Subject: Line Array discussion
Posted by Anonymous on Thu, 02 Sep 2004 15:59:34 GMT
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On another forum, the line array topic came up. Maybe someonehere with line array experience can explain why DIY'ers are havingsuccess with good sounding near field line arrays even though theyclaim the science behind it is terrible.http://forum.soundillusions.net/showthread.php?t=38445

Subject: Re: Line Array discussion
Posted by Ralph on Thu, 02 Sep 2004 17:04:20 GMT
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I didn't see people claiming the science was terrible. Dan Wiggins looked askance but he was the only one. Dr. Griffin is more authoritative on the subject of arrays, IMHO.

Subject: Re: Line Array discussion
Posted by Kramer on Thu, 02 Sep 2004 18:23:40 GMT
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Yeah, that was weird. I've seen Dan Wiggins around here and there, but I mean that time he was really wiggin! Rybaudio looked to be right on point and basically showed ways to make a good array. Jim Griffin obviously knows how to make a good array and Thylantyr and Atomic Fusion referenced his white paper. That was useful. Brian Tatnall and everybody else seemed to be just talking about talking, no points made. Wiggins and Co. seemed to be bent on the point they can't make a near-field array. Good enough, stay out of the thread!

Subject: Re: Line Array discussion
Posted by Anonymous on Thu, 02 Sep 2004 19:12:14 GMT
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I asked them to close that thread over there because nobody wasable to offer ideas on how to build a good sounding near fieldline array even though they claimed that Jim's white paper is flawed.The data they posted is fine, they explain the 'bad science' behindline arrays. It's good data. But the data seemed more useful to dissuade the DIY'er from making an attempt to build. I was expectingsome positive reinforcement on how to combat some of the issues.It's no big deal. I view this as an example where science clasheswith a subjective topic. The human perception of sound qualitymay not be measured variable, everyone has their own tastes in audio.analogy,You

like Loudspeaker 'A', I don't like Loudspeaker 'A'.Speaker design is a game of compromise and even though a designmay have 'bad science', that is no indicator that the gremlinswill be audible.Even if there is mixed opinion on the sound quality of a design,that is no reason to discard the design either. But if a 100 outof a 100 people vote 'no' on design due to audition, then youmay have to come to the conclusion that you need a redesign of yoursound system.The specific part that I'm interested in is wondering how somethingwith bad science can be interpreted as sounding good. The onlything that comes to mind is the 'human equation'.

Subject: Re: Line Array discussion
Posted by Jacob on Thu, 02 Sep 2004 19:21:40 GMT
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Thylantyr,No one claimed that the science behind nearfield line arrays is terrible like you suggest. Wiggins and Co. claimed that arrays used nearfield are sporadic. Rybaudio showed that and explained some of the difficulties. What they say is that it is bad engineering and decision making to use arrays nearfield because there are other options with less obstacles to overcome. It is not the science that is bad, it is the decision to use an array in that application.

Subject: Re: Line Array discussion
Posted by Jim Griffin on Thu, 02 Sep 2004 21:14:50 GMT
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Thanks for the message. I just read the thread that you referenced. I have no reason to critic Dan Wiggins' (or anyone else's) comments or question his acoustical physics training. He brings a great deal of expertise to the subject. Unfortunately, Dan doesn't provide us with references or such to fully explain his comments. I encourage those of you who have an interest in line arrays to first read about them. Also make an effort to actually hear some of the recent line arrays--DIY and commercial should be available--before jumping to conclusions as to whether they are bad or good. It is like a lot of things in life--you may or may not like how line arrays sound--while others may have a different impression. Remember bad science or not a well executed line array design may float your boat. If you wish to read more informative recent reasearch on the line arrays, start with the papers written by L-Acoustics reseachers which are available on their site:http://www.l-acoustics.com/anglais/accueilgb.htmClick on the R&D tab and you will see a list of "Wavefront Sculpture Technology" papers published in AES journals. The most recent one is the October 2003 AES Journal paper which summarizes their earlier work which can be downloaded once you click on it. These papers cover more that 14 years of study and work to develop L-Acoustics arrays. The www.JBLpro.com references the JBL line array work but much of it is from the far field analysis viewpoint. Far field analysis is more amenable to pro sound applications than home applications. You can click the Technical Library tab and proceed to the VERTEC series papers to get downloads of the JBL work. Most of these are AES Journal and Convention papers but should be read to understand their research.I used much of this material in

my writing of my Near Field Line Array white paper.Jim
Near Field Line Array White Paper

