
Subject: Smoothing in Frequency response graphs
Posted by [Marlboro](#) on Sat, 16 Feb 2008 05:08:54 GMT
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What do people here usually use in regard to FR smoothing? My program does as accurately as 1/48 octave smoothing. I've seen some commercial plots that use 1/3 octave smoothing which when I use it on my cheap tiny little computer speakers look positively spectacular. I would prefer at least 1/12 octave. What do people use to represent? Marlboro

Subject: Re: Smoothing in Frequency response graphs
Posted by [Wayne Parham](#) on Mon, 18 Feb 2008 06:00:13 GMT
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What's the best level of smoothing to use? What kind of measurements should be taken? Those are questions with a lot of right answers and a lot of wrong answers. There is no one right answer for each question, but there are a lot more wrong answers. For me, there are only a few absolutes:

1. If you don't have the right equipment or you don't have experience with test equipment or both, you're better off NOT measuring. The results you get may be wrong and may lead you in the wrong direction.
2. Unless, of course, you're practicing. In that case, it's worth doing but don't necessarily trust your results.
3. You can measure a speaker, or you can measure a room. That's two entirely different things.
4. When measuring a speaker, bass should never be measured indoors.
5. When measuring response in a room, bass must be measured at several locations within the room.
6. Bass measurements should not be smoothed at all.
7. Above 300Hz or so, some smoothing can be used to remove the "grass". But smoothing beyond 1/6 octave removes so much detail pretty much everything looks smooth.
8. When comparing two speakers, the same level of smoothing should be used. Best to compare using the same type of test equipment and test setup.
9. Outdoor ground plane measurements are easiest to get accurate measurements from. Bass response can be measured with the speaker sitting on the ground in a wide open space outdoors. Higher

require you to dig a pit and/or make a false baffle and point the speakers upward with the measurement mic suspended above it.

10. Indoor pseudo-anechoic measurements can be made using some equipment that has gating, but it is only accurate above a few hundred Hertz, depending on the position of the speaker under test, the microphone and boundaries (floor, walls and ceiling).
11. Real-world in-room measurements should be made with the speakers where they will be used. Several measurements should be made throughout the room. This will show room modes and other effects of boundaries like floor bounce notches, etc.
12. In-room measurements should never be used to compare speakers, unless they are gated to remove reflections. If the room is measured, the speaker is not. Room effects swamp almost all other acoustic details that could have been seen specific to the loudspeakers at least at low frequencies in the modal range (below about 300Hz). And the one most important - Listen to the experts. Measurements are not a trivial exercise. You can't just get an RTA and a microphone and expect anything reliable to come from it. I've seen a lot of people do that, and they'd be better off using a modeling program. It would give them more accurate results, particularly below

300Hz. There are a lot of measurement methods, and a lot of ways to get it wrong. For that reason, I'd ask this same question over on the Measurement forum. Maybe Keith Larson will chime in. He's done a lot of work in the field, and I think his input would be very helpful. While there are a lot of wrong ways to do it, but there are a lot of right ways too. There are several good methods, a lot more than what I described above. Maybe some of those methods can be examined in detail in a series of threads.

Subject: That's terrific, Wayne!

Posted by [Marlboro](#) on Mon, 18 Feb 2008 19:13:48 GMT

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I'm copying it to my remember lines. So many people over on the PE forum are most likely doing bad measurement. And then we have the situation with the commercial speaker manufacturers who are using 1/3 octave smoothing for their speaker systems, and the curve looks so good, for their \$5000 speaker system. Using 1/3 octave with a bad mic makes my 1 inch computer speakers look great! Thanks so much. Marlboro

Subject: Measuring a room with line arrays.

Posted by [Marlboro](#) on Tue, 19 Feb 2008 01:13:46 GMT

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I'm wondering that what must be done for line arrays is not measuring of individual speakers, but actually measuring rooms. Those who put passive crossovers into their systems may be able to measure the speaker system, but when you are talking about a system that has two 12 inch woofers, 34 three inch midranges, and 60 3/4 dome tweeters, I can't see anything other than measuring the whole room. Marlboro

Subject: Re: Measuring a room with line arrays.

Posted by [Wayne Parham](#) on Tue, 19 Feb 2008 18:05:44 GMT

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If you measure the speaker in an anechoic space, then you are truly measuring the speaker. If you do not, then you are measuring the speaker and the space. This is OK if that's what you want to do, like is the case if you are setting up your system. But if you are trying to compare loudspeakers, you don't want the room contaminating the data. Otherwise, you're comparing rooms more than you're comparing speakers.

Subject: My Ears

Posted by [chris](#) on Mon, 03 Mar 2008 19:24:06 GMT

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Roger Russell says I cant hear comb filtering, so I just let my ears and the room "smooth" it out, and not "worry" about it.

