



SURROUND SOUND TECHNOLOGY TRAINING

HISTORY OF SURROUND SOUND

As far back as 1940, with Walt Disney's production of "Fantasia", surround sound has been a concept that nearly everyone finds exciting. Consumer electronics tried to take advantage of surround for music in the early 1970s with various forms of quadraphonic sound. It never really became a mainstream success, however, due to limited recorded software and much more expensive phono cartridges or tape decks needed to play it back.

Dolby Labs really brought surround sound into the public eye (and ear) in the late 1970s with their breakthrough film soundtracks, starting with "Star Wars", "Close Encounters of the Third Kind", and "Tommy". As home video began to grow in popularity, and Dolby made videotapes and laserdiscs more widespread and economical, as well as backwards-compatible with conventional two-channel systems, the resistance to buying four speakers and more advanced electronics began to fade away.

Starting with Dolby Surround, which used four channels (front left, front right, phantom center, mono surround – though usually using two speakers), the public began to expect the increased realism brought about by sound location cues being able to move across the front soundstage, and from front to rear for ambience or special effects. Since the derivation of the center and surround channels was passive, the directionality was not very precise, and the separation between channels was actually even less than in a stereo recording.

Within a few years, Dolby brought out Dolby Pro-Logic as an enhancement of their original system. Now there was a true center channel separate from the left and right, and much greater separation between front and rear, or adjacent front channels. The primary advantage now was greater audibility and centering of dialog on movies. Rear channels were still monophonic, but there was increased separation from the front, so the soundstage was much larger.

In 1995, the full benefits of digital sources (laserdisc and DVD) were brought home with the advent of Dolby Digital and DTS surround. These systems, for the first time, used discrete channels of information for front left, front right, center, rear and/or side surrounds, and subwoofer(s). This information was not just artificially derived from a stereo mix as done previously, but the actual source material was mixed in multiple channels, and this separation and steering logic followed all the way through the reproduction chain. Now a listener could actually follow a sound from speaker to speaker in any direction, with virtually unlimited separation, and hear exactly what the director intended his film or music to sound like in the theater or on a concert stage.

As we've moved forward from 1995, we've added additional channel capability beyond the original 5.1 (5 main channels + 1 dedicated bass channel), and surround sound has become nearly ubiquitous whether the source is music, a movie or TV show, or a game. Both Dolby Labs and DTS came out with HD uncompressed soundtracks to go along with high-definition video formats, and we're now seeing additional surround channels being added to provide additional sonic cues to enlarge either the width or the height of the soundfield, making the room boundaries even less apparent as we watch a movie.

When you watch a scene in a movie that takes place outdoors or in a cathedral, you want the sound to appear to be much larger than your room – you don't want to hear the room boundaries. Conversely, if a character is speaking in a phone booth or a closet, you want to hear the constricted size of that space rather than the size of your listening room. We often talk about "willing suspension of disbelief" when watching a movie, and much of that comes from audio cues. Having a realistically-sized soundfield is a major contributor to our enjoyment of movies.

Surveys have concluded that the impact of surround sound and good sound quality contribute AT LEAST 50% to the enjoyment of watching a movie, with some studies showing as high as 65%. Our clients expect us to know the latest technologies and be able to advise them on how to implement them in their environments to gain this advantage of sonic performance.

TYPES OF SURROUND SPEAKERS, AND WHERE TO USE THEM

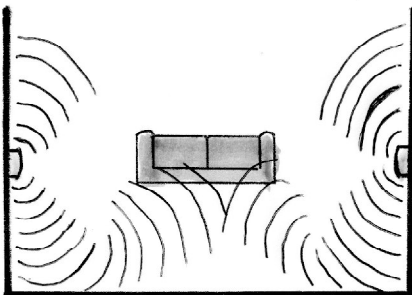
There are a number of different schools of thought about what make an ideal surround speaker. Much of this difference comes about due to the placement options within a room, or to the personal taste of the owner. Some people like to hear surround effects coming from very specific locations, while many prefer to be enveloped in a large space, feeling that is more believable in most situations. The most important performance characteristic to maintain in a system design is that all speakers should be timbre-matched (tonally identical), in order to blend properly as a sound moves from speaker to speakers. This means using all speakers from a single manufacturer, and making sure that they are from the same family within that manufacturer's offerings (make sure in particular that the midrange and tweeters match). If speakers are not timbre-matched there will be discontinuities as you listen to sounds moving around. For example, as a spaceship moves from front to back on the screen, the sound will jump suddenly from front to back rather than panning smoothly and evenly overhead. This is an extremely important design parameter to be aware of as you plan your system.

