Subject: Midrange smear in transmission lines
Posted by Doug Mc on Tue, 31 May 2005 22:48:06 GMT
View Forum Message <> Reply to Message

How do you kill midrange spikes on transmission lines? Is it done with stuffing? Taper? I am considering a fullrange speaker and wondering what route to take. I know quarter-wave pipes have spikes at 1/4wl, 3/4wl, 5/4wl, 7/4wl, etc. so I wonder what you do to prevent midrange smear. All comments welcome.Doug

Subject: Re: Midrange smear in transmission lines
Posted by roncla on Wed, 01 Jun 2005 00:30:18 GMT
View Forum Message <> Reply to Message

How do you kill midrange spikes on transmission linesUse the proper Qts driver.ron

Subject: Re: Midrange smear in transmission lines
Posted by roncla on Wed, 01 Jun 2005 00:46:49 GMT
View Forum Message <> Reply to Message

Sorry , i should have answered more fully. Stuffing will generally dampen the upper harmonics. When the harmonics overlap the vocal range(hay! Barry White can get LOW) then you have a problem. I still believe in stuffing to suite as there is so many differences in what sounds good to the individual that a given stuffing is more of a guideline than a given.ron

Subject: Designing a TL
Posted by Bob Brines on Wed, 01 Jun 2005 12:02:46 GMT
View Forum Message <> Reply to Message

Ron's suggestion of using a driver with the right Qts is correct but a little lacking in detail. If the Qts is in the low 0.20's or lower, the driver belongs in a back horn. Performance in a quarter-wave pipe will be disappointing. If the Qts is much higher than 0.50, then the driver is going to act as if it is on an Infinite Baffle when mounted in a quarter-wave pipe, so why not put it on an IB in the first place. Drivers with Qts in the .030's work best in short, fat, straight choked pipes -- MLTL's. Drivers with Qts in the 0.40's work best in conventional tapered TL's. There are exceptions, and you can always force any driver into any type cabinet if you are willing to make enough compromises. I continually shake my head at guys who go out an buy expensive drivers, then ask for a cabinet design to put it in.Quarter-wave resonant cabinets have acquired a whole litany of

terms, none of which make any sense. First of all, what we call transmission line speakers bare no resemblance to electrical transmission lines or audio wave guides, my understanding of which can be written on the head of a pin. The TL speaker works on the basis of standing waves of odd-order harmonics -- a stopped pipe. The classic TL speaker "fixes" the standing waves by stuffing the bejesus out of the pipe, leaving for all practical purposes an IB. BTW, this is not all bad, since a true IB will give you some of the best bass you will ever hear if you can stand the real estate required.Martin King invented the term Mass Loaded Transmission Line -- MLTL -- a few years ago, which addresses the physics of the problem, but leaves the mathematically challenged bewildered as to the connection between TL's and a 40" pipe that supports an Fp of 40 Hz.This has generated a long, loud and misinformed argument that MLTL's are simply BR's in disguise. They are not -- the physics are entirely different. If you are wondering why your new tower BR tunes way too low and has lumpy mid-bass, I have the answer for you.OK, now to your question. The tuning frequency of a quarter-wave pipe is dependent on the length, cross-sectional area, taper and port dimensions. The greater the taper ratio, the shorter the pipe. TQWT's (Voigt pipes, pointy at the top) are the longest, conventional TL's the shortest. Tuning frequency can be lowered by reducing the size of the port and increasing its length. If you can't run Martin's model and choose to cut-and-try, you chances of getting it right are minimal.A quarter-wave pipe will have a series of harmonic in the pipe output. An end-loaded conventional TL is the worse, followed closely the TQWT. The 3rd or 5th harmonic can be easily suppressed by by placing the driver at the harmonic node. Normal design procedure is to place the driver at the 3rd harmonic in a TQWT and at the 5th harmonic in everything else. The physical dimensions of the pipe make this convenient. With one of these harmonics suppressed, the bottom end of the frequency response smooths dramatically. Further smoothing of the mid-bass is accomplished by moving the port up the pipe a little. Again, this must be modeled. There is no chance of guessing at it. If you have done the design right, you will need very little stuffing. My designs use no stuffing at all. I rely on a fiberglass lining to bring the frequency response to better than +/- 3 dB throughout the bass and mid-range.Bob

