Subject: More HornResponse
Posted by lunkie on Mon, 22 Mar 2010 06:07:27 GMT
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Hello to all. First post here, great forum too. Trying to use Horn resp (first attempt)to model a B&C 8 PE 21 8" mid-range driver and trying to figure out if I have this thing somewhat right. Here's what I have so far. Input parameters.

And the spl response

I'm looking to cover 200 to 2000 hz. This looks almost to good to be true. What am I doing wrong here?

File Attachments
1) 8 PE 21 in param..jpg, downloaded 9440 times
2) 8 PE 21 Responce.jpg, downloaded 9477 times

Subject: Re: More HornResp
Posted by Wayne Parham on Tue, 23 Mar 2010 01:25:28 GMT
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That response curve does look nice. The first thing I notice is probably a show-stopper though. The throat area is tiny, so small it will probably cause problems. It's hard to say without measurements, since this is a midrange horn, but generally that small of a throat is hard on cones.

You might also want to check the sizes of the front and rear chambers, to see if they are physically possible. Sometimes you find a really great set of parameters in a modeler that aren't realizable in practice because of physical constraints. So watch out for that too.

Subject: Re: More HornResp
Posted by lunkie on Mon, 29 Mar 2010 04:11:23 GMT
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Thanks for the reply Wayne, I've been slow to get back to this because I'm fighting malware/spyware issues on the computer that has the horn response files in it. Yes I thought the mouth was going to be somewhat small. With a larger mouth the Hf side rolls down a bit. The rear chamber I thought was about .5 cu ft so I don't think size is an issue there. I varied it from .25 to 1.0 cu ft, did not seem to effect the response that much, added a little more ripple. As for the front chamber what would be a good average size? If your mounting the speaker, face on the baffle, with the throat cutout in it, it would seem the chamber area would not be all that large. Unless

mounting the speaker on some thick gaskets to increase this area? A couple other questions. Can this program be made to work without adding an s2 to s3 section? I couldn't get it to work with only s1 to s2. That's why the real short second section. The mouth and throat areas given are for circles, correct? The throat can be made into a square as long as the area is the same, correct? Same for the mouth, only I'd want to go with a 2 to 1 length to height ratio?? I'm one of those guys waiting on the mid horn flat packs your soon to offer, but you've given me some extra time to try some different things out.

Subject: Re: More HornResp
Posted by Wayne Parham on Mon, 29 Mar 2010 04:27:28 GMT
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The front chamber acts as a low-pass filter, so you can pretty much size it to suit. Most times, you only really want a large one on basshorns. The throat, mouth and each section can be whatever shape you want, as the program only deals in cross-section area. About the number of sections, you actually can have a single section horn, such as is the case with a pure conical. You only need to add sections when there is a change in expansion rate.

Subject: Re: More HornResponse
Posted by lunkie on Thu, 17 Jun 2010 15:03:11 GMT
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It's been awhile since my last post on this but home matters always seem to put speaker matters on the back burner. And I've been playing around with hornresp also, somewhat getting the hang of it (at least for straight horns). I've probably run over 30 different drivers through it and keep coming back to the B&C 8 PE 21. So here's what it looks like now.

With this response.

It's a little smaller in the throat and mouth. Yes the throat seems small, so I decided to email the folks at B&C and ask them what compression ratio they recommended. They replied and said to use D.B. Keele's formula for horn throats and said that a 5.5 to 1 CR is OK for the 8" and using Keeles formula that's what it worked out too. I've bought a 3/4" sheet of MDF and have laid out the horn on it (boy was that fun) and one of these days will get around to cutting it out.

Some observations about using hornresp, at least for straight S1 to S2 horns.

Yes the mouth does effect low freq response but not as much as I would have thought, for a given

driver. Going down from 288 inch/sq to 200 inch/sq did not effect the low side all that much. Changing the driver can really effect the low end, for a given horn.

The size of the throat really effects the high freq reponse, so does the Le of the driver. Also, note 2, page 17 of hornresp says that the upper response can be up to and over an octave higher than predicted. Anyone experience this?

The rear chamber effects low reponse, when the volume is small.

The front chamber effects high response.Start small and go up.

The loudspeaker wizard is really neat.

And a disclaimer for all the above, different drivers may and will not always model as per the above.