There are three main types of speakers used for surround applications, with a BG Radia-specific fourth subset for certain types of rooms. Let's look at how each should be used.

DIPOLE – A dipolar speaker system uses one speaker that emits sounds from both its front and back surfaces, or in most cases, two identical speakers set back to back. They are wired to be out of phase, meaning that when one speaker moves out to energize the air, the other is moving back in to rest. The net result of these speakers working out of phase with each other in this “figure 8” arrangement is that sounds goes both ways from the speakers' faces, but nothing happens in between them. Newton's Third Law of Motion states that equal and opposite forces will cancel each other out, and the acoustic result of this from a dipolar speaker is that there is very little sound when you listen from the side of the speaker.

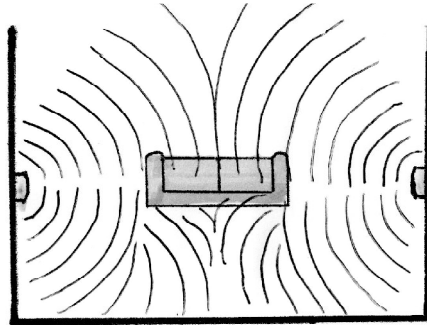
In the early days of surround sound, when there was not much directionality or separation in the rear channel(s), dipolar speakers were often used because their “out-of-phase-ness” created a large soundfield out of a limited signal. As surround technology got more sophisticated, dipoles were often used and recommended for home theaters, particularly where the listening area was such that speakers could be placed properly to take advantage of this null in the on-axis response. When seated directly between the center of speakers placed on the side walls, the desired effect of a large and diffuse soundfield can be obtained.

Unfortunately, many rooms don't lend themselves to this application, with seating that can't be directly between two surround speakers, or having the inability to mount two speakers directly across from one another. Depending on the room's layout, many people prefer their surround speakers behind them to create a larger soundfield, and dipoles are not well-suited for rear-wall placement. In summary, dipolar speakers filled a need in the early days of surround systems as they tried to mimic the multiple speakers used in commercial cinemas. If they are properly placed relative to the seating area, they can be a useful tool for creating effective surround effects.



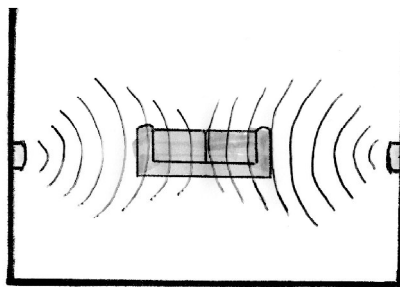
BIPOLE – (No psychological jokes about speakers with good and bad sides, please) Like the dipolar speakers we discussed above, a bipolar speaker uses two speakers back to back in an enclosure, but this time the speakers are wired in phase so they move in and out at the same time relative to the signal they receive. The effect of this working in phase is that the soundfield is more like a hemisphere than a dipole's figure-8. This means that bipoles work equally well in creating a large diffuse soundfield on side walls or back walls, or in the ceiling, and their placement relative to seating is not as critical. This makes them an ideal solution for most "real world" listening rooms and most people's taste.

If a room's layout or structure precludes having surround speakers exactly to the sides of the seating, or if the couch is against the back wall, or if the speakers can't be symmetrically placed, bipolar speakers give the advantage of a huge, enveloping soundfield with more forgiving placement options.



MONOPOLE – As mentioned in our overview, some people like to be able to localize the sound effects they are hearing, particularly in multi-channel music recordings. A monopolar speaker is just a fancy name for a conventional forward-firing speaker, such as those nearly all of us have for our front speakers. Particularly in a large room, these speakers can work as surrounds because their sound has a chance to spread out in the room before reaching your ears. In smaller rooms however, a diffuse-field speaker usually will produce a more satisfactory experience of "making the walls and ceiling go away."