Subject: Re: Line Array discussion
Posted by DanWiggins on Fri, 03 Sep 2004 20:26:24 GMT
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Well put! IMHO, line arrays (and in fact, arrays in general) should be avoided in the near-field. Far-field use is great and often quite appropriate; however, I feel the nature of the near-field within a line array results in too many compromises and, to my ear, a less than stellar result.Some of my more used references include:- Fundamentals of Acoustics by Kinsler, Frey, Coppens, and Sanders- Audio Engineering Handbook by K. Blair Brown- Underwater Acoustics by AckerMeyersound has a great little white paper describing the issues with line arrays: http://www.meyersound.com/support/papers/line_array_theory.htm . It's pretty complete in its treatment of the subject. One should note that Meyersound sells speakers specifically designed for use as line arrays - they are a VERY strong proponent of line arrays, but also caution against use in the near-field situation, and explicitly state that line arrays do NOT create cylindrical wavefronts.I also see that Art Ludwig has some good descriptors of the near-field and field calculation on his website. It can be found at http://www.silcom.com/~aludwig/Physics/Exact_piston/Exact_piston.htm . Note that he shows the chaotic nature of the near-field of a piston radiator at http://www.silcom.com/~aludwig/Physics/Exact_piston/Cone_near_field.gif - it is, IMHO, quite instructive of the nature of the beast being dealt with.One can use this equation to superimpose the output of multiple sources on an arbitary point; I wrote a small Windows program back in 1992 or so that did just that. Iterating the point through a surface (sphere or plane) allowed a visual graph of the pressure of the array over the surface. Iterating across a bandwidth and flipping images (after considerable processing time) allowed an animated image of the nature of the acoustic power on that plane. It quickly became apparent to me that working within the near-field of a radiator is loaded with problems, and that simply staying out of the near-field was, IMHO, the best solution. In SONAR or audio.Does this mean that no one should like line arrays? Of course not! I don't like 2W SET tube amps either, but I know many who do, and more power to them. The whole issue arose over a request for help on line arrays, and some general feedback about some of the issues that I feel should be considered when working with them. It's not preference - it's about understanding the definite tradeoffs one makes when working in the near-field of ANY radiator. Arrays tend to be more problematic simply because the near-field extends out so much further.Anyway, IF you had to do a near-field line array, I think Dr. Griffin's paper is a good starting point, and said so up-front. He has a good treatise on the issues at hand, and the use of a Bessel array definitely solves many of the associated problems. It does mean reducing much of the acoustic gain one gets from the line, but again that is not because of a bad implementation, it is because of the underlying physics. Rybaudio's posts confirmed that where bandwidth and power output was adjusted across the elements of the line to make an IMHO very bad situation less bad.I hope this clarifies the whole issue. Anyone is free to enjoy what they want; however, there are definite advantages and disadvantages to any particular implementation. My experience and knowledge has led me to a different set of problems (and solutions) than line arrays used near-field. Is that bad? No, it's different.There was no slight or put-down intended of line-array

proponents; just a caution about some of the issues that should be considered when dealing with these complex build-ups.Dan Wiggins

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Subject: Re: Line Array discussion
Posted by Kramer on Fri, 03 Sep 2004 20:46:20 GMT
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You make very lucid comments here and I misjudged you, sorry.

Subject: Re: Line Array discussion
Posted by DanWiggins on Fri, 03 Sep 2004 20:56:13 GMT
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Thanks - no worries or hard feelings on my part! Just always looking to achieve the ever-moving goal of sonic nirvana...:)Dan Wiggins

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Subject: Re: Line Array discussion
Posted by Anonymous on Fri, 03 Sep 2004 21:22:45 GMT
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Dan made some odd comments days ago and I interpreted this as "The Griffin white paper is good, then bad". Dan's new messageclaims it's good again.**********Dan said;"I've read Dr. Griffin's paper, and while it is generally good, it does overlook much of the near-field issues that a good strong reference (Steven's recommendation of Fundamentals of Acoustics by Kinsler et al is excellent) cover."Then he said;"The paper linked is Jim Griffin's paper, and it's not accurate at all."http://forum.soundillusions.net/showthread.php?t=38445&page=1&pp=15Then he said here days later;"Anyway, IF you had to do a near-field line array, I think Dr. Griffin's paper is a good starting point, and said so up-front."**********It's not a big deal really, but it's easy to misjudge when the poster is sending mixed signals or changing their minds midstream :)

