aX Interviews Eduardo de Lima

Eduardo de Lima, President/Owner of Audiopax, Brazil, was the keynote speaker at the European Triode Festival 2007, held at the end of November in The Netherlands (**Photo 1**). His designs are unique in the way he strives to produce synergy between the components of a stereo system. And his unusual creations have won many awards. Regular Contributor Jan Didden tracked him down to find out more about him and his design philosophy.

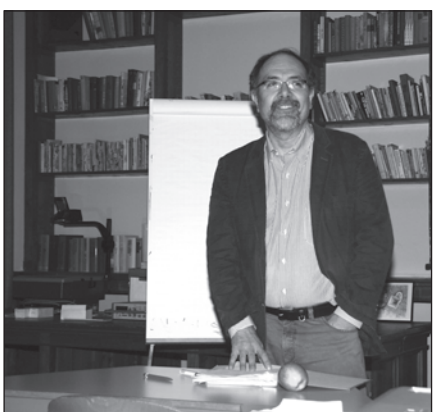

PHOTO 1: Eduardo de Lima explaining his concepts.

Jan Didden (JD): Mr. de Lima, *aX* readers know a bit about you from your article in *Glass Audio* in 1996. But before we go into your design philosophy, can you give us some background on you and your company?

Eduardo de Lima (EdL): Please call me Eduardo. Yes, of course. I think I built my first SE amp, a 300B design, more than 15 years ago. Just out of curiosity, really. I didn't think it would sound any good. It sounded much, much better than expected, but, to my consternation, it didn't make sense in view of the measurements. The THD was relatively large, and the output impedance of more than 3Ω, of course, ruined any chance of speaker damping. This very much intrigued me and set me on the path that I still travel today.

JD: So, why did it sound so good?

EdL: Well, one of the mistakes we often make is to look at the amp in isolation. But, of course, we don't listen to amps; we listen to speakers driven by that amp. The speaker has its own way to "voice" the musical signal. Actually, simple speakers and simple (SE) tube amps have many similar attributes. Both are simple in the sense that both produce simple harmonic distortion spectra. It's not often that speaker distortion and spectrum are quoted on a spec sheet, so I started to measure speakers in this respect. If you then compare that to a SE amp, you see in both cases a similar spread in predominantly low-order harmonics, with similar envelope.

JD: Are you saying that in the case of your amp, some of that amplifier distortion was cancelled by the speaker distortion?

EdL: Cancellation is too strong a word; I'd rather call it "compensation." You can imagine that the harmonic structure of both the amplifier and the speaker vary depending on program material, especially the frequency content and the level. Ideally, if the 2nd harmonics of the amp are in opposite phase of those of the speakers, they would cancel. If they are the same phase, they would reinforce each other. It is also a matter of statistics.

I have done much analysis on this, and as long as the phase difference is between 120 and 180°, the combined distortion is less than 1% of each of the two. So, statistically, you can expect a 33% chance that significant compensation occurs. Now, if you reverse the speaker connections, you even end up with a 67% chance of significant compensation! To look at it another way: If your amplifier THD is half of your speaker THD, you have almost a 90% chance that the resulting system THD is less than the original speaker distortion.

Engineers tend to discard effects that are not totally predictable, but these numbers are worthwhile. There is quite an audible difference between partial compensation and reinforcement!

JD: So that caused the surprisingly good sound of your first 300B. I guess you just got lucky with your speakers!

EdL: Absolutely. And I just mentioned harmonic distortion, but there is a similar effect from the amplifier output impedance. That has quite an influence on the speaker characteristics as well.

Once I found this out, I started to look more closely into that speaker, a home-made speaker with an unusual 24dB crossover between the woofer and the midrange that just by chance exhibited an almost totally resistive behavior. In other words, it looked largely like a resistive load; I mean much more so than normal complex speakers with a complex crossover.

I started to develop my own speakers with this in mind and I found that the effect can be predicted to some extent. It is not totally predictable, of course. Both amplifier and speaker behaviors under signal conditions are dynamic, and harmonic structures and phases vary constantly. But there is a lot of overlap, and by listening to the music, it is possible to find a "best match" that sounds best. And the differences are not subtle but clearly identifiable.

JD: Can you measure the effect? And how would you characterize the sound difference?

EdL: Yes, you can. The speaker measurement part is, of course, the most difficult. Repeated, consistent speaker measurements are very difficult to do.

But by using an anechoic chamber, you can make a measurement series within the same setup as comparative measurements.

The series of graphs in **Fig. 1** show the results of one such session. The differences between the speaker response with a "perfect" amplifier (**Fig. 1a**) and with a "complementary" amplifier (**Fig. 1c**) may not seem huge, but they are clearly audible. The audible difference mostly affects the stage width, instrument placement, and focus.

JD: There are very many different types of speakers out there; how can you design an amplifier that shows a worthwhile improvement in those different circumstances?

EdL: We design our amplifiers with adjustment controls that let the listener tune in to the best match between his particular speakers and our amp. I don't want to go too much into detail, because part of that is our intellectual property, of course. But one way to change the "character" of your SE amp is to use partial cathode feedback from a tap on the output transformer, the way Quad used to in the Quad II (although that was push-pull), as well as using the screen tap usually called ultralinear (**Fig. 2**).

