

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 Acoustics The 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