Subject: Re: Line Array discussion
Posted by Kramer on Fri, 03 Sep 2004 22:16:02 GMT
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What do YOU think about Jim Griffin's paper and speakers based on it? He deals with HF lobing by adding a tweeter. The array is shut off at high frequencies and crossed over to a tweeter. The array isn't chaotic at low frequencies because waves are long compared to driver diameter and line length. I think that's basically it in simple terms.

Subject: Re: Line Array discussion
Posted by Anonymous on Sat, 04 Sep 2004 00:34:47 GMT
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==What do YOU think about Jim Griffin's paper and speakers based on it?Good stuff!

Subject: Re: Line Array discussion
Posted by Jim Griffin on Sat, 04 Sep 2004 01:40:38 GMT
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Dan,Thanks for checking in and giving us some background about your earlier remarks. I realize that if you read all of the literature on near field line arrays (or choose most any other speaker type if you wish not just line arrays), you likely would not take the time to design or build one. Line array downers (examples, are Lipshitz and Vanderkooy's AES Convention paper from 1986 and more recently Earl Geddes' "Audio Transducers" book dated 2002) would not inspire your confidence that near field line arrays will produce pleasing sound. However, I would urge you to read more of the recent line array articles that I referenced in my earlier reply in this thread. The L-acoustics work is especially noteworthy. If one takes the time to adequately design and build a near field array for home usage, you may find it to be a rewarding experience as I detail in my white paper. There I detail is a specific set of criteria that can result in a pleasant listening event. My goal was to avoid or limit the near field chaos that would be haunting to a less exacting design.

I would like to reply on your reference to the John Meyer's magazine article. First of all, the 'cylindrical waves' statement is true to a degree. But in the near field the vertical wavefront (created from overlapping outputs from the drivers) is concentrated between the ends of the array--very little energy impinges from the floor and ceiling surfaces. The near field energy flow radiates parallel to these surfaces versus the normal spreading flow from a point source. Furthermore, Meyer's own data does support an average of 3 dB per doubling of distance sound falloff if you look at his data in Table 1 for the 4 and 8 meters distances (practical in-home near field distances unless you live in a castle). Furthermore, John's concerns about high frequency extension are difficult to mitigate for a high power pro sound line array but can be easily overcome via readily available small ribbons and such. Bottom line is that pro sound and in-home line array design/usage are vastly different issues. John's article is good magazine material for a pro sound line array audience but can be a misleading interpretation for an in-home near field array. Thanks again for the posting. Jim

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Subject: Re: Line Array discussion
Posted by DanWiggins on Sat, 04 Sep 2004 14:38:31 GMT
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Jim,Thanks! I agree that Lipshitz and Vanderkooy, and Geddes as well paint a pretty bleak picture of near-field line arrays (NFLA). I don't think they're THAT bad - clearly enough people enjoy them that their strengths carry a lot of weight with lots of people! And I've perused most of the other references (although I have not spent in-depth time); my understanding is that most acknowledge the acoustical issues when operating in the near-field, but feel these can be shaded down so that listener preference is positively influenced.I've built quite a few arrays, and I've always found that in the near-field, I simply don't like the sound. Far-field, well, they can do some really cool things...;) But I just don't like the near-field. Likewise, I'm not a big fan of large, near horns either. Dynamics are great, and you can have great accuracy in terms of phase and frequency response (like the Unity horns). But to my ear, they sound like wearing a really big set of headphones - image is all left, right, or middle - nothing in between. I think the extreme dispersion control removes too much of the reverberant field of the room that I believe is fundamental to the creation of a large and open image.Personally, I've designed NFLAs for clients, and will do so in the future too! If the client is happy, then I'm happy. I may not like what the results are like personally, but then again it's not for me. I do the same with drivers, amps, and other audio products all the time. And I hope that no one assumes that because I personally do not enjoy listening to near-field line arrays that I automatically relegate NFLA adherents to the lunatic fringe or dismiss them! Preference is, IMHO, inviolate. Those who find their path to sonic nirvana should pursue it, but also allow others to follow their own path. Preference for a different path does not make anyone's path lesser or greater. However, I also believe that the more we can tie hard physics and acoustics to preference (Tolve's 1989 article in JASA is, IMHO, a landmark work on the subject) the better off all designers are. And to do this means that everyone needs to fully acknowledge the strengths AND drawbacks of their path. Knowing how the path for you is set allows you to extend it even further and faster... Those who are in to extreme dynamics should know what they really like, and go after it. Those into extreme flat frequency response likewise. Those into broad images, the same. It's about learning the stones that make your path, and the underlying physics that creates those stones, and searching out ways to make more...Thank you and everyone here for the cool, level-headed place to discuss this! Definitely class acts! And if there ever are questions anyone has about my likes/dislikes and experiences with arrays (line and circular), just ask!Dan Wiggins

