Subject: Flanking Subs vs Helper Woofers
Posted by zheka on Thu, 29 Nov 2012 17:57:52 GMT
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Wayne,

Have you ever considered a crossover option for your 2-ways to connect a helper woofer? The enclosure would have a set of terminals to feed the helper woofer box from. Is this even theoretically possible?

In general, would you agree that true helper woofer implementation is a cleaner approach than the flanking subs one? My reasoning is based on the fact that flanking subs deal with summed LF signal where as helper woofers would only get the signal intended for a given channel. After all, at the frequency we are discussing, some spacial queues can be expected.

Thank you

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Thu, 29 Nov 2012 18:58:02 GMT
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Flanking subs do not get a summed signal - They get the same signal as the main speaker they are flanking, with a low-pass filter applied. They're stereo subs. That's one of the key distinctions between flanking subs and more distant distributed subs in a multisub configuration. Flanking subs are closer than distributed subs, and they are sent a low-passed copy of the same signal as the mains they're flanking.

You could use a speaker level passive filter, but the problem is most subs are 10dB less efficient than the mains, at least the ones we're talking about here. So that makes a separate amplifier the most attractive option, mostly for matching SPL.

In my terminolgy, helper woofers and flanking subs are the same thing. Both are woofers that augment another woofer in an overlapping band. The low-passed woofer in a 2.5-way is a helper woofer, but its disadvantage is that it cannot be positioned independently of the main woofer. That's a pretty significant disadvantage, in my opinion, because it limits placement options and prevents the owner from setting them up in a way that mitigates self-interference from nearest boundaries. That's the whole idea of the flanking sub approach - To use a physically separate helper woofer positioned between the mains and the nearest boundaries to smooth self-interference notches and higher frequency room modes.

A multisub configuration should include flanking subs and distributed subs. A typical arrangement has two flanking subs and two distributed subs. Flanking subs smooth the upper modal region and self-interference notches in the 80-160Hz range. Again, flanking subs aren't summed - They are sent a low-passed version of the signal going to the main speaker they're flanking. Distributed subs smooth the lower-frequency range, below 80Hz. At those low frequencies, localization isn't

as much an issue, so the signal to the distant distributed subs is summed. I actually think flanking subs are more important than the distributed subs, because response anomalies in the 80-160Hz octave are more noticable than deeper bass modes. But the best response can only be achieved using both.
Helper Woofer Location

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Thu, 29 Nov 2012 20:04:51 GMT
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Interesting. I never thought of it this way because I am dealing with multichannel HT so bass management is a given. If I used subs for the individual channels only, they would never get the LFE or LF content from other channels. Seems a little wasteful to me. Besides I would not know how to implement it even if I wanted to try. I guess if the receiver has line level outputs this could work. Still I'd probably want at least one powerful sub upfront that would be getting summed LF signal.

The (apparently wrong) way I had it done in my system was by setting the LPF on the receiver high, say 120-150Hz, setting the mains to "full", and adjusting LPF on the distant subs only to values under 80Hz. This indeed helped with the interference notches all the way to 200Hz or so.

How powerful would the flanking subs have to be in your scenario? Can they be limited to, say, 60-250Hz range?

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Thu, 29 Nov 2012 20:39:52 GMT
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You're right that home theater sound processors don't have any provisions that make flanking subs or distributed multisubs any easier. Honestly, the underlying philosophies and technologies most home theater processors are based on was developed before multisubs and flanking subs became popular. This whole approach is less than a decade old, and its common acceptance is just a few years old. It's still in its infancy, relatively speaking.

The way to do a flanking/multisub approach is to set the mains to "large" or "full" so they aren't high-passed. We want the mains and subs blended, overlapping in the modal region. Use an external low-pass filter and amplifier for each flanking sub. The low-pass filter can be an inline crossover or it can be the built-in crossover of a plate amp. Distributed subs are a little easier, because they can just be driven by the sound processor's built-in summed subwoofer output.