One final thought / question on straight sided cd horns vs radial cd horns (like the H290). From what I can gather hornresp does not model radial horns. What if you took the mouth, throat and length dimensions of a radial horn and plugged these values into hornresp for a straight cd horn? How similar or not would the response be for a given driver use in both types of horns? Or asked another way what are the response differences between a straight sided cd horn vs a bi-radial cd horn of the same dimensions, using the same driver?
Thanks in advance for any input anyone has.

File Attachments

1) B&C 8 PE21 8inch.jpg, downloaded 8928 times
2) PE21 Responce.jpg, downloaded 8620 times

Subject: Re: More HornResponse
Posted by Wayne Parham on Thu, 17 Jun 2010 21:38:35 GMT
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The throat area (40cm2) is much larger than your original model (13cm2). So that's good, and I'd be more comfortable with it. It's basically a 2.5" square hole. I may have gone a little larger, but I am fairly conservative with paper cones because I don't want them to be too stressed at high SPL. I've seen them fold and rip. But this 40cm2 throat is probably fine, and if the manufacturer OK'ed it, that's encouraging.

My experience with horn mouth size is that smaller ones give more ripple. Of course, the boundary conditions can offset this, sometimes quite a lot. This is because a constrained space modifies the radiating pattern, effectively modifying the horn, itself. In fact, a trihedral corner has the same area expansion as a square mouthed 70° conical horn. A horn placed in a corner can be truncated quite a bit and the additional expansion from the corner will complete the flare. So a horn placed in a corner won't need to be nearly as large as one with similar specs used in freespace.

into the "Ang" field, for example, and see what happens to your response curve. But I don't think the intersection of two boundaries, i.e. radiating into quarter-space.

Most times, I think, horns used indoors in home environments act like they are radiating into an boundaries (including the ground). A tweeter in the air and not on a baffle would be an example.

My experience with drivers is the same as yours, that the driver parameters have a large impact on bottom end response. I would have expected more leeway with drivers, using rear chambers to set the bottom end with reactance annulling. But there's only so far you can go with that, so some drivers just don't have the ability to go low on a horn, while others can. Similarly, the upper end response is largely driver-dependent, but for an entirely different reason. The cone's breakup characteristics have a lot to do with the behavior up high, and this means two speaker models with the exact same electro-mechanical specs can perform completely differently at high frequencies.

Another thing that sets (on-axis) high frequency response is directivity. A pure conical horn will have constant directivity, so the on-axis response tracks the power response. But horns with other shapes have directivity that changes at different frequencies. Most tend to become more directional as frequency goes up, so even if power response sags, the on-axis response may get some boost from increasing directivity.

The earliest versions of HornResp could not model directivity, or its influence on the on-axis response. I understand that the later versions can, but I never have taken advantage of this feature. I have been using HornResp since version 3, and have always used it just to predict power response. On-axis response usually tracks power response at low and midrange frequencies, so a power response simulation is very useful, even without any consideration for directivity.

Directivity is probably not terribly difficult to model, but it isn't trivial either. A hypothetical infinite conical horn would give purely constant directivity. One that was very large would too, but as it gets smaller, the lower limit of the passband rises. At some point, directivity opens up at low frequencies, and in the transition region, there is some ripple in directivity from mouth diffraction. This is all stuff you can see in any single slit diffraction simulator applet, so modeling it is not too hard.

But what makes it a little more difficult are the numbers of these kinds of features in a real-world horn. There are many places where this kind of directivity modifier becomes relevant. And even more difficult to simulate would be cone breakup. I don't think it's realistic to try and model that. You could, but you'd have to know diaphragm material, strength, thickness and shape. It's just not something that this kind of model can simulate.

So these are the thing that affect high-frequency simulations, and the reasons why you will see deviation at the top-end of the response curve. You'll usually see more output on-axis than the simulation predicts because of increasing directivity and cone breakup. But even so, since these aren't usually significant at low and midrange frequencies, the simulation is very useful for predicting bass horn and midhorn response.

Finally, a word on the differences between constant directivity horns with straight sides verses those with curved sides. A couple paragraphs up, I mentioned that there is a transition region between the range where the horn walls set the pattern and below that where the pattern opens up. In this transition region, there is some ripple in directivity from mouth diffraction.

You'll see many CD horns that have straight walls up to about the last 1/3 to 1/4 of their length, closest to the mouth. They then open up a little more, right near the mouth. This is because the pattern narrows close to the lower limit, where pattern control is lost and it opens up. It is like a blip in the pattern, constant from the top down to the transition region where it narrows slightly as it starts to lose directional control, then opens up as pattern control is lost completely. By opening up the flare near the mouth edge, the pattern is maintained more closely constant down through the transition region. Instead of narrowing before finally opening, it stays about the same beamwidth down to the point where it loses control entirely.