---

Subject: Re: Designing a TL
Posted by Doug Mc on Wed, 01 Jun 2005 17:20:55 GMT
View Forum Message <> Reply to Message

Why not use ported reflex instead? As I understand it, the helmholtz property makes no harmonics. It is like a spring or a pendulum with only one primary and no harmonics. What do you think?Doug

---

Subject: Re: Midrange smear in transmission lines
Posted by Doug Mc on Wed, 01 Jun 2005 17:23:40 GMT
View Forum Message <> Reply to Message

Thanks for your answer. I guess its a delicate balance getting the right amount of stuffing to

remove harmonics without taking life from the midrange. Sounds iffy.Doug

---

Subject: Re: Designing a TL
Posted by Bob Brines on Wed, 01 Jun 2005 18:50:09 GMT
View Forum Message <> Reply to Message

Were that is was so simple!The current trend in speaker aesthetics is the tower speaker, driver at ear level, baffle as narrow as possible and still hold the driver. So.... We use one of the calc programs, WinISD, Unibox, whatever, design a BR, then adjust the dimensions to fit the form factor. Voila, a tower BR. But wait! The tuning is all wrong. Got to shorten the port by half. And the mid-bass is lumpy. Got to add stuffing.Mother Nature is a b...., and she makes the rules. Once the ratio of cross-sectional area to length reaches a certain number, and I don't know what that is, the Helmholtz resonance breaks down and quarter-wave modes set in. I do know that the normal range of dimensions for tower BR's guarantees that they are not BR's.Here's my Fostex FE167E BR:24 liters, tuned to 60 Hz.Here's my Fostex FE167E quarter-wave pipe:53 liters, tuned to 40 Hz. Note that both speakers have nearly the same cross-section and the baffle width is identicalThat's probably about right for an EBS BR, but to have the box operate as a helmhotz resonator, it would have to have somethinglike golden ratio dimensions. This would make it pretty chunky in decor terms, and it would have to be stand mounted to get it to ear level. Not real good WAF.Final point. MLTL's seem to control the driver better below cut-off. I don't know why that happens, but it does. This means a lot less doppler distortion under heavy bass. I believe that this is why the bass of MLTL's sounds so good. At least with pipes the size and cut-off of my stuff.Bob

---

Subject: Re: Designing a TL
Posted by Wayne Parham on Wed, 01 Jun 2005 22:56:15 GMT
View Forum Message <> Reply to Message

As I see it, pipe mode resonance and Helmholtz resonance are not mutually exclusive. It's not an either/or proposition and I don't think either is necessarily better or worse. However, I do agree that Helmholtz resonance does not have harmonic modes. Since cabinet dimensons aren't used to set the Helmholtz frequency, you can make a cabinet with dimensions that are unrelated to the Helmholtz frequency.There is nothing magical about either method. However, pipe tuning requires standing wave modes, so equally spaced harmonics are assured. You can position things to get around them, but they are a necessary consequence of the design.I also want to point out that cabinets that are physically tall aren't necessarily configured as transmission lines. There are standing waves modes inside any chamber, but if the primary tuning feature is Helmholtz resonance, then the speaker is configured as a bass-reflex system. If the primary tuning feature is length related, then it is a tuned pipe. Unwanted standing wave modes should be suppressed in any loudspeaker cabinet, and the same techniques that are used to suppress harmonics in a tuned pipe can be used to supress standing waves in bass-reflex cabinet, or any other, for that matter.