Low-pass frequency for flanking subs should be between 80Hz and 150Hz, and use second-order or third-order for best results. Fourth-order can be used, but it doesn't sound as good to me - It doesn't blend as well. The higher the slope, the higher the the crossover frequency. So for example, second-order at 90Hz or 100Hz often works well, third-order is better around 125Hz and

fourth-order usually has to be set higher still. Set the amplitude for SPL matching the mains in the overlap band.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Thu, 29 Nov 2012 20:58:22 GMT
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If flanking subs are designed to address boundary interactions and room modes only in the 80Hz-200Hz region, can "mid-bass" bass-reflex modules with high efficiency pro-drivers be used instead of full fledged subwoofers designed to go much lower?
The sub channel signal would still go through "conventional" multisub.

What do you think?

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Thu, 29 Nov 2012 21:32:16 GMT
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I think that's a fine approach. What you are suggesting essentially is to use high-efficiency woofers both for midwoofers and for helper woofers. Blend them together in the modal region, but low-pass the helper woofer to prevent it from developing any output above the Schroeder frequency. Roll off the helper woofer gracefully in the transition region.

blends with the bass bin between 100Hz and 250Hz.

it with a speaker level passive crossover, just a coil or maybe a coil/cap and Zobel. This solves the problem of matching sensitivites of the two subsystems, and therefore removes the requirement of separate amps. What you would have is a 2.5-way loudspeaker with a detached helper woofer, placed in a flanking sub configuration.

The trade-off, of course, is that you either have to sacrifice bass extension or you have to make the helper woofer box really big. But for the midbass blending - what the flanking sub approach is designed to address - you don't really need the extension anyway. So you could run the same size box, and use the more distant subs for LF extension.

However, this yields another consideration, and that is when flanking subs are run deep, they provide modal smoothing down low as well as up high. They provide additonal bass sound sources used in conjunction with other more distant subs. We want distribution of sound sources in the deep bass range, and the flanking subs can provide that if they're generating deep bass output. If not, you're back down to a small number of sound sources in the deepest bass range.

As with all things, it comes down to a matter of competing priorities and trade-offs. I think if I didn't notice problems in the deep bass, I'd probably be happy with high-efficiency helper woofers and one really deep sub. Likewise, I am also happy in many rooms with just a pair of deep-reaching flanking subs, for much the same reason. Some rooms have better modal behavior than others, and particularly homes with framed drywall construction have some damping that smoothes the lowest modes a little bit. Other rooms, like those with brick, stucco or concrete walls, really benefit from a full compliment of four subs, two (deep running) flanking subs and two distant subs.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Thu, 29 Nov 2012 21:36:04 GMT
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That's a lot to think about.
Thank you very much!

Subject: Re: Flanking Subs vs Helper Woofers
Posted by dheflin44 on Fri, 28 Dec 2012 18:18:25 GMT
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Wayne Parham wrote on Thu, 29 November 2012 14:39
The distant subs are a little easier, because they can just be driven by the sound processor's built-in summed subwoofer output, with crossover set somewhere between 50Hz and 80Hz, depending on how far away the subs are placed.

Would it be better to run the mains, flanking subs, and distant subs from the same "large" L/R signals (with appropriate low-pass cut-offs on the flanking and distant subs) in order to get both mid and low frequency blending? Is there any low-bass content I would miss out on if I didn't use the LFE channel at all?

Thanks,
Darrell

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Fri, 28 Dec 2012 19:02:31 GMT
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Flanking subs and distributed multisubs are different animals. They have a similar purpose and correspondingly similar execution but have some specific differences because of the frequency ranges where they are intended to be most effective. Flanking subs are stereo subs that are relatively close to the mains and each is sent a low-passed copy of the main speaker they're

flanking. Multisubs are placed further away, distributed throughout the room, and each is sent an LF signal that is summed from all channels. They can optionally incorporate decorrelation filters to increase their ability to smooth the LF modes, but they would still be sent a single, summed LF signal.

Flanking subs are stereo subs, each blended with the main speaker they're flanking. They're run high enough they would be localizable if they weren't physically close. But they're just far enough away from the mains in all three planes to provide smoothing of the response anomalies caused by self-interference from nearest boundaries. Their main purpose is to reduce the notches created from the reflection off the wall behind the speakers and from the floor. They also smooth the higher frequency room modes, between about 80Hz and the Schroeder frequency, around 200Hz to 250Hz.

