Not Your Father's Driver

Igor Levitsky talks about planar ribbon design

Igor Levitsky, designer of SLS Loudspeakers ribbon drivers, has been involved in planar magnetic technology for more than 15 years. We recently caught up with Igor to talk about his work as well as the specifics of the "how and why" of ribbon drivers. – *Keith Clark*

Igor Levitsky

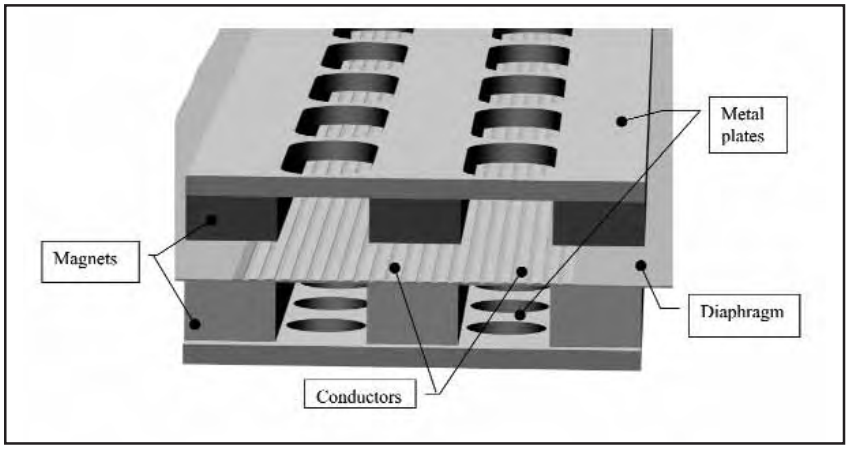
Live Sound: You've been involved with planar magnetic driver development for a long time. What led to this interest?

Igor Levitsky: I graduated from Polytechnic University in Kiev, Ukraine (in what was then the Soviet Union) earning a degree in the study of acoustics. I was lucky to start my professional career right away with research and development of planar ribbon transducers and systems, and later, after I moved to North America, I continued to pursue my interests, developing the whole line of ribbon drivers and systems for Hi-Vi Research, a planar ribbon driver manufacturer in the consumer market.

Joining SLS Loudspeakers in 2000, I took my experience and ideas to another level, resulting in the successful development of planar magnetic transducers with parameters that meet the requirements of professional applications.

From the very beginning, I've been fascinated with the high quality and accuracy of sound that planar ribbon and electrostatic systems deliver. Planar ribbons and electrostatic transducers both use tensioned thin film as a radiating element. The clarity, resolution and ethereal airiness of a thin film driver has always allowed me to hear more detail, to "look" into the sonic picture of the recording, to feel the palpability of the harmonic richness of voice.

In my view, this kind of experience has never been possible to achieve with traditional dome tweeters. When attending live concerts, I was rarely satisfied with sound quality when the music was amplified through conventional loudspeakers with compression drivers. Implementing planar ribbon drivers in a system for live performance and then hearing your favorite performer playing live has always sounded to me like a dream of a loudspeaker engineer and music lover come true.



Construction schematic of SLS planar ribbon driver motor structure.

Live Sound: What do you see as the inherent benefits of planar magnetic ribbon drivers?

Igor: The way in which planar ribbon drivers radiate sound waves. A planar diaphragm is directly driven; there are no transitional components such as a

voice coil bobbin, glue joints, domes, compression chambers, phase plugs, etc, that are present in conventional compression drivers.

The planar ribbon driver has a push-pull motor with a rather symmetrical magnetic field. Driving force is evenly distributed over the entire radiating surface and excites the diaphragm with the same phase and equal amplitude. This is an ideal condition for pistonic radiation. There is no break-up modes, severe structural resonance, or compression chamber distortion.

The planar diaphragm is also extremely light and comparable to the mass of associated air that vibrates along with the diaphragm. In other words, in the case of a planar driver, we have an almost ideal, simplistic and pure transition from electromagnetic energy into acoustic energy of oscillating air. All this results in extended frequency response up to 40 kHz, clean transient response and low distortion.

However, the most distinctive feature of a planar ribbon driver is its extremely high resolution related to its fast decay of secondary diaphragm vibrations. This impulse control results in transient response that faithfully reproduces just the original signal, without the spurious resonances (distortion) that i find inherent in other types of drivers.

