Subject: Baffle step and collapsing directivity
Posted by Wayne Parham on Mon, 16 Feb 2009 18:20:06 GMT
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I was just in another discussion with some folks that considered baffle step correction a mandatory step in crossover design. I don't dismiss it entirely, but I do think it is sometimes given too much emphasis. Another thing I noticed is that these people didn't consider the collapsing directivity of the drivers, which may or may not have been more an issue than directivity changes from the baffle becoming acoustically large at high frequencies, which is what baffle step really is.Art Array Crossover - Further EvaluationThis speaker isn't being held up as an example of the state of the art in line arrays or anything like that. It has a line of eight midwoofers and a single point source dome tweeter. It is a capable speaker that sounds good on a budget. But I bring it up here because the midwoofers do appear to exhibit rising response from collapsing directivity, either due to radiator size or baffle size. In spite of that, it tends to get rave reviews from people that have heard it.ART Array DIYAll speakers rolloff due to mass and inductance. But all also have collapsing directivity as frequency rises. In some cases, rolloff from mass is countered by on-axis rising response from collapsing directivity. A speaker like that will have flat response on-axis up to the point where inductance kicks in. I've noticed that high-efficiency woofers often have rising response from collapsing directivity that rises faster than mass rolloff falls. Smaller woofers also sometimes exhibit this behavior, and those are the kinds of drivers that are probably common in mini-monitors and line arrays.Whether directivity increases at HF due to baffle size or radiator size, there is going to be some directivity increase at HF, and that does introduce acoustic EQ on-axis that effectively introduces rising response. In some cases, mass rolloff will counter it with falling response that matches or exceeds it, in other cases, mass rolloff will not quite counter the increased directivity and on-axis response will rise slightly at HF.That's only on-axis response though. Power response is arguably more important indoors, since it represents the power radiated in all directions. Whether or not on-axis response rises, stays flat or falls, power response will almost always fall as a result of mass and later from inductance. The only thing that can cause HF to increase above mass rolloff is resonances across the cone surface. If cone breakup is well damped, that may be useful but in most cases breakup is undesirable and crossover is done before breakup becomes severe.Another issue in arrays is the interaction between drivers. At some point, the summing between drivers in an array transitions from being fully constructive to a more complex pattern. This plays heavily in the directivity behavior, ultimately affecting both power response and on-axis response. I assume this would be one main criteria in crossover selection, and why many people prefer active crossovers, especially those that provide digital processing. You can do a lot with something like that. But in the case of the ART Array speaker, an entry-level loudspeaker having an array of midwoofers crossed over to a point source tweeter, I see that in the overlap band, the tweeter acts like just another source in the array. As frequency goes up, the array output becomes reduced and the speaker transitions to a point source.So to me, the issue becomes, do we want to equalize for flat on-axis response, which may involve attenuating the upper portion of the midwoofers' passband that has begun to rise on-axis due to collapsing directivity? Since power response has most likely begun to fall by this point, further attenuation only reduces power response further, making the reverberent field less spectrally balanced. Or do we want to leave some rising response on-axis, which may improve the power response but leaves the on-axis response less flat than it could be with some equalization.To me, the best way to approach this is to look at the polars. If the power response is truly falling at HF, then I might not want to add any more attenuation even if that means the

on-axis response has a slight rise in some region where drivers are becoming more directional.If I see off-axis energy is rising off-axis, roughly tracking the on-axis curve, then I would probably provide some EQ in the crossover. This might be the case if rising response were due to certain types of cone surface resonances. Usually this kind of thing results in highly directional peaks, but not always. Whatever the case, if response rises off-axis over a fairly wide arc, I'd say that merits electrical compensation to appropriately reduce the rising HF output. Might be better to remove it altogether, to crossover before cone breakup becomes an issue.This is one of those problems that is really tough to solve without compromise. The only "no compromise" solution is to make the speaker constant directivity, which solves the problem at its source rather than compensating for it. But it is not an easy solution to provide. I only know of one way to really do it.As for BSC and whether to do it, I think it really depends a lot on whether or not the speaker just plain sounds thin without it. It becomes a subjective matter, really. A good case can be made either for or against it, depending on whether you focus on power response of on-axis response. Seems to me the little mini-monitors with tiny "woofers" need it most, for obvious reasons. They don't have the surface area and displacement to produce any bass anyway, and so need all the help they can get. On larger speakers, I think it is not necessary to provide this kind of compensation to get good full sounding bass.