Subject: Re: Midrange smear in transmission lines
Posted by Martin on Wed, 01 Jun 2005 23:23:00 GMT
View Forum Message <> Reply to Message

Doug,What do you mean by midrange smear? Not sure I follow what you are trying to describe.If you design the enclosure geometry and distribute the stuffing correctly, then I don't think you will have spikes in the midrange response. You may end up with a +/- 2 dB ripple but this is small compared to all of the other artifacts from the room and front baffle on the SPL response. Probably the safest and smallest classic TL design is a tapered pipe. This enclosure will push the 3/4, 5/4, 7/4 ... standing waves higher in frequency where they should not be a problem.Martin

Subject: Re: Designing a TL
Posted by Martin on Wed, 01 Jun 2005 23:37:40 GMT
View Forum Message <> Reply to Message

Hi Wayne,The MathCad worksheets can calculate the response of either a Helmholtz or a 1D pipe resonance. The lumped parameter freeware programs most people use only calculate Helmholtz resonance so they never predict standing waves. Classic bass reflex enclosures will have standing waves that effect the SPL response, see Figure 6 in my ML TQWT article. People assume that if the SPL plot shows a flat response it must be flat, unfortunately this is not the case. One of the benefits of using the current versions of the MathCad worksheets is that you also model standing waves in one of the three enclosure directions. If you run the worksheets three times, you can get a hint about the impact of the standing waves in a classic bass reflex design. I have a 3D version of the worksheet but it is not completely debugged and is sitting on the far back burner.One of the other great myths of bass reflex design is that you only line the walls and place nothing in the center of the enclosure. This will produce almost the worst case standing wave situation, the worst is totally a empty box. None of the freeware lumped parameter models will give you a hint at the potential for standing waves in the bass reflex enclosure.If you are designing a tall bass reflex enclosure then I recommend using my Ported Box worksheet which will include any standing waves in the long direction and allow you to optimize the placement of both the driver and the port along the tall dimension. Using the freeware lumped parameter models will only tell part of the story, I hate surprise endings.Martin

Subject: Re: Designing a TL
Posted by Wayne Parham on Thu, 02 Jun 2005 02:29:36 GMT
View Forum Message <> Reply to Message

Hi Martin,I have recommended your spreadsheets on several occasions, both for transmission lines and for bass-reflex cabinets. They have been especially helpful to people who wanted to build a loudspeaker from my plans, but with some cabinet modifications. If they intend to make a tower, I frequently suggest they check the impact of their modifications using your bass-reflex

spreadsheet.About insulation, I don't think that myth is limited to builders of bass-reflex speakers. I've seen it coming from several sources. We've all seen people talk about lining some part of a cabinet with felt, or something else thin like that. But the best place for an absorbent material is spaced away from the boundary, so a thin sheet would be best hung, suspended inside the cabinet. If attached to the wall, it doesn't do anything.Wayne

---

Subject: Re: Designing a TL
Posted by Bob Brines on Thu, 02 Jun 2005 13:45:53 GMT
View Forum Message <> Reply to Message

theoretically, but from a practical point, is is sort of a red herring. I agree that will exist in a quarter-wave pipe, but it will most likely be overwhelmed by the quarter-wave harmonics. Also, as Martin points out, the math takes care of the issue anyway and the designer need not worry about it.Now, the point I was REALY making, and apparantly not very well, is that once the quarter-wave genii is let out of the bottle, it must be delt with. You CANNOT build a tall, thin BR without concern for quarter-wave modes.This is the modeled output of a 53 liter cubic box with a 3"x4" port, the same as on the quarter-wave pipe to follow -- a pure helmholtz resonator.The peak at 900 is the half-wave resonance between the walls of the box.This is the modeled output of the 53 liter MLTL with the same port. The driver and port are at optimum positions.Just in case you think that the model is blowing smoke, here is the actual nearfield output of the MLTL.If you do not model your design, then the only way to know if quarter-wave modes exist is to do a nearfield measurement of the port. The answer will be obvious.----------Another point you raise is that you can mix helmholtz resonance and quarter-wave modes in the same design. Yes you can, a few years back, there were a number of very complex designs with multiple pipes and resonators, all designed to tame quarter-wave resonances in essentially conventional TL's. Unfortunately, these were complex solutions to a simple problem. Proper pipe geometry and driver/port placement does the job in a simple, straight pipe.One more graph. This is the outdoor, 1 meter farfield, no splice output of my 53 liter MLTL.The dip at 150 Hz is primarily floor bounce.See, it works! Bob