The elongated "ribbon" form factor of the planar diaphragm gives a planar transducer another inherent benefit that makes it valuable for line array systems - arrayability. For a line array system to work properly and deliver consistently smooth coverage without lobing and high frequency holes, the elements of the array must be spaced very closely and their radiating surface should cover at least 80 percent of the line of the vertical plane.

These criteria, I believe, are best met with elements with a planar wavefront. If radiating elements do not have a planar wavefront, a line array will not work as a continuously coupled line source. A planar ribbon driver is the element that meets all these requirements not only in mid bands but also up to very high frequencies.

Live Sound: What are the potential drawbacks of planar magnetic transducers?

Igor: In the recent past, just a decade or so ago, there were quite a few limitations in planar driver technology that kept it in the boutique segment of the high-end consumer market.

It's been possible to overcome most of these limitations due to advances in material science over the past few years. High-energy grade neodymium magnets have become available at much lower prices. Diaphragm materials with working temperatures exceeding 600 degrees (Fahrenheit) are also available at reasonable prices.

These technologies and materials finally emerged from the "space materials" category and came down to earth. Therefore, reliability and cost factors are not the issues anymore. Quantity production and consistency issues are the real challenge.

A planar ribbon driver can be very sensitive when it comes to parts geometry and materials. Sometimes the relationship between the targeted acoustic parameters, mechanical geometry and/or material properties are not quite straightforward, and in general can be considered more complex than other driver design and production.

One performance parameter where planar magnetic transducers still yield to the best compression drivers is the absolute maximum SPL for a single driver. Clearly, using high-ratio compression chamber and large horns, a compression driver may have noticeably higher sensitivity. This however comes with a well-known price – very high distortion. It can be argued whether those maximum sound pressure levels (SPL) with often unbearably high levels of distortion is what is actually required by listeners.

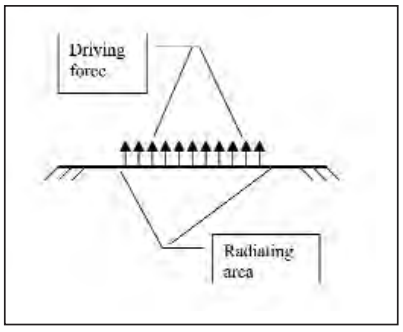
This advantage in maximum SPL quickly disappears when we turn to line array systems. The whole principle of line array coupling and cylindrical wave-front propagation at high frequencies creates conditions where the use of a planar ribbon driver (operating as a tweeter) is no longer a limiting factor in maximizing the SPL of a line array system.

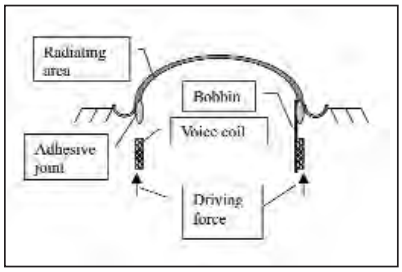
If we consider that most applications that require extremely high levels now use line array systems, this last advantage of a compression driver may not apply anymore.

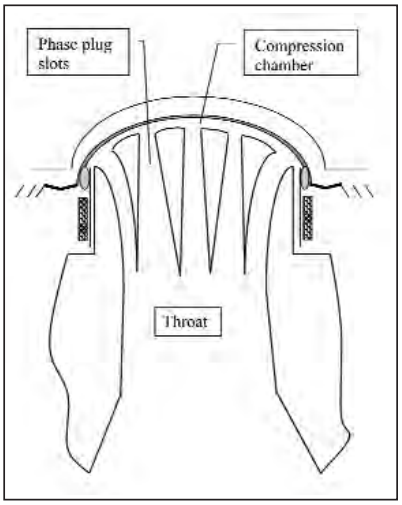
Live Sound: What were your goals and design criteria in developing the PRD500 and PRD1000 drivers?

Igor: At the top of design criteria I put power handling and sensitivity.

Once I found that these criteria







Compare and contrast: Motion systems for ribbon drivers (left), dome tweeters (center) and compression drivers (right).

could be achieved in practice, my next goal was to optimize the design to reach desired consistency and cost effectiveness in production. Reliability was another important factor. Extending the useful frequency range down to mid frequencies was also crucial in order to properly couple the ribbons to large format woofers and maintain consistent coverage angles.

Innovation was also important. Many of the specific design, material, and production techniques have been kept as trade secrets, while others have patent-pending protection.