Distributed multisubs are mono subs, each sent a low-passed signal that is summed from all channels. They are placed further away, and would be localizable if they weren't low-passed at a relatively low frequency, usually no higher than 80Hz to 100Hz. Use the LFE signal to drive the distributed subs. They are there to smooth room modes below 80Hz.
Room modes, multisubs and flanking subs

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Fri, 28 Dec 2012 21:31:35 GMT
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Quote: Multisubs are placed further away, distributed throughout the room, and each is sent an LF signal that is summed from all channels. They can optionally incorporate decorrelation filters to increase their ability to smooth the LF modes, but they would still be sent a single, summed LF signal

Can you explain what the decorrelation filters are, how they work, how effective can they be in multisub and what kind of processors are used to make them?

Thank you very much.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Fri, 28 Dec 2012 23:20:39 GMT
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zheka wrote on Fri, 28 December 2012 15:31Can you explain what the decorrelation filters are, how they work, how effective can they be in multisub and what kind of processors are used to make them?
A decorrelation filter randomizes the signal. It is like adding jitter or reverb. That way the self-interference pattern is not well-defined. It's like putting the subs in several places at once.

Here is a paper on the subject of decorrelation filters used in echo cancellation:

Acoustic Echo Cancellation for Surround SoundThis technique is common in noise reduction circuitry, and shows how the process works. From this, you can get an idea how it could be applied to the room mode problem.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by dheflin44 on Fri, 28 Dec 2012 23:33:34 GMT
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Wayne,

After reading several of your postings, I think I understand how flanking subs blend with the mains to alleviate modal problems in the mid-bass region. I was wondering if it's possible to also have the flanking subs help with modal problems below 80 Hz by blending (not summing) the flanking subs with the distant subs. In other words can I get the equivalent low frequency smoothing of 4 distant subs by having 2 flanking subs + 2 distant subs.

Thanks,
Darrell

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Fri, 28 Dec 2012 23:46:37 GMT
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Absolutely. That's precisely what you want to do. The more bass sound sources there are, the better. So the two flanking subs become two of the four distributed multisubs at low frequencies.

The summed LF output is only being run to the distributed subs, of course. The flanking subs are getting a low-passed copy of the mains they are flanking. So there may be sounce material where each flanking sub has different signal content. In this case, the blend will be different than if all subs got the same signal. But then again, if the flanking subs received truly different signals, they could be uncorrelated in the source material, itself. However, in practice, this is rarely the case. Usually the LF content of both left and right front channels is nearly the same. It is pretty much summed in the mix, in most cases.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Sat, 29 Dec 2012 02:27:04 GMT
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Wayne Parham wrote on Fri, 28 December 2012 17:46Absolutely. That's precisely what you want to do. The more bass sound sources there are, the better. So the two flanking subs become two of the four distributed multisubs at low frequencies.

The summed LF output is only being run to the distributed subs, of course. The flanking subs are getting a low-passed copy of the mains they are flanking. So there may be sounce material where each flanking sub has different signal content. In this case, the blend will be different than if all subs got the same signal. But then again, if the flanking subs received truly different signals, they could be uncorrelated in the source material, itself. However, in practice, this is rarely the case. Usually the LF content of both left and right front channels is nearly the same. It is pretty much summed in the mix, in most cases.
I can see how this works with stereo. But it's not as clear to me when it comes to multi channel audio where the LF content from at least 3 more discrete channels and LFE are all summed in the subwoofer signal.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by dheflin44 on Sat, 29 Dec 2012 03:02:02 GMT
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I see now. I was under the impression the summed LF output was disabled when the mains were set for "full".

Thanks,
Darrell

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Sat, 29 Dec 2012 15:09:57 GMT
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zheka wrote on Fri, 28 December 2012 20:27I can see how this works with stereo. But it's not as clear to me when it comes to multi channel audio where the LF content from at least 3 more discrete channels and LFE are all summed in the subwoofer signal.
You can use flanking subs on every main speaker you have, for every channel. But I think the most important channels are the L/R mains, because they are so important to the presentation. Still, you could run flanking subs on every channel. That would certainly be ideal.