Subject: Re: My Ears

Posted by [Jans](#) on Mon, 03 Mar 2008 22:36:31 GMT

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Greetings! I think if the interference is dense enough you can't hear it. That's what he means, yes? Not big nodes spaced a foot apart but small ripples less than an inch apart. I don't think I can hear small closely spaced ripples but big variations in response from square meter to square meter is clearly audible. Jans

Subject: Re: My Ears

Posted by [Marlboro](#) on Tue, 04 Mar 2008 03:01:01 GMT

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What you can hear is loss of highs. If comb filter distortion starts at 9,000 you'll hear it as loss of sparkle. Problem is that the line array's sound stage and lack of distortion may mask the lack of highs unless you can hear another line array with much higher start up of comb filter distortion as a comparison. Before I hooked up the tweeters, I ran the system with the 3.5 inch mids running full range. It sounded great, but the comb filter distortion from a 5 inch center to center caused a huge loss of upper frequencies. I didn't realize how much better it could sound until I connected the tweeters, and comb filter distortion didn't start until pretty near the limits of my 58+ year hearing (15,800 Hz). Marlboro

Subject: Re: Smoothing in Frequency response graphs

Posted by [Keith Larson](#) on Wed, 05 Mar 2008 19:29:06 GMT

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I have built a pair of line sources, so they are particularly interesting to me. You will however find that with a limited length response will change with distance. My configuration is a combination of active and passive crossovers. The active part (going to my amplifier) compensates for the HF rolloff while the passive part splits the woofer, mid-bass and tweeters in a traditional 3-way

crossover. Not surprisingly it helped quite a bit being able to measure the system response. There are a couple of averaging methods to consider. One of the most common is smoothing the dB response using a line smoothing algorithm. This simply removes the squiggles, or as it was aptly put 'cuts the grass'. On the other hand if you take many responses true amplitude noise can be reduced producing the raw frequency response (with grass), that you can then 'line smooth'. Hope this helps, Keith Larson

Subject: Re: Smoothing in Frequency response graphs
Posted by [Edward2](#) on Wed, 05 Mar 2008 22:50:58 GMT
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keith That sounds like an equalizer in front of a standard passive crossover. An active crossover has to do the splitting, and by its nature requires multi amping since the crossover network goes Pre-amp -> active crossover -> 2 or 3 different amps -> 2 or 3 different speakers. Ed

Subject: Re: Smoothing in Frequency response graphs
Posted by [Wayne Parham](#) on Wed, 05 Mar 2008 23:56:38 GMT
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I have more experience with point sources, but I have measured arrays too. One thing I noticed right away is the absence of the floor bounce notch. Any time I measure a tower speaker or a monitor on a stand, I see a notch from floor bounce. Arrays don't have this because of the number of drivers. Because of this, ground-plane measurements took on a slightly different meaning to me for arrays. The ceiling and ground are like reflectors of the line. Jim Griffin and others describe this, and it surely makes sense. The ground reflector isn't a good thing if there is a single woofer at ear level, but it's fine if there is an array of woofers from the floor up. Do you have any other observations about measurement techniques specific to arrays? They're definitely a different breed than point source speakers. On a similar topic, one thing I suggest to guys with deep pockets is to use several subs in a room. It does sort of the same thing that vertical arrays do to remove floor notch. Using a few strategically-placed subs balances bass throughout the room. One can use a program like CARA to decide where to place the subs. Earl Geddes suggests a random placement, with one sub in a corner, one sub above mid level height and one or more subs placed randomly in the room. I agree with him on the idea of using multiple sources to improve the uniformity of bass energy throughout a room, although I prefer trying to keep the subs symmetrical and somewhat close to the mains, if possible. My suggestion is a layout that is more like an oblique array, with a few subs at different points along the horizontal and also at different heights. Most importantly, I suggest checking any proposed placement with CARA rather than depending on randomness to take care of averaging. But whichever way you slice it, the idea is to use a handful of subwoofers to smooth room modes.

Subject: Re: Smoothing in Frequency response graphs
Posted by [Keith Larson](#) on Thu, 06 Mar 2008 03:05:27 GMT
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Hi EdIn actuality my configuration is one step further from traditional. Since I have not yet actually taken the step of converting the EQ to a standalone op-amp circuit. My EQ is in fact a purely RC circuit that filters the response coming from a first amplifier (a NAD acting as a big gain stage). I follow this with a Hafler DH500 after the appropriate attenuation. If you think of each amplifier as nothing more than a big op-amp (thats what they are), it makes sense. The DH500 does indeed drive a conventional crossover (one 12", 4" mids and 3/4" tweeters). I also have an 18" sub that extends the low end into the mid teens. Best regards, Keith Larson

