

Dipole Background Information:

A dipole speaker differs from a typical box speaker in two major ways.

- 1) There is no box that encloses the woofers. Thus there is no box to vibrate and add its own lingering colorations to the audio signal being sent to it by an amplifier.
- 2) The radiation pattern of a dipole at low frequencies is a doublet. That is, it radiates little, if any, acoustic energy in the plane of the transducer. This minimizes the excitation of resonance modes in a listening room. In contrast, a box speaker radiates low frequencies nearly uniformly in all directions. This maximizes the excitation of resonance modes in a room. This is the usual culprit when people find that their audio systems sound boomy. Their woofers are exciting a particular room resonance mode and it takes a while for the acoustic energy at this frequency to dissipate.

I was introduced to the dipole concept by Toby Guynn ten years ago, but only recently did I start appreciating the advantages. The dipole allows you to hear the sound created by the speaker drivers with significantly less resonant coloration from the room and from the speaker box. In technical terms, a better signal to noise ratio. When people are first exposed to this they usually find it hard to describe. To me it just sounds more like music, and less like speakers. The more complex the music, the more noticeable the lack of resonant coloration when switching back and forth between a dipole and a typical box speaker.

The vast majority of current dipole speakers available to the public are planar speakers which use ribbon or electrostatic transducers. Due to their limited excursion capability, they tend to be quite large and expensive in comparison to a box speaker with similar acoustic output. The first time an individual is exposed to a planar dipole you can usually see the "Wow!" written all over their faces as they experience uncolored audio reproduction for the first time. Then, after considering the size and cost, they realize that there is no way they will ever be able to own the speakers they are listening to. So, they settle for a box speaker.

My goal was to create a dipole speaker small enough and cheap enough to compete directly with box speakers for use in typical home audio environments. Initial efforts revolved around the use of multiple small drivers in 2 or 3 way designs to try and emulate the radiation pattern of the planar dipole speakers. Although these designs resulted in a different sound reproduction experience, it was not vastly superior to the typical box speaker and didn't warrant the larger size and higher cost. I was not admitting defeat, but was definitely out of ideas.

While browsing the internet I stumbled on to Seigfried Linkwitz' web site, <http://www.linkwitzlab.com>. I quickly realized that his loudspeaker design goals were similar to mine. However, instead of trying to emulate planar dipoles, he actually improves upon them. Seigfried's designs are state of the art constant directivity dipole speakers using electronic crossovers and separate amplifiers for each driver. Although expensive, this approach allows him to electronically time align the drivers and more accurately implement driver crossovers and equalization. Believing that imitation is the sincerest form of flattery, I endeavored to use Seigfried's design models to produce a dipole speaker that would also meet my cost and performance goals.

The Dipole Speaker, Model DP2.1

The Drivers:

The selection process is much more involved than merely selecting the most expensive drives that will fit in the budget. More expensive does not always mean more performance or lower distortion. Not all drivers are suited for particular applications. Additionally, the selected woofer and tweeter will need to be integrated together via the crossover network. Some drivers are more easily integrated than others.

The dipole speakers use a state of the art 8 inch Peerless mid-bass driver with a motor structure and suspension that is capable of providing the necessary acoustic output and efficiency for a dipole speaker system. This driver also has extremely low levels of harmonic and intermodulation distortion thanks to the use of an aluminum shorting ring. The cone is made up of layers separated by damping material to reduce stored energy in the cone. The spider is ventilated to achieve the lowest possible compression and to allow air to flow freely to create a cooling effect for the voice coil.

The tweeter used is the newly released XT ring radiator from VIFA. This also is a state of the art driver with aluminum voice coil, copper shorting ring and pole piece cap (to eliminate intermodulation distortion), high power handling without the use of ferro-fluid (use of ferro fluid results in loss of low level detail), and frequency response extending to 40 kHz. Toby uses this tweeter in all of his top of the line speaker systems.

The Crossover:

Unlike Seigfried's cost-no-object designs, a passive crossover network is utilized in order to meet the cost target. To facilitate successful integration of the woofer and tweeter outputs it was necessary to delay the tweeter output in the crossover region. A passive all-pass filter network implements this time delay. The tweeter is effectively moved backwards in space 1.5 inches to line up with the acoustic source location of the woofers. Then, Toby Corporation's new computer modeling/optimization programs were used to achieve a true 4th order Linkwitz-Riley acoustic crossover between the woofers and tweeter. This type of crossover places the woofer and tweeter in phase throughout the crossover region providing extremely uniform off-axis response. As one moves horizontally off axis, the frequency response remains flat, lowering in output as you move further and further off axis. Listeners will notice that music sounds remarkably good both in and out of the "sweet spot", even from another room.

The Results:

The combination of dipole strengths and careful driver selection results in un-colored high-resolution sound comparable to the best planar speakers but with dynamic capability most planars simply aren't capable of. Image realism is exceptional if well recorded. This performance is packaged in a compact slim line baffle at a price comparable to typical box speakers.