---

Subject: Re: Designing a TL
Posted by Martin on Thu, 02 Jun 2005 15:32:34 GMT
View Forum Message <> Reply to Message

Bob,You wrote :"If the Qts is in the low 0.20's or lower, the driver belongs in a back horn. Performance in a quarter-wave pipe will be disappointing."My latest thinking on these "back-loaded horn" designs is that almost all of them are really TL's for the lowest frquencies. If you look at the mouth area, multiply it by between 2 and 8 depending on room placement, you will find that the horn cut-off frequency is probably much higher then the designs claimed low end performance. So the enlcosure exhibits TL responses for two or three modes and then transitions to a horn like response. Compare Nelson Pass's Kleinhorn with the Fostex designs. There is nothing wrong with this approach and I am using it in my latest design.Martin

---

Subject: Re: Designing a TL
Posted by Wayne Parham on Thu, 02 Jun 2005 15:37:03 GMT
View Forum Message <> Reply to Message

I am familiar with the models and agree with your points. However, my point still stands as well, and that is that Helmholtz resonance and standing wave resonance are not mutually exclusive. All vented boxes have both properties in play; There is no other way.I also wanted to make a point, a clarification of a definition really. If a cabinet uses Helmholtz resonance as the primary feature and is designed in such a way to eliminate or suppress standing wave modes, then it is a bass-reflex enclosure. If it is designed to use the primary quarter-wave mode as its main feature, then it is a quarter-wave pipe. This is less determined by appearance and more determined by the actual mechanism at play. The only way to really know is by modeling or measurement.There is evidence that shows each type of speaker can be optimized to perform well. I've seen good examples of both types. Transmission line enclosures must size the port and cabinet so that Helmholtz resonance is out of band. It must also suppress quarter-wave harmonics. Bass-reflex cabinets must be sized to move standing waves out of band, or they must be suppressed using the same techniques as transmissions lines employ, i.e. port/driver placement and stuffing. In my opinion, there are more similarities than differences.

Subject: Re: Designing a TL
Posted by Wayne Parham on Thu, 02 Jun 2005 15:40:47 GMT
View Forum Message <> Reply to Message

This is something I've observed too. Refer to the post in the Pro Speakers forum called "Basshorn or Transmission Line."

Subject: Re: Designing a TL
Posted by Bob Brines on Thu, 02 Jun 2005 16:00:35 GMT
View Forum Message <> Reply to Message

Wayne,I think that we are actually in complete agreement on the physics of the problem. We are arguing some nits in the impementation that boil down to personal preference and technique. Everyone comes from a different place and is walking a different path.Bob

Subject: Re: Midrange smear in transmission lines
Posted by Doug Mc on Thu, 02 Jun 2005 17:16:02 GMT
View Forum Message <> Reply to Message

Thanks all for your comments. Lots to think about here.Doug

Subject: Re: Designing a TL
Posted by jorge on Thu, 02 Jun 2005 21:31:43 GMT
View Forum Message <> Reply to Message

can't claim that i have any understanding of the physics and/or geometry, but did build a ml-tl design for the fostex fx200 based on bob's martin inspired plans and did, on a whim, hang some insulation on a lower brace...i have nothing to compare it to but they do sound great to these old ears - many thanks to all of you for your collective wisdom

---

Subject: Re: Designing a TL
Posted by roncla on Thu, 02 Jun 2005 23:35:40 GMT
View Forum Message <> Reply to Message

My latest thinking on these "back-loaded horn" designs is that almost all of them are really TL's for the lowest frquencies. If you look at the mouth area, multiply it by between 2 and 8 depending on room placement, you will find that the horn cut-off frequency is probably much higher then the designs claimed low end performance. True, the trick is to blend the action. As far as the mouth size i disregard the normal final expansion and make the mouth open up in a more radical fashion and with the sloped final stage it allows the wave to expand more rapidly and gives the effect of a larger mouth as well as brings the wave centerline (maxium response axis) up closer to the driver which helps the mechanical crossover of horn mouth/driver. However this requires a slight fudge on the wave form as at the lowest frequencies it is more of an upright oval than a true circular wave. This is all accomplished for a smaller footprint and slightly exceeds the old rule of a 1:1.6 aspect ratio. However i tried a 1:1 aspect ratio and while the lower Hz was a bit cleaner the size of the mouth required was not to my liking.ron

---

Subject: Re: Designing a TL
Posted by Wayne Parham on Sat, 04 Jun 2005 06:12:19 GMT
View Forum Message <> Reply to Message

Hanging insulation on a brace in the cabinet is a good idea. Another good method is to cut sheets the same size as the cross-section and place several of them inside, spaced apart from one another, each spanning the cross-section.

