Subject: Re: Time Alignment
Posted by Wayne Parham on Sat, 26 Jun 2021 14:02:26 GMT
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When you have a forward lobe that's centered with equally-spaced upper and lower vertical nulls, then your system is "time-aligned."

I personally never liked the phrase "time-aligned" because there are so many phase shifts in the system. Even with voice coils physically aligned, this doesn't ensure "time alignment" and, in fact, usually ensures that the acoustic phase is not aligned. Voice coils aren't always coincident with acoustic centers, so the positions of the voice coils aren't really significant. It's pretty close for direct radiators - disregarding phase shifts in the crossover - so that's what some people focus upon. But read the last link included below, and you'll learn that the actual acoustic center of a driver in its cabinet is sometimes not even located within the box, but somewhere in front or behind it, and that it moves with respect to frequency.

Anyway, the thing that does matter is the position of the forward lobe. That's something you can easily see in measurements. It's useful to also measure impulse response, looking for a single spike rather than a spike followed by a hump or a hump followed by a spike, indicating a multi-cycle shift. Then look at the vertical off-axis response and find the upper and lower vertical nulls. If they're equally spaced, then the system is aligned.

See the links below for specific information how to adjust the crossover to achieve this kind of alignment. I do this for all my loudspeaker designs as a standard part of their development. Check out the video, which shows exactly how its done.
DI-matched two-way loudspeakers
Crossover optimization for DI-matched two-way speakers
The Acoustic Center: How it applies to Loudspeaker Measurements