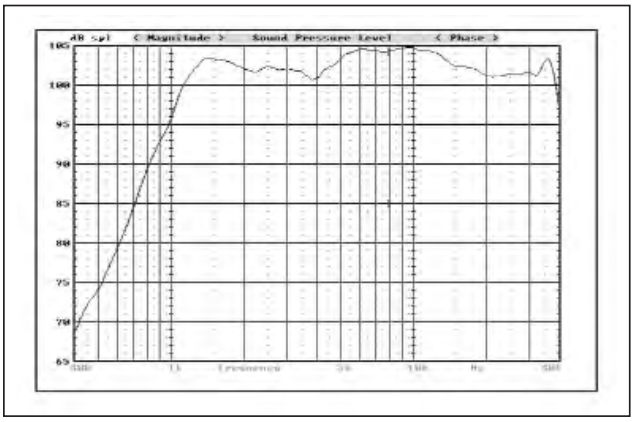
Live Sound: Line array element manufacturers have been trying to emulate a ribbon driver's performance for a number of years. Why didn't they just use ribbons in the first place?

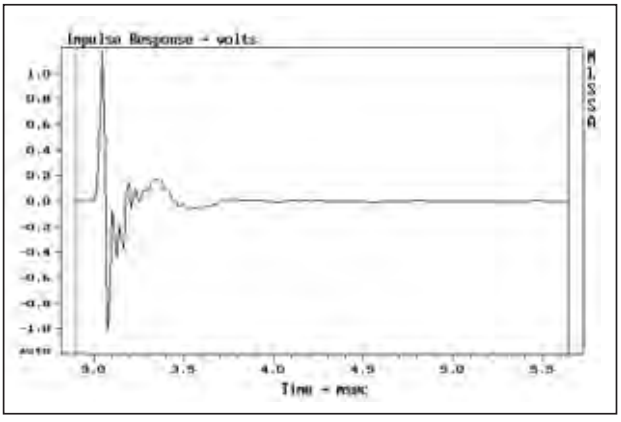
Igor: Some actually did. I know of two who built their "reference" systems in the early R&D stage to see how a nearly ideal line array works. However, many of these manufacturers have expertise in compression drivers, which have been their bread and butter. I think that this naturally defined their vision on line arrays and the ways to build them.

On the other hand, historically, planar ribbon drivers have the reputation as being very fragile and sensitive components. This notion had its grounds. In the '70s and beginning of the '80s, planar ribbons had rather low sensitivity and diaphragm materials didn't handle enough power to reliably generate the high SPL required for pro audio applications.

A close look at the PRD500, and how they fit into an SLS line array system.

Later, when better materials and magnets became available, the cost to build a high-power, high-sensitivity planar ribbon was simply prohibitive. Only select high-end brands could afford to build small ribbon drivers





Measured SPL response for the SLS PRD1000 driver (left) and the measured impulse response for the SLS PRD500 driver (right).

with rather limited response used mostly as super tweeters from 4 kHz to 5 kHz, up to 40 kHz.

I think these were the technical factors that created a certain notion about this technology. Consequently, when the contemporary concept of a line array system started to develop in the mid-'90s, I guess that many didn't even consider a planar ribbon driver as a potential technology for line arrays.

And again, only recently has it become practical to contemplate and build reasonably priced planar transducers that can deliver high fidelity sound with professional market requirements for SPL, power handling and reliability. I also think that certain marketing, financial and production related factors dictated the choice of a compression driver as the only high frequency transducer for their line arrays.

Time changes, and as line array competition heats up, I'm sure manufacturers will be considering all possible ways to stay ahead in this race and keep or even gain their market share.

Live Sound: How have your ribbon drivers been faring in pro-audio applications?

Igor: The systems are being used on tour, in high-profile dance clubs, in restaurants, studios, schools, custom homes - all kinds of applications. The materials and design techniques we use are robust, and two levels of protection are built into the components as well.

Not much processing is needed in order to make these systems sound good, so the digital signal processing is primarily used as for its crossover, delay, and limiting functions. We typically use three to four parametric filters for each system. Besides the limiting, there is a circuit built into the line array elements that provides an additional level of protection. There have been instances where the cone drivers in a system have let go without the ribbons being damaged.

So far, we've had positive feedback from the field. Very often, comments are along the lines of "overwhelming" and "truly emotional." ■