Flanking subs are primarily there to smooth the self-interference notches, so they have to be placed relatively near the speaker they are flanking, and they need to be low-passed in the low midrange. They are used in conjunction with distributed multisubs for best results.

What I don't understand, is how anyone can use distributed multisubs and not include flanking subs. It's like getting your car's wheels aligned but then running underinflated tires. The biggest problem is still there.

Distributed multisubs are becoming increasingly popular, and yet most discussions describe a process that only works to 100Hz. But the 100Hz to 200Hz range cannot be smoothed with distributed subs, that requires flanking subs. Room treatments cannot help in this range, only placement. So flanking subs are at least as important as distributed subs. I think the stereo pair are most important, but all speakers used indoors can benefit from a blended helper woofer to smooth the midbass and lower midrange.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Sat, 29 Dec 2012 15:55:12 GMT
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Wayne,

I totally buy the idea. I always wandered what can be done about the ugly notches right above subwoofer crossover point. With my faulty implementation of the flanking subs technique, I've seen the proof of how well additional sources in the region can deal with the problem. I am still planning to try a passive helper woofer or small sealed active sub with pro woofer approach you suggested a few post earlier.

But I am not sure properly set up (blended, one per channel) flanking subs can act as front stage subs for multisub in home theater environment. I would probably still use at least one powerful subwoofer upfront reproducing summed LF signal.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Sat, 29 Dec 2012 17:48:14 GMT
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Absolutely. Best results are obtained when both flanking subs and distributed multisubs are used, with the distributed subs running a summed LF signal, and the flanking subs running the same (low-passed) signal as the mains they are flanking. Some people use just one distributed (summed) subwoofer, but I prefer to use two. When you use just one distributed sub, its position is pretty important, but with two distributed subs blended with the flanking subs, it almost doesn't matter where you put them.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Wed, 23 Jan 2013 17:57:19 GMT
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I just watched a video of an audio gathering, where several presenters gave talks on one thing or another. One of the presenters was Earl Geddes, who did a talk on multisubs:

SMWTMS Meeting, January 19, 2013 (That's Southeastern Michigan Woofer and Tweeter Marching Society, if you're curious.)The whole meeting was recorded, and it's about two hours long. Earl gives his talk about an hour and a half into it, so you can move the slider until you find him. He looks sort of like John Malcovich, if you haven't seen him before and don't know what you're looking for.

While listening to his presentation, I realized he has now morphed his multisub procedure into one that is virtually indistinguishable from Welti's. Not that this is bad, in any way, it's actually very good, in my opinion. Hat's off to both of them, to Welti for pioneering the approach and to Geddes for continually investigating it and popularizing it with DIYers. It's just that I think it no longer makes sense to distinguish between Geddes and Welti arrangements because they are now fundamentally the same thing.

They always were similar, really, in that everyone agreed that individual subwoofer positions weren't that important provided you used enough subs. But in the mid 2000's, most would have considered Welti placements to be symmetrical (four corners or four wall midpoints, or less optimally two wall midpoints) and Geddes to be asymmetrical and pseudo-random (one corner, one opposite wall midpoint and one randomly placed, but not near another sub or in a corner or wall midpoint).

Later, Geddes modified his technique to include measurements to find the best subwoofer locations. With just three subs, position was a little more important than if you used four subs, so that became an important part of the "Geddes procedure." And Welti added a processor box that equalized the response sent to each subwoofer using FIR filters, calling this technique "sound field management". Now Geddes has begun to employ this approach as well.

I think the history of multisub development is fascinating, so I'll provide a few historical links that show its evolution:
Sub placement
The Subwoofer thing
Computer Simulation of Room AcousticsThe second thread listed here is the one I regularly link to as "Room modes, multisubs and flanking subs". I link to a particular post near the end of that thread where I've summarized and made some conclusions.

You will notice there was a wager mentioned in the simulation thread. Geddes was trying to get some traction with his "random" subwoofer placement scheme, which at the time did not use measurements to optimize. So he proposed a wager that he could prove his random arrangements were always better than Welti arrangements. Geddes lost that bet, and has since revised his strategy to include measurements. Without measurements to optimize individual subwoofer positions, some Geddes placements were as good as Welti placements, but some weren't.