Subject: Re: Smoothing in Frequency response graphs
Posted by [Keith Larson](#) on Thu, 06 Mar 2008 03:28:12 GMT
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Hi Wayne, If you want to get into the math behind a line source its not really all that bad. The trick is knowing that you need to sum pressure (volts) and not power (watts). The 'power' of a point source does indeed fall $1/R^2$, but the pressure is $1/R$. That is, power is proportional to V^2 . I learned this back in 1985 when I was in college and built my first line source system. Even though I don't think he really knew what I was up to, it was my DSP professors that helped me figure out the $1/R$ issue. When I mentioned the $1/R^2$ power relationship he quickly picked up on the fact that you don't sum power, you sum volts. The model I have predicts many of these effects quite nicely, but it lacks floor and boundary conditions. This would not be hard to add, but for best results reflectivity and absorption would need to be known. Or, you measure and then make the appropriate corrections. Hope this helps, Keith Larson

Subject: Re: Smoothing in Frequency response graphs
Posted by [Wayne Parham](#) on Thu, 06 Mar 2008 03:51:29 GMT
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I've never really studied arrays, although I do like the concept very much. My focus has always been on point sources, both direct radiating and horns. I guess I may have kind of gone off on a tangent on the floor bounce thing, but we were talking about measurements and it is one of the things I noticed about line arrays. They don't have a distinct floor bounce notch even when standing upright because of multiple path lengths from driver(s) to floor to microphone. So I was thinking out loud that ground plane measurements probably make more difference in the response graphs of point source speakers than they do of line arrays. I like the idea of multiple subs for a similar reason, smoothing room modes.

Subject: stereo subs vs all around the room subs
Posted by [Marlboro](#) on Thu, 06 Mar 2008 04:01:25 GMT
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I know that bass below a certain point is supposed to be omni-directional, but I've heard the omnidirectional sub and I've heard systems where there are two subs in stereo configuration. The two sub system beats the omni hands down. Of course people have shied away from that by limiting bass in their MTM's or whatever, and then just using a sub for sounds below 60 hz. I still think they would do better with a threeway, and using at least two high X-max woofers calibrated to go down to 20hz. 4 would be better, 6 even better. sound volume could go up, but would go down is distortion in the bass range. I hope to do that some time in the future but don't have the funds at the moment to buy 4 more \$130 woofers(\$520) + the cabinets. Marlboro

Subject: Re: stereo subs vs all around the room subs
Posted by [Wayne Parham](#) on Thu, 06 Mar 2008 04:09:21 GMT
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Bass is omnidirectional unless the sound source is very large. The deal with room modes is interference between a reflected wave and the source, or between two reflected waves. It makes pockets of high and low energy throughout the room at frequencies below about 300Hz. When you use multiple strategically-placed subs, you can fill in the holes. A notch formed by interference between one sub and a boundary's reflection is energized by a different sub that doesn't have destructive interference at that particular location.

Subject: Re: stereo subs vs all around the room subs
Posted by [Marlboro](#) on Thu, 06 Mar 2008 04:24:28 GMT
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Understand what you are saying. I'm just telling you that my personal experience in comparing an omni with a stereo sub system is that the stereo sub system beats it out in perceived quality of the bass in the music presented, at least in the homes where I heard them. I've no doubt that you are right; my ears also present me with a different view. Now, I've never heard an omni system with 5 subs spread around the room. Perhaps I should keep my current system and add 3 or so spread around the room. Of course if I were to add 4 more subs to my current array bringing up a true bass line array to go with the 34 mid ranges and 60 tweeters, that would be A SOUND SOURCE THAT IS VERY LARGE. Marlboro

Subject: Re: stereo subs vs all around the room subs

Posted by [Wayne Parham](#) on Thu, 06 Mar 2008 04:37:03 GMT

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I agree with you about stereo subs. One of my favorite implementations is a three-way speaker, with horn-loaded tweeter and midrange that goes down to nearly 100Hz. The woofers are only used up to ~200Hz, and are acoustically close to the midhorns. Extra subs can be added if desired, placed fairly close to the mains but spaced enough to average room modes. These extra subs are crossed-over very low, with low-pass cutoff well below 100Hz. This prevents abnormal

is omnidirectional unless the sound source is very large. But most subs touch the midrange, which really starts around 80Hz. You can localize sounds from about there upward in frequency. That's one reason why you can sometimes tell that bass is coming from a sub if it's far away from the mains. There is a completely different issue that is sometimes a problem, and that's room modes. Sometimes they're not bad, thanks to framed drywall construction which tends to damp room resonances somewhat. The walls have some give, and that helps a great deal. But room modes can make certain bass notes drop out in specific places in the room. The cause is interference between a reflected wave and the source, or between two reflected waves. It makes pockets of high and low energy throughout the room at frequencies below about 300Hz. When you use multiple strategically-placed subs, you can fill in the holes. A notch formed by interference between one sub and a boundary's reflection is energized by a different sub that doesn't have destructive interference at that particular location.

Subject: Did you Try EQ ?

Posted by [chris](#) on Thu, 06 Mar 2008 21:06:53 GMT

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That is what Roger Russell does. Hey, got an idea ??? Buy some old Bose 901's, and simply array the drivers vertically, LOL Seriously, did you TRY to eq the midrange drivers ?? What you MAY have been hearing is the drivers inherent roll off ?
