Subject: Constant Directivity Speakers Using DSP
Posted by AudioFred on Wed, 26 Oct 2011 23:19:26 GMT
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Lately I've been experimenting with a dbx Driverack PA+ loudspeaker management system. The PA+ is an amazing signal processor that retails for $500. Many audiophiles would sneer at the idea of introducing a $500 product into the signal path of a high end system, but I figure if a high end manufacturer every decided to sell it they would put the circuit board in a fancy silver case, sprinkle in some magic dust, and price it at $1,500 or more, so it's not out of place in my modest system.

http://www.parts-express.com/pe/showdetl.cfm?Partnumber=246-171

I finally got around to bypassing the crossovers in my Econowaves and hooking the drivers directly to the speaker terminals. My version of the Econowaves uses an Eminence Delta 12LF with a Selenium comprssion driver attached to a Parts Express 6"X12" waveguide. Each speaker is driven by its own two channel amp, with the PA+ inserted between the preamp and the amps. In this system the PA+ functions as electronic crossover and equalizer, and I'm also using the delay feature to time-align the woofers and tweeters.

I was concerned about the effect of this digital device in the system, but I found any disadvantages are offset by eliminating the cheap crossover parts I was using in the passive crossover. The treble especially is noticably clearer with the PA+ substituted for the passive crossover.

I set the crossovers for 1.6khz with a LR24 slope on both drivers. I'm using the equalizer to null a couple of room peaks in the midbass and also to add the treble boost needed for a CD horn. Works great!

The only issue I've found is that the tweeters with no L-Pad are so sensitive that they pick up an audible sustained "sssssss" sound from the amp. I would imagine at room filling volume levels I'm probably using less than one watt from a 125 watt amp.

In spite of the fact that the PA+ outputs are adjustable for driver sensitivity differences, I wonder if a fixed resistor L-Pad before the tweeter would be useful. If anybody has an opinion I would like to hear it.

Subject: Re: Constant Directivity Speakers Using DSP
Posted by Bill Wassilak on Thu, 27 Oct 2011 01:43:49 GMT
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Fred said: The only issue I've found is that the tweeters with no L-Pad are so sensitive that they pick up an audible sustained "sssssss" sound from the amp. I would imagine at room filling volume levels I'm probably using less than one watt from a 125 watt amp.

Fred,
Try increasing the hi freq. level on the DBX and turn down the volume on the hi freq. amp and see

if this gets rid of the "ssssss". If it dosen't it could be the source before the dbx. I myself wouldn't go the L-pad route The only thing you should have between the amp output and the tweeter is a cap to stop low freq (should you set a x-over freq to low) and power on/off transiets.

Subject: Re: Constant Directivity Speakers Using DSP
Posted by Wayne Parham on Thu, 27 Oct 2011 02:02:22 GMT
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As you know, this is a design approach that I'm very experienced with. The Econowave borrows heavily from my designs, and I see the builders of those speakers as kindred spirits. In fact, the

with it, and can go so far as to say I know its exact properties. I have a great deal of experience knowing how it reacts with various crossover points and slopes, with and without fixed delays in addition to those caused by reactive phase shifts.

All that to say I am not opposed to active crossovers, but do think that the whole enchillada is in the time spent optimizing them. Without a properly designed crossover, its really not a constant directivity loudspeaker, its just a box of parts. Spend an appropriate amount of time dialing it in, and it's a wonderful loudspeaker, but just pick an arbitraty crossover point and slope and it's really not, even when the delay is matched.

It doesn't matter if you have a $500 DSP or a $100 passive crossover - what matters is that the transfer functions be right for the drivers, their spacing, orientation and directivities. It is really important to get the best out of a design like this.

Beyond the obvious matters of matching sensitivities and compensating for mass rolloff with top-octave EQ, I think the main thing is to make sure the forward lobe is centered, and you can check that with measurements. The vertical nulls should be above and below the baffle normal (centerline) by at least 20°, for a 40° spread. It isn't hard to get a 50° spread with that combination so strive for that.

Watch the video at the link below, which shows how to find the location of the vertical nulls. I think you'll recognize the cabinets.

Don't settle for anything less than on-axis amplitude response that's flat within +/-3dB through the whole audio band, and through a horizontal arc of 90° and a vertical arc of 40°. You can actually get it down to +/-2dB with those parts, when the crossover is right.
Crossover optimization for DI-matched two-way speakersAs for the tweeter hiss, I agree with Bill. I wouldn't add anything between the amps and the drivers, because that takes away some of the advantage of biamping. Increase the crossover/processor output signal, but not so far it will ever clip, allowing for adequate dynamic range. Then set the amplifier gain to match sensitivity. This will improve digital resolution as well as signal-to-noise. If the amp is too noisy, get a different amp. Might try one of your tube amps for the tweeter.

Subject: Re: Constant Directivity Speakers Using DSP
Posted by AudioFred on Thu, 27 Oct 2011 12:16:30 GMT
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Thanks, Wayne and Bill, for the feedback. The tweeter issue is solved. Each amp has a volume control, and I turned the tweeter amp's volume down and readjusted the dbx's tweeter attenuation to compensate. The hiss I described would be inaudible with the typical 89dB sensitivity dome tweeter unless you put your ear to it, but it's amazing how loud it can be with a 109dB compression driver.

Wayne, I did some intital measurements to dial in the driver levels and top-octave EQ. I'll be checking the forward lobe and the off axis response as well.

Subject: Re: Constant Directivity Speakers Using DSP
Posted by Wayne Parham on Thu, 27 Oct 2011 12:53:41 GMT
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Very good. Sounds like you're well on your way to creating an excellent system!

Subject: Re: Constant Directivity Speakers Using DSP
Posted by AudioFred on Wed, 02 Nov 2011 01:48:51 GMT
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The final verdict is that the speakers sound better using the active crossover. Getting it right took quite a bit of experimenting, but this is much easier with a fully adjustable active crossover than it would have been substituting parts in a passive crossover. The dbx component has a graphic equalizer ahead of the crossovers and your choice of up to three parametric equalizers for each of the woofer and tweeter crossovers, and the graphic eq can be used for room effect adjustment. I found a bell shaped PEQ centered at 16khz can be adjusted perfectly (gain and Q value) to do the job that the 0.47uF cap does in the passive crossover. The biggest difference I hear is much greater treble detail and clarity, including some subtle percussive sounds that weren't audible with the passive crossover.

I finally solved the tweeter hiss problem by using a Harrison 12dB attenuator for each amp's tweeter channel. This provides exactly the attenuation needed, so the amps' volume controls can be turned all the way up and the woofer and tweeter level adjusstments can be set to 0dB.
http://www.parts-express.com/pe/showdetl.cfm?Partnumber=266-244

Subject: Re: Constant Directivity Speakers Using DSP
Posted by Wayne Parham on Wed, 02 Nov 2011 03:23:50 GMT
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Thanks for your comments. I took a few minutes to write-up some notes about the design process for a speaker like this, regardless of what kind of crossover is used (active, passive, analog or digital).
Notes for the DIYerI am able to get very good on-axis and polar response using this approach.

Subject: Re: Constant Directivity Speakers Using DSP
Posted by AudioFred on Wed, 02 Nov 2011 10:36:07 GMT
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Wayne Parham wrote on Tue, 01 November 2011 22:23
Thanks for your comments. I took a few minutes to write-up some notes about the design process for a speaker like this, regardless of what kind of crossover is used (active, passive, analog or digital).
Notes for the DIYerI am able to get very good on-axis and polar response using this approach.

Thanks, Wayne. I've never seen all these issues summarized in one place before. This will be very helpful.