I think Geddes' approach is fine now, as it has morphed into a procedural method that includes measurements to find good subwoofer positions. And on top of that, he has added equalization

for each sub to improve response even further. This is obviously a good way to do it.

But a few other observations are in order:

One is that most experts agree - and are confirmed in measurements - that once you get to four subwoofers, it almost doesn't matter where you put them. This makes the distinction between the arrangements typically attributed to Welti and Geddes somewhat irrelevant. As long as they aren't clustered together, multiple distributed subs will always provide better response and seat-to-seat consistency than a single subwoofer, no matter where they are placed.

A second observation is that placements can be optimized for any single listening spot, but then this almost guarantees they will not be as good in another location, especially if few subs are used. In fact, if only a single listening spot is to be optimized, one could simply use a single sub in the near field. Set the sub very near the listener, because that way the direct sound is louder than the reflections. But this is usually inconvenient, and the whole multisub approach is to improve seat-to-seat consistency simultaneously with improving response in the listening area. So the generally accepted method is to measure at multiple points in the area, to find placements that satisfy both requirements.

A third observation is the more subs that are used, the better consistency is. However, there are diminishing returns when adding subs. The improvement from one to two is great, from two to three, still significant but less, from three to four, less improvement still. Past four, the improvements are minimal. Remember that the multisub configuration works by creating dense interference. So what might have been a 15dB to 20dB variation using a single sub is reduced to maybe 6dB ripple with four subs.

A fourth observation is that while response is improved with multiple subs, it can be improved even more with equalization. Multiple subwoofers improve spatial consistency, and they also improve response at almost every specific location. But the room still imparts a sort of sonic signature, an average filter function of all modes combined. So where averaged response isn't flat, specific equalization of each individual subwoofer will yield even more smoothing than unequalized multisubs can.

But there is another implication, which is that multiple subs provide improvement even when no additional equalization or processing is used. The original multisub proposals were strictly placements without equalization, and yet they provide a great degree of useful modal smoothing and are a huge improvement over a single sub. You can expect unequalized multisub installations to improve seat-to-seat consistency compared to a single subwoofer - If they leave you with 6dB of ripple, that's still significantly better than 20dB ripple.

So don't be discouraged and think that you have to use equalization to implement multisubs. If you can make all the measurements, and then provide a conjugate EQ filter with DSP for each sub, that's awesome. You can expect your in-room response in the modal region to be ruler-flat and seat-to-seat consistency to be good. Just measure each sub individually at several points in the room, average the curve, and create a DSP filter that conjugates that curve. But even if you cannot do that, you can still expect multiple subs to improve response and seat-to-seat consistency.

And as I often say, the one thing that always seems to fall through the cracks in multisub discussions is the transition range. For example, you'll notice in the Geddes presentation that his fully optimized installation improves bass response very well, but above 100Hz, there is almost no benefit. I always questioned why this was overlooked, since it is so easy to solve, and by nearly the same method.

With four subs, you can easily get the bass below 100Hz to be smooth. Put 'em just about anywhere as long as they aren't grouped together. But what about the midbass and lower midrange, the region just below the Schroeder frequency? What do you do to smooth the 100-200Hz range? To me, that's even more important than the deep bass range.

My answer, as you can also see evolve in those early multisub discussions, is the helper woofer or flanking sub approach. I find this to be more important than the position of the distributed subs. Best if there are two flanking subs and two distributed subs, whether you want the distributed subs to be placed as Welti would have them or where Geddes would have them. With four subs, it doesn't really matter.

Flanking subs "fill in the holes" created by boundary reflections. So they reduce 20dB notches down to the 6dB range. This is a significant improvement, all by itself. And it allows the listener to equalize the 6dB reduction, if desired. One could not have equalized out the 20dB notch, as it is caused by complete cancellation. But the flanking sub prevents complete cancellation, because where one source cancels, the other doesn't making the total output more like 6dB down. To me, this smooths the sound field significantly, and I do not feel the need for equalization. But you can if you want, just like EQ for distributed subs, it is certainly an option when flanking subs are used as well.

Helper Woofer Location

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Wed, 23 Jan 2013 20:10:36 GMT
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Thank you, Wayne!