Like other speaker varieties, monopoles are widely available in many form factors: free-standing, bookshelf or stand-mounted, on-wall, in-wall or in-ceiling. This makes them very versatile for use in any position in a surround system. Again, though, in many rooms you'd be better served by using a diffuse-field speaker to create a larger and more enveloping experience.



LINE ARRAY – This technology has been around for many years, and is a staple of the professional audio world. You've seen concerts or plays or large churches use a vertical array of speakers. This close coupling of multiple monopolar speaker drivers creates two sonic effects that are very important for sound reinforcement, but are equally applicable to residential use in high-performance home theaters or music systems in larger rooms. If you are designing a system for a large space you should look seriously at line array speakers.

The first characteristic of a line array is that its vertical dispersion does not spread as far or as fast as the sound from a conventional point-source speaker. This means that it does not produce reflections from the floor

or ceiling until the sound has travelled a long distance from the speaker, creating a cleaner and more intelligible sound for a larger audience. In a church, for example, this means that the pastor's will be more easily understood further back in the church, without as much reverberation. In a home theater the same effect means that dialog will be clearer, and that other sounds will be more distinct and more precisely placed in the soundfield, creating a more enjoyable experience.

The second feature of line arrays is that their volume decreases over distance at half the rate of a point-source. For both professional sound and home theater use, this means that all listeners will get a more even volume level – listeners in the back rows will hear things louder than with point-source speakers, while those in the front won't be "blown away" by things being too loud. Compared to the decreasing volume as shown in the Monopolar diagram above, a line source will create a sound that quickly reaches its normal level, then stays there over a much longer distance before decaying. In a large home theater setting this means that everyone hears all channels at close to the same volume level regardless of where they sit. For surround channels, an added advantage is that those seated closer to one of the speakers than another will not hear a large difference in volume between them, and thus more listeners will be able to enjoy a movie with optimal sound quality than ever before.

BG RADIA SURROUND SOLUTIONS

Since its inception in 1994, BG Radia has produced high-performance line array speakers based on planar ribbon speaker technology. Using planar ribbons, which are actually lighter than the air they excite to create sound, makes them much more detailed and responsive than conventional cone and dome speakers. This translates into increased intelligibility and accuracy, whether used for music or movies.

We recognize that rooms are very different in their architectural details, often making speaker placement an exercise in optimizing compromises. This is especially true when it comes to the multiple speakers needed for a surround sound home theater. We also know that individual tastes vary when it comes to the type and level of surround sound performance. Because of this, BG Radia is alone in producing speakers for virtually any type of surround sound application, and meeting any performance expectation. This make us uniquely suited to provide the best possible solution for your needs, whether your system is simple or world-class.

DIPOLAR – The R-18i is a true dipolar speaker, meaning that it uses a single main speaker that produces sound off both its front and back. This means that there are no phase anomalies produced by separate speaker systems as used in nearly all other "dipolar" speakers. Using a single driver for the midrange and high frequencies also means that we can rotate that driver to focus the sound where desired, so the R-18i solves many installation issues in many rooms where an on-wall speaker can be used.



R-18i

BIPOLAR – We offer two different bipolar speakers to produce a very large diffuse soundfield, the SS-202 and SS-303. Both are designed to be used in-wall or in-ceiling, and both share their speaker drivers with the rest of our acclaimed primary speakers, both woofers and planar ribbon midranges and tweeters. By carefully

adjusting mounting angles and studying how the adjacent speakers interact as they form a series of coherent sound waves, we are able to produce speakers that not only have very wide dispersion to fill your room, but also exhibit very linear and smooth frequency response over their entire response area. This means that everybody in your listening area will hear the same tonal quality and the same detailed and articulate sound, whether they are right in front of a speaker or well off-axis.

The SS-202 is a two-way speaker, featuring four 4" Neodymium woofers set in a concave array, and two Neo3 3" planar ribbon tweeters in a convex array. It is approximately 12" square, so it can fit nearly anywhere in a wall or ceiling, and its depth allows it to fit into a standard 2 x 4 framed wall, even using its optional extruded aluminum back box. It's available in black or white, or can be custom painted on-site to match the room.

The SS-303 is a larger three-way system, suitable for extremely large, high-performance theater systems. It features two 8" dual-gap woofers, the same as used in our flagship speakers, two Neo10 10" planar ribbon midranges in a concave array, and two Neo3 3" planar ribbon tweeters in a convex array. The SS-303 will also fit into a standard-depth framed wall, and measures 32" x 11-5/8". Like all BG Radia speakers, it is also available in black or white, or can be custom-painted to match its environment.



