is more affected by the leading part of the sound than by the trailing part. The brain prefers, so to speak, a continuous stream of first impressions.

This brings us to the prevailing orthodoxy of loudspeaker design. The widespread availability of sophisticated, low cost measuring equipment has brought about an interesting convergence of loudspeaker philosophy and configuration from many different designers, driven often by the measurement preferences of reviewers. The resulting convergence is, alas, not toward perfection. It is rather a convergence on satisfying the measurement methods. Unfortunately this has not brought the industry closer to "realism" or, more importantly, to an emotional connection with the music.

A particular example of this is the widely used "waterfall" plot of cumulative decay spectra. It reveals in excruciating detail how the sound ends but tells nothing about how it begins.

It seems to us that the industry has become derailed in search of good measurements. What is required is to back up and reconsider what we really want to accomplish.

We at High Emotion Audio have done that by considering our own experience and by studying some of the (very large) literature about human auditory perception from acoustical, psychoacoustic and neuroscientific perspectives. This literature seems oddly uninteresting to the majority of the audio community.

One of the most important things we found is that we hear with unexpectedly high time resolution. This manifests itself is a variety of ways some of which are susceptible to measurement and some not. It turns out that the ear is fairly sensitive to the timely arrival of all the constituent frequencies in a complex sound. This is described technically as group delay distortion (GDD). When GDD is low, all the sounds come out of the speaker at the correct relative instants. This is another way of looking at phase. When GDD is low, phase is flat once the excess causal delay is removed from the measurement. Looked at the other way around, group delay is the negative frequency derivative of phase.

Interestingly, low GDD results in improved perception of timbre. So timing and timbre have a close relationship. Low GDD also equates with the perception of "speed".

The basic speed of a transducer should be able to be defined by its bandwidth. Fourier says so. This is mostly true in an anechoic environment. But a loudspeaker in a room is NOT a linear time invariant system. The reflections in any normal environment (even a "treated" one) cause the system to become time varying.

In such a situation many factors come into play. Human hearing expects this time-variance and any attempt to remove or supress it results in difficulty in perception of timbre.

Frequency response is generally taken to represent the steady-state output of a transducer. But music is never in the steady-state. All normal sounds are transient. Frequency response, especially in a real environment, does not describe transient response. Neither does a waterfall plot. One view of the Heyser Spiral, the so-called ETC, or energy-time-curve (also known as the magnitude of the impulse response) gives some idea of the whole transient response, but interpretation is not obvious.

Physics tells us, and we know instinctively that heavy things are hard to move quickly. It should be fairly obvious that the moving parts of a loudspeaker i.e. cone, voice coil, suspension, should be as light as possible. The fact remains that a = f/m, acceleration equals force divided by mass. The argument for electrostatic speakers, for example, is the extremely light diaphragm. But the force available from the electrostatic driving principle is correspondingly weak so there is no net advantage. Also, if what you want is a superclean waterfall plot, one way to get it is to damp the cone by making it heavy. This can produce a nice measurement and a dreadful speaker.

It takes a lot of design attention to achieve ultra low mass, high driving force and freedom from spurious responses all at the same time. The HEA 5" and 7" drivers are unique and proprietary. You won't see them anywhere else and you won't hear similar results anywhere else.

It is more important to design from a philosophical understanding than to design toward a measurement objective.

The unusual visual feature of our S5 and S7 speakers is the tweeter assembly mounted on top. This is our Leading Edge Transducer, or LET. This is a patented device which uniquely achieves the required properties for musically convincing and emotionally involving high-frequency reproduction.

The LET belongs to the (sparsely populated) class of bending-wave transducers. The driving force launches a travelling wave in the curved film. Think of cracking a whip. No attempt is made to accelerate the entire mass of the film, but rather the force is imparted to the proximal end and the resulting wave travels to the distal end where it is terminated. The motor produces very high force due to a proprietary magnetic circuit and materials in combination with an ultra-low mass voice coil. The result is a transducer capable of much higher acceleration than any conventional tweeter be it ribbon, planar, dome or electrostatic. Further, the coupling area of the diaphragms is much larger than any conventional tweeter resulting in very high mechano-acoustic efficiency. This translates to very little power in the voice coil and complete freedom from thermal compression.

So, what does all this add upto? Is it just techno-BS?

Well, you really have to hear the result. No one who has is unaffected. The overriding impressions are:

Truth of Timbre
Truth of Rhythm
Clarity. An uncanny ability to hear into the music
Emotional communication.

Many of the objectively presentable aspects of High Emotion Audio loudspeakers are either patented or patent applied for or pending. We will from time-to-time publish pertinent measured data. In the end, all the objective technology has to be merged with judgement and technique. That last part of the recipe is proprietary and we are not interested in teaching eveyone how to do it. We are happy to offer the results as our products for sale.

Oh, by the way…watch for this approach in line arrays…coming soon.
Happy listening.