That's a lot to think about. I'll be back with questions.

"Southeastern Michigan Woofer and Tweeter Marching Society" - heh. As much as I hate marching, I can see myself marching with a group like this.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Wed, 23 Jan 2013 22:31:19 GMT
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zheka wrote on Wed, 23 January 2013 14:10"Southeastern Michigan Woofer and Tweeter

Marching Society" - heh. As much as I hate marching, I can see myself marching with a group like this.
I thought that was kind of a funny and interesting name for their group too.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by zheka on Thu, 24 Jan 2013 02:39:11 GMT
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the simulation thread is a fun read. do you use CARA these days?

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Thu, 24 Jan 2013 03:34:03 GMT
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I used it a lot back in those early multisub simulation days. But I started to see a trend, which was that once I had four subs, I could put them in several places and get good response. Geddes and Welti agreed, so that became sort of a "take away" for me. You can see each of them make statements confirming this on various messageboard threads. But the CARA simulations were a very good study.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by andy_c on Fri, 01 Feb 2013 20:12:56 GMT
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Wayne Parham wrote on Wed, 23 January 2013 11:57
And Welti added a processor box that equalized the response sent to each subwoofer using FIR filters, calling this technique "sound field management". Now Geddes has begun to employ this approach as well.
Hi Wayne,
The situation regarding Harman and multiple subs has been somewhat confusing. The first multi-sub processor box they made that I'm aware of was the BassQ. As far as I can tell, it used FIR filters and a pretty sophisticated algorithm for computing them, based on measurements at multiple listening positions. But the article by Welti and Devantier describing Sound Field Management (SFM), Low-Frequency Optimization Using Multiple Subwoofers, describes a technique that's different from what BassQ uses. In fact, I was pretty surprised at how crude the method is. For each sub, there is a variable gain and delay, but only a single biquad IIR filter: a cut-only parametric EQ stage. For each subwoofer, the gain, delay, and biquad parameters are

configured so as to minimize the variation in frequency response with position of the combined subs, without regard to what the frequency response is. They assume that global EQ will then be used to clean up the response. SFM is used in the ARCOS system (which also implements global EQ). Confusingly, the sub-blending approach of the BassQ looks to be much more sophisticated than what ARCOS is doing. BassQ seems to be computing its filters using the matrix inversion approach described in the above Welti and Devantier article (but not used for SFM).

It looks like what Earl is doing is much more sophisticated than ARCOS regarding the blending of the subs as well, though probably not as complex as the BassQ processing. The strange curves he gets at around 32 minutes into his presentation show that his filters are fairly high-order, though it's hard to tell exactly what the filter order is.

I am also fascinated by the history of the multi-sub approach, but somewhat puzzled by why Harman did not continue with the approach used by the BassQ.

Edit: It may also be that I'm overestimating the complexity of the BassQ, as there hasn't been much information disclosed about it by Harman.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Fri, 01 Feb 2013 21:35:30 GMT
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I would agree (and expect) some differences in details, but I'm not sure how significant those details are. At least, less significant than the main idea, which is to use multiple sound sources spread apart spatially, and to use EQ, where appropriate for even smoother response. I also think that the more sound sources, the less important their positions or individual filters are. The fewer the sources, the more important those things become. It appears both Geddes and Welti would agree on those points.

As for differences, I do think we have seen some erosion of the unique features that set each approach apart. Used to be - around 2005 - Welti was symmetrical and Geddes was asymmetrical. At that time, Geddes clearly made statements that distinguished his process from Welti's. Then Welti began to use EQ to modify subwoofer response, optimized by measurements made from multiple positions. Geddes now also proposes using EQ to modify subwoofer response, and his procedure is also now guided by measurements. These similarities, combined with the agreement on both sides, that once you get to four subs, Welti and Geddes arrangements are pretty much identical with respect to performance, makes me see what is essentially a unified approach. Yes, there are differences in details, but I think we see pretty much an over-arching agreement.

I think "both" approaches are excellent, although as I said, I think "both" are now pretty much one and the same.