Subject: What is the effect of a standing wave?
Posted by akhilesh on Mon, 06 Jun 2005 16:58:03 GMT
View Forum Message <> Reply to Message

HI Martin,Thanks for your post. Some basic questions that come up are:1. What is the impact of a standing wave? 2. SHould one then use unequal dmensions for the bass relfex?3. Does adding cross-braces in the middle of the cabinet help, vertically and depthwise? thanks-akhilesh

Subject: Re: What is the effect of a standing wave?
Posted by akhilesh on Mon, 06 Jun 2005 18:40:49 GMT
View Forum Message <> Reply to Message

OK, after my post, I dd some reading, and it seems that standing waves can be eliminated or reduced significantly with non parallel alls. So isn't that an easy fix? Trapezoidal box?-akhilesh

Subject: Re: What is the effect of a standing wave?
Posted by Martin on Mon, 06 Jun 2005 22:51:55 GMT
View Forum Message <> Reply to Message

I don't believe that non parallel walls eliminate standing waves. The shape of an enclosure will determine the natural frequencies and mode shapes of the standing waves but I do not know of any shape that is free of resonances. I think that the position of the driver, the port, and fiber fill for damping can be used to minimize the impact of standing waves on the back surface of the driver. A standing wave with a pressure maximum on the back of the driver's cone will tend to reduce the cone motion and cause a null in the driver's SPL response. Again, look at Figure 6 in the ML TQWT article.Martin

Subject: Re: What is the effect of a standing wave?
Posted by akhilesh on Tue, 07 Jun 2005 16:07:30 GMT
View Forum Message <> Reply to Message

HI Martin,Thanks for your reply. Here are some websites that seem to indicate that non parallel walls do reduce standing waves:http://www.trapagon.com/Audio/Products/body_products.htmlhttp://www.crystalaudiovideo.com/cmptechnology.asphttp://www.gspr.com/canton/ref2.htmlhttp://www.humanspeakers.com/diy/cabinets.htmAnd many more. The conventional wisom seems to be that parallel walls encourage standing waves. I haven't tried to analyze if this should be true or not. The conventional wisdom is

probably based on empirical experience of different builders. What do you think? I am trempted to build my future BR cabinets with trapezoidal shapes. thanks-akhilesh

---

Subject: Re: What is the effect of a standing wave?
Posted by Martin on Tue, 07 Jun 2005 23:08:15 GMT
View Forum Message <> Reply to Message

Hi akhilesh,I looked at each of the websites you reference and they all say that non-parallel walls will not support standing waves. I think this is great marketing lingo, I don't believe that standing waves in an enclosure can be eliminated. There will always be resonances and mode shapes in any volume. Maybe the non-paralel walled enclosures will have "weaker" modes as seen from the back of the driver cone compared to the nice rectangular enclosures, I don't really know. The location of the driver and port on the front baffle can also be used to mitigate the number of standing waves excited. Stuffing also does a great job of attenuation. Having built one tall thin trapazoidal enclosure, I am not looking to tring and odd shape again. Nice and square is much easier.Martin

---

Subject: Re: What is the effect of a standing wave?
Posted by akhilesh on Wed, 08 Jun 2005 16:00:32 GMT
View Forum Message <> Reply to Message

HI MArtin,I don't know. I have seen many speaker desgners who build world class speakers like John Otvos use a trapezoidal shape. I may try that in my next set of full range enclosures. What the heck do i have to lose expcet $200 or so in extra carpentry costs. -akhilesh

---