This same widened mouth pattern shaping feature can be done with a gradual curve. The traditional CD horn has the sharp break near the mouth, with straight side walls, then an edge and a slightly wider angle at approximately 1/3 to 1/4 back from the mouth. But the same thing can be done with a horn that slightly curves, gradually opening up near the mouth. This avoids a diffraction edge but maintains constant directivity. Do not confuse this curvature with the shape of an exponential or tractrix horn though. Exponential and tractrix horns generally have deeper throats and do not maintain anything close to constant directivity.

Another place where diffraction can be used to control the pattern is at the throat. Some CD horns have sharp edges in the throat, which makes a sort of launch point diffraction slot. This makes the pattern wide, even at fairly high frequencies. The horn walls then constrain that pattern, and force it into the beamwidth shape desired. This approach has some consequences though. For one thing, the apparent source position is at the edge at off-axis angles, but it is deeper inside the device on-axis. Since the edges are usually positioned on each side of the throat (to increase horizontal dispersion), this makes the apparent source position nearer to the listener off-axis in the horizontal plane. This causes an astigmatic condition which is difficult to work with, particularly in arrays. It also causes internal reflections, which cause response anomalies in both the time and frequency domains. Most people identify this as a harsher sound.

The other alternative is to gradually bend the source from the throat entrance to the wall angle. Since compression drivers are designed to generate plane waves, the entrance is basically straight and this can be curved gradually to the desired wall angle. In practice, the pole piece of a compression driver (which forms the beginning of the horn) is usually 6° to 10°, so the throat of the horn starts there. It can be gradually radiused to the wall angle with an oblate spheroidal or quadratic curve. This results in a much gentler expansion and greatly reduced diffraction which most people think sounds better. However, at the highest frequencies, the pattern is set by the narrow 10° "stub" of a horn inside the compression driver. For a 1" exit driver, this beaming

doesn't start until about 15kHz though, so it is probably not significant.

Subject: Re: More HornResponse
Posted by lunkie on Fri, 12 Nov 2010 17:01:19 GMT
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Thanks for the detailed reply Wayne. It's been a very busy and hectic summer/fall here so the audio stuff suffers and I've been slowly trying to digest everything in you response. I have managed to assemble the four sides of the first horn, but have not had the time to go any further. I also found an inexpensive Galaxy Audio 5" driver that models well in this horn to experiment with. I also see you have the mid horn flat pack kits for sale now. A couple questions, The price I assume is for 1 kit/horn? Is the kit for just the 4 sides or does it include the mounting plate? Or simply, what's included in the kit? Thanks again Wayne

Subject: Re: More HornResponse
Posted by Wayne Parham on Fri, 12 Nov 2010 20:26:22 GMT
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The midhorn kit contains all four sides, the backplate and Miller dowels for alignment. The panels are pre-drilled for the dowels so assembly is a snap. Just run a small bead of glue on the edges, put it together and insert the dowels. They align everything so you don't need any sort of assembly jig and you really don't even need clamps.

Subject: Re: More HornResponse
Posted by lunkie on Mon, 06 Dec 2010 17:00:58 GMT
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Thanks again Wayne, I have received your mid horn kits, nice job all the way around, and assembled the horn from my above experiments with horn response, not nearly as nice as yours. The low freq response is good with both horns, but the upper end of the freq band is not as good. I think I'm having issues with the front chambers. I have not taken into account the thickness of the mounting plate in computing Vtc. Is the thickness of the mounting cutout part of Vtc? Also, the volume of the cone (frustum)is part of the Vtc? I think my Vtc may be too large which is hurting the upper end.

Subject: Re: More HornResponse
Posted by Wayne Parham on Mon, 06 Dec 2010 23:07:32 GMT

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Yes, the front chamber includes both the area behind the plate and also the area formed by the cross-section and thickness of the mounting plate.

What I found when designing the midhorn is the upper end is largely determined by the driver's cone and its voice coil cap. Without a phase plug, there's nothing to make the distances between points on the diaphragm and the throat equal, so it all boils down to cap shape.

There is also the matter of diaphragm breakup. If you're using a cone that peaks a lot in the 2kHz-3kHz range, then the upper end rolloff from different path length distances and the low-pass filter from the front chamber is probably a welcome thing. But if the cone is highly damped, then the rolloff isn't probably as necessary or desirable.