SS-202



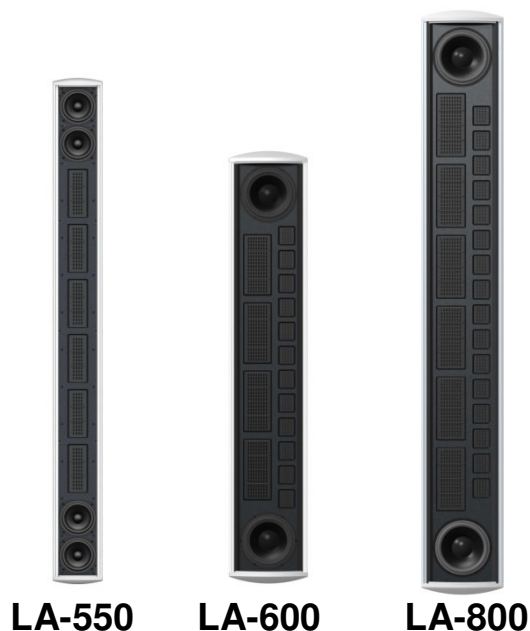
SS-303

MONOPOLAR – If your taste runs to more specific placement cues for surround effects, you will probably want to use monopolar speakers. Most of the speakers offered by BG Radia, as by most manufacturers, are monopoles. From the RT-6CJ in-ceiling speaker at \$300/pair to the SA-500 in-wall selling for \$4000/pair, BG offers traditional monopoles to fit nearly any situation. Remember that BG's more basic in-wall and in-ceiling speakers share the same planar ribbon drivers as used throughout the product line, so they are timbre-matched to any main or center channel you choose. Proper selection will depend on the size of the room and its layout, and the performance level desired. Please consult with an authorized BG dealer to determine the best mix of products for your particular room.

There are several models of more traditional in-wall and in-ceiling speakers in the PD and RT series. These are appropriate for many systems in smaller rooms, or where ultimate performance (and its corresponding price tag!) is not an issue. For higher output in larger rooms, the SA series offers several models ideally suited for installation in walls or columns, due to their narrow 7" width. The SA models utilize Symmetrical Array design to control their vertical dispersion, resulting in less primary reflections off the floor and ceiling.



LINE ARRAY – For the ultimate in sonic performance at any position in a surround sound system, BG Radia offers true line array speakers. As described above, this function limits vertical dispersion so that if you were to visualize the speaker coming out of the wall and travelling through the room in a straight line – that is the height of the mid and high frequency output. This dramatically decreases reflections and increases detail and intelligibility. Line arrays also have very wide horizontal dispersion, so each listener can hear all of the sound from each speaker, even if he is well off-axis to one side. In a very large room, this is an important criteria for even surround coverage to all seats, just as it is to create a perfect soundstage from the front speakers. In addition, as also discussed above, a line array’s tendency to decrease in volume at half the rate of a point-source also contributes to everyone hearing a good mix of all channels no matter where they sit.



SUMMARY

Throughout its history, surround sound for the home has grown and changed dramatically in response to the technological advances used in Hollywood. Digital processing power has increased exponentially, giving equipment designers the tools to improve performance as was never even dreamed of just a few years ago. Because of the differences in room layouts and furnishings, and in personal performance and budget expectations, homeowners and system designers face many challenges in recreating the excitement of a state of the art theater or concert system.

Recognizing these facts, BG Radia has engineered a number of unique products that are truly solutions to many of the problems faced when trying to create a fabulous home theater. By paying attention to the principals of physics to determine the proper types of speakers to work in varying acoustic environments, and designing speaker drivers that can react accurately to the smallest nuance of a performance, BG is at the forefront of the industry and has won numerous awards to prove it.

One of the greatest challenges is to “make to walls and ceiling disappear” so that any type of fantasy world can be reproduced sonically. BG is ideally suited to be your prime choice in speakers, offering a wide selection of not only main speakers, but purpose-built surround speakers for any type of application. No other vendor outside the professional realm can make that statement, and no other vendor can solve any and all acoustic challenges like BG Radia.