Stockman has shown that a triode is just a pentode with feedback. By varying that feedback from both the cathode connection and the screen connection, you go from triode to pentode and anything in between. This way, you can have almost complete control over the amp's THD level and structure as well as phase.

In our ASTAT (Asymmetric Series Twin Amplifier Topology) amplifiers, we went so far as to construct it out of two amplifiers whose outputs are combined at the secondary of the output transformers, which themselves are slightly different. Each amplifier also has slightly different parameters, and you can adjust many of those while listening. The possibilities may seem overwhelming at first, but it is my experience that most people can zoom in on the best settings quite easily. The interesting thing is that most listeners come to almost the same settings for a particular installation. But the speed with which they zoom in varies significantly, with some listeners able to find the best setting very quickly.

JD: If I don't have speakers yet, what type should I buy to benefit from your amplifiers?

EdL: Well, of course, you can buy our speakers (smiling), but in general look for simple, not complex units. High-efficiency ones, with light cones, the Lowter types, are the best suited. They are simple mechanically and so have a simple nonlinearity character. Simple construction will give simple behavior. And I should also mention that you should do your adjustments at the level and with the type of music that you use most. The improvement will be very rewarding, as it has been for me for many years now.

JD: Eduardo, thank you very much for a most interesting discussion.

Further reading: www.audiopax.com/whitepapers

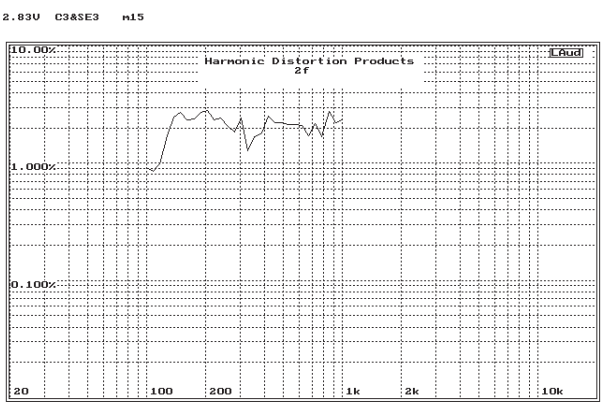

FIGURE 1a: Speaker output distortion when driven by a 0.05% THD amp.

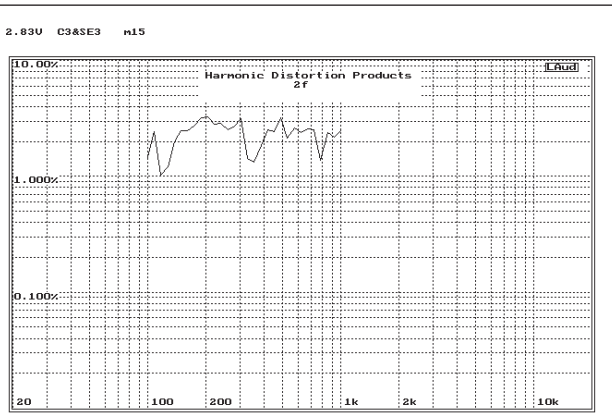

FIGURE 1b: Speaker output when driven from the SE amp.

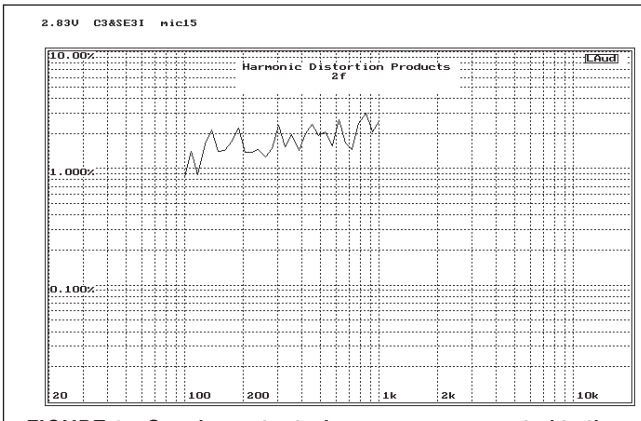

FIGURE 1c: Speaker output when reverse-connected to the SE amp.

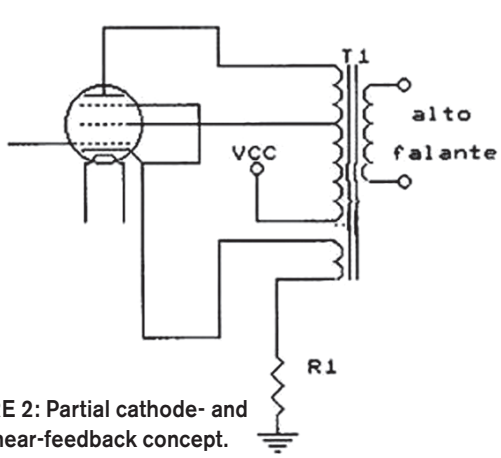

FIGURE 2: Partial cathode- and ultralinear-feedback concept.