Subject: Re: Line Array discussion
Posted by jdybnis on Sun, 05 Sep 2004 07:25:13 GMT
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Dan,I find this interesting. Can you elaborate more on near-field behavior of line arrays? Do the lobing effects you and Rybaudio described still exist at frequencies with a larger wavelength than the center to center spacing between the drivers?Do you know if there are off-the-shelf tools to do the simulations shown by Rybaudio? (I'm posting this here to avoid creating an account on yet another fourm.)Thanks,-Josh

Subject: Re: Line Array discussion
Posted by Kramer on Sun, 05 Sep 2004 17:30:29 GMT
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Hi Dan,Please see my message to you in the car audio section.Thanks,Kramer

Subject: Re: Line Array discussion
Posted by DanWiggins on Mon, 06 Sep 2004 14:21:15 GMT
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Josh,There's lots of programs that will do the simulation, but they tend to be quite expensive. You're probably better off rolling your own program. Here's one page with the equation for a single piston:http://www.silcom.com/~aludwig/Physics/Exact_piston/Exact_piston.htmYou want equation P7. Here's an image of the output, using the equation:http://www.silcom.com/~aludwig/Physics/Exact_piston/Cone_near_field_phase.gifIt's quite accurate (also the same equation as derived in Fundamentals of Acoustics). Examining the equation, you can see there is a linear dependency on wave number k, so at lower frequencies the problems are reduced. With arrays the issue still exists until the wavelengths are longer than the longest center-to-center distance in the array. For example, assuming an array of ten 4" diameter woofers packed with centers 5" apart, you have a maximum center-to-center distance of 50". You'll have interference patterns (which is really what's going on, in Rybaudio's images) with wavelengths less than 50" long (about 270 Hz).Now, the interference is reduced as the wavelengths approach this size; and any resulting lobes tend to be at high angles, so they really do not affect the direct field, even in a 45 degree vertical coverage (sit down/stand up test). They can affect the total power response, though, so if you are in the reverberant field of the speaker, it will affect the perceived tonal balance.Dan Wiggins

Subject: Re: Line Array discussion
Posted by jdybnis on Tue, 07 Sep 2004 00:14:06 GMT
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Interesting. If I understand this correctly it implies that a typical 5" ribbon tweeter (single, not in an array) is going to suffer from these same problems operating in its normal range (>3000Hz).

Subject: Re: Line Array discussion
Posted by DanWiggins on Wed, 08 Sep 2004 13:48:06 GMT
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Yes, it will have reduced vertical dispersion, and it may put the listener in the near-field. HOWEVER, the near-field can be approximated by d^2/l, where d is the diameter (or effective radiating length in the direction under consideration), and l is the wavelength.Given a 5" long ribbon; approximate d is 12cm or so (length of the ribbon). At 3000 Hz, the wavelength is approximately 4.5 cm, so the near-field is (12^2/4.5) 32 cm away. To reach the typical 2-3m listening distance (assume 2.5m), we'd need to reproduce frequencies with a wavelength of (12^2/250) 0.58 cm, or (13560/0.57) 23.8 kHz.It's the d^2 thing that really kills you as far as near-to-far-field transition is concerned. The larger the effective radiating diameter/length, the further the near-field. A single 5-6" long ribbon isn't really a concern in terms of near/far-field response differences until you're closer than ~2.1 meters (7 feet or so). Doubling up on the ribbons doubles the effective radiating length, which quadruples the near/far field transition.Dan Wiggins