All in all, I found that there are some drivers that work better than others. Most will work well to 1kHz, but going to 2kHz is a different story. It's a combination of many things - diaphragm and voice coil cover shape and material, front chamber size and voice coil inductance - all play a part in the upper end response curve.

Subject: Re: More HornResponse
Posted by lunkie on Mon, 13 Dec 2010 03:42:09 GMT
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Yep, I have a front chamber issue, On the smaller horn I built, I also have a 3/4" mounting plate with the 2.5 sq inch cut out. Using real small "seed beads" to measure the B&C 8" cone volume I have a total of over 28 cu inches in the front chamber. The response in horn response is not good, will not not go above 1k with a big bump in the 500 to 800hz region, which is pretty much what I measure in my smaller horn. I can thin out the mounting plate and make it thicker from the under side, but what to do about the 23.5 cu inches that the cone area displaces? A bigger dust cap on the speaker, but I suspect that will play havoc on the parameters. I think it better to use a driver that wants a larger front chamber, but getting to 2k may not be possible. Time for more beer.

Subject: Re: More HornResponse
Posted by Wayne Parham on Mon, 13 Dec 2010 05:21:28 GMT
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You can also build up the area inside - behind the mounting plate and in front of the driver - making an inverse cone to displace some of the front chamber volume. Just be careful not to go to far so that the cone would strike it at high excursion levels.

Subject: Re: More HornResponse
Posted by lunkie on Sun, 13 Nov 2011 23:30:25 GMT
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Hi all. It's been nearly a year since my last post on this but don't think I've given up on this. We just got crazy busy at work the past year and I haven't had any spare time to do anything. Work is still busy but surgery has put me on a 4 to 6 week disability so I might find some time to get back to this. I was looking into making a plug of some sort to take up space in the front chamber, as Wayne suggested, and I found some pottery plaster that mixes with water that will pour into the speaker cone (covered with plastic wrap of course) It looks like it will make a good mold that I could push some modeling clay into to make a plug to take up the front chamber volume space. When I can get active/mobile enough I'll give it a try.

Subject: Re: More HornResponse
Posted by Wayne Parham on Mon, 14 Nov 2011 05:30:42 GMT
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Interested to see what you come up with. So when you get around to it, please keep us posted.

Subject: Re: More HornResponse
Posted by lunkie on Wed, 23 Nov 2011 02:43:40 GMT
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Actually I found out that the pottery plaster drills, cuts and sands pretty easy. So I molded 2 more casts from the speakers. Just waiting for it to completely dry before I put a throat cutout in them.

Subject: Re: More HornResponse
Posted by lunkie on Sun, 08 Apr 2012 04:05:48 GMT
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Hi all, did get around to making a "volume plugs" but just using the pottery plaster. It dries pretty hard but drills, cuts and sands very easy and made a just about perfect mold of the speaker. So I cut a hole in it to match the throat and glue it to the horn. How well did it work? It definitely helped the high end, but the response had 2 big dips. One centered at 770 hz, about 200hz wide at the top, and the other centered at 1895 hz about 300 hz wide at the top. The depths were about -15 db and -30 db respectively. Not good. I tried putting different things in the throat, varying the rear chamber, plugging the vent in the speaker, nothing would vary the dips more than 3 db. If I added gasket thickness to the speaker on the faceplate (increase the front chamber volume) the dips would slowly push up in frequency and lower in depth, but at the expense of high freq response. So out comes the mold. Now what? I let it rest for a couple weeks and to drink some beer and keep re-reading Wayne's previous posts. I have Wayne's mid horns sitting there, so just for fun I

punch in the B & C speaker specs into Wayne's horn and come up with this.

If we look at the 100db level I have 100 hz to 2000 hz response. I'm using a BBE DS26 DSP as a crossover network which has 5 bands of parametric Eq for each of the 3 way band passes I'm using. Maybe I can Eq this out, so I mount the B & C to the horn and test. The response is close but the peak is at 300 to 600 hz and at 2000 hz is about 12-13 db down. So by lowering the higher peaks by 6 db and raising the higher end by 6 db I ended up with a fairly flat response. It sounds pretty good rolling into the DE 250 driver / H290 horn on the top end. I'm pretty happy with it for now and those that have heard it really like the sound. Singers and instruments sound like they are in the room is the most common comment I get. But I think I can make it better, still digesting Wayne's previous posts, but for now I'm just listening.

File Attachments

1) B & C 8.jpg, downloaded 2581 times