And I also think that - unless the main speakers are sitting right on the wall, soffit mounted or constant directivity cornerhorns - that sound sources blended in the 100-200Hz range should be used in addition to the distributed subs blended below 100Hz. The multisub approach is great for

smoothing the bass below 100Hz, but it does nothing to address the anomalies from nearest boundaries, most significantly the wall behind the speakers. Flanking subs can (and usually should) be part of the multisub equation, since the flanking subs provide additional bass sound sources. Said another way, you can have two stereo flanking subs and two distributed subs, or three flanking subs in an LCR setup with one distributed sub, for a total of four subs to provide modal smoothing.

Subject: Re: Flanking Subs vs Helper Woofers
Posted by andy_c on Thu, 07 Feb 2013 17:46:52 GMT
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andy_c wrote on Fri, 01 February 2013 14:12Edit: It may also be that I'm overestimating the complexity of the BassQ, as there hasn't been much information disclosed about it by Harman. Just to update this, I found some detailed information about the BassQ in the BassQ thread on AVS Forum. Roger Dressler posted a PDF of the patent application for it. I've attached it below, because I think one needs to be logged in at AVS in order to download it. It turns out that BassQ uses FIR filters and the matrix inversion process described in Welti's paper but not pursued further in that paper.

Also, after watching Earl's video for the umpteenth time, I heard him say that he uses six parametric EQs per sub, which seemed like a lot to me. So I asked Earl about that, and he says he uses up to six parametric EQs per sub, but can usually get by with one or two.

So given the typical implementation of Earl's approach with just one or two parametric EQs per sub, it seems that his approach is very close to what Harman is doing with SFM (which always uses one parametric EQ per sub), while the BassQ is rather different from SFM and Geddes in its use of FIR filters and matrix inversion.

It seems a bit strange to me that JBL introduced the BassQ in 2008, after Welti published AES articles that de-emphasized the approach used by BassQ. It's an interesting history.

File Attachments
1) BassQ_patent_application.pdf, downloaded 374 times

Subject: Re: Flanking Subs vs Helper Woofers
Posted by Wayne Parham on Thu, 07 Feb 2013 18:19:22 GMT
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I'm not sure the use of FIR filters is a significant difference in this case, since there is no need to adjust magnitude and phase independently. I assume that's what was originally on their minds though - They may have chosen that filter approach so they could manipulate frequency and time

response independently. But since phase in the room is all over the place anyway - the whole approach it to create dense interference - I think IIR or analog filters are just as useful. I don't think they are necessarily better in this application though either, more that it's six one way and a half dozen the other. Which brings me back to the point that I think we're seeing some convergence of approaches here. They're becoming very similar not just in concept but also in execution.

And again I would remind any readers that I think whatever method you chose to smooth response below 100Hz, do not forget to deal with the range above that. I believe the octave between 100Hz and 200Hz is as important or more so than the octave between 50Hz and 100Hz, which is primarily what distributed multisubs address. Flanking subs smooth the the range above 100Hz, through the transition region, and distributed subs smooth the deeper bass range below 100Hz. What we are essentially seeking is a spatially distant array at low frequencies (<100Hz), narrowing to a closer-spaced array at low-midrange frequencies (100Hz-200Hz), gradually transitioning to a point source in the statistical region above 200Hz.
Flanking Subs vs Helper Woofers, revisited

Subject: Re: Flanking Subs vs Helper Woofers
Posted by andy_c on Fri, 08 Feb 2013 01:07:08 GMT
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Yeah, I'll be doing what you call flanking subs out of necessity. I only have room for two subs, one to the left of the left mains and one to the right of the right mains. So I decided to make two sonosubs, with each sub having one up-firing and one down-firing driver with a separate amp and LPF on each of the total of four drivers. Each enclosure will be internally divided into two halves because of having different signals applied to the top and bottom drivers.

I hadn't heard of flanking subs until a couple of weeks ago when I followed one of zheka's links here. I hadn't actually thought of the benefits of subs close to the mains in terms of the 100-200 Hz range before. But my system needs some help there, as I have a 10 dB suckout at about 125 Hz. So I'm going to try crossing at least two of the subs over at 150 Hz or so to get some fill-in.

I had originally considered the need to have the subs and mains close to be a disadvantage, but I hope be pleasantly surprised now. The subs will be behind the mains, as close to the wall as I can get them.
