ISSUE
04
Volume 4

A Lifetime of Music

This Issue

Earth, Wind, and Fire install PMC/ Bryston

Bryston is pleased to announce Earth, Wind & Fire have purchased a PMC/ Bryston active monitoring system for their Kalimba Recording Studio in Santa Monica California. The first new Earth Wind and Fire album in 15 years will be produced on this new reference system.

The monitoring system consists of a Stacked Pair of MB -1 Active Loudspeakers employing two 12 inch Transmission Line woofers, one 3 inch PMC proprietary dome midrange and 1 PMC custom tweeter per stacked unit.

Amplification is handled by 4 PMC Series 7B's, 2 PMC Series 4B's and 2 PMC Custom Electronic Crossovers.

Paul Klingberg commented:"As the audio engineer for Maurice White (Earth, Wind & Fire) at Magnet Vision studios, our PMC MB1 system with Bryston amplification gets a full workout everyday. The MB1 sound is big and bold when

Fundamentals for Small Room Acoustics

Based on the terrific response we had to our last newsletter discussing room acoustics I asked Doug Plumb of ETF Acoustics to provide an article giving a more detailed overview of small listening room acoustics.

"Small room acoustics is a notoriously difficult subject area. Humans hear a frequency range that can be as wide as 20 Hz to 20 KHz, which encompasses a range that is over three decades in bandwidth. Effective wavelengths range from several meters to only a few centimetres. To produce the full audible spectrum to hi fidelity standards, two or often more separate loudspeaker drive units (woofer, midrange and tweeter) are usually required.

By comparison, radar systems, radio and cable transmission often deal in frequency ranges much smaller. The FM radio band is less than a single octave in width. For this reason, a single transducer (antenna) may be employed to broadcast the full frequency range. In addition to this, room acoustics does not enjoy the same attention in terms of research as these other more widely applicable and profitable fields.

Talk to a few different practitioners of room acoustics and you will get some very different opinions on exactly what should be done in any given setting. Part of the reason for this difference of opinion is that some of the fields related to room acoustics are relatively new fields and not fully developed to apply to this science. The psychology of human hearing is not well understood but is now receiving more attention due to its applicability to military and weapon sciences.

In this short article, we will illustrate the techniques for small room acoustic control (less than 10,000 cubic feet) along with their known respective advantages and disadvantages. To consider a room (closed space) in terms of the full audible spectrum, a room can be divided into three basic frequency ranges. These are: 1. Low Frequency Region, 2. Diffusion Region and 3. High Frequency Region. This separates the bands of the room into three distinct models of acoustic behaviour, the model used depends on the frequency band of interest and the size of the room.

Further to this, room acoustics is often broken into two categories: large room acoustics and small room acoustics. Small room acoustic models use differential equations, finite element analysis and wave theory. Large room acoustics employ statistics such as reverberation time, direct to reverberant ratios, and various other statistical methods.

Typically large rooms such as stadiums, concert halls and theatres have sound reflections that occur at a greater time than 50 ms after the direct sound (sound travels as the rate of approximately 1.13 ft/ms). Single first order reflections (reflects from one surface before reaching the listener) form a large part of the sound field in these environments. In typical small domestic and professional monitoring environments sound has reflected from many surfaces before reaching a listener after 50 ms. Sound gets absorbed very quickly in these comparatively small places. Consequently large room statistical methods are not often used in these smaller spaces.

For any given room, mapping these three regions can be difficult. In fact, the diffusion region exists because it is so difficult to separate the low and high frequency region in a quantifiable way.

The low frequency region of a room is characterized by a response that consists of a set of resonance, each one highly discernible from another. This frequency range is approximately between the lowest resonant frequency and approximately three octaves above this frequency. A room that has the lowest mode of resonance at 20 Hz would have a low frequency region that spans as high as approximately 160 we need it to be for rhythm tracking but transitions very accurately to the delicate nuances of a mix played back at very soft volumes. The MB1's have it all!"

Earth Wind and Fire was just recently inducted into the Rock & Roll Hall of Fame. We look forward to hearing this new recording.

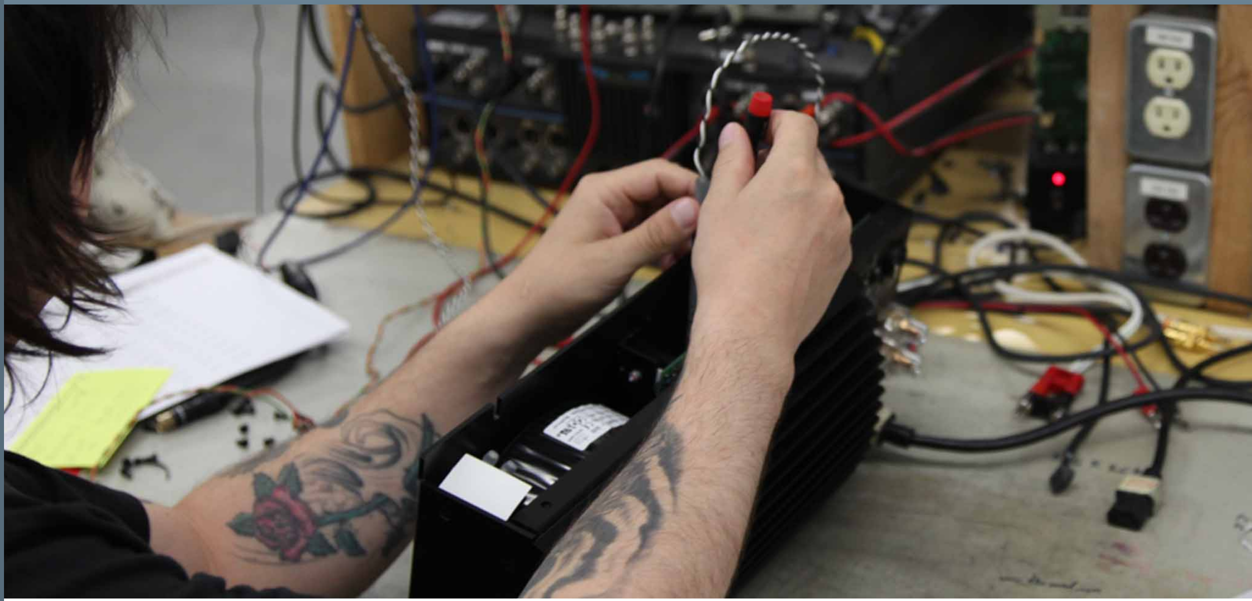
Bryston Wins Export Award

We are very pleased to announce that Bryston Limited has received a 1999 Ontario

Global Traders Award.

This award is given to the manufacturing company which best exhibits "Excellence in Exporting." There were five Ontario companies nominated for 1999 and Bryston was presented the award at a special dinner held in Ottawa. Hey, we even got a trophy.

As a Canadian company the export market is a very important segment for Bryston and we would like to express our sincere thanks to all our international customers for their continuing support.



Hz. The quality of sound is essentially determined by the spacing of these resonance's. In ideal situations, the density of the resonance's will rise exponentially as a constant band of interest is increased in center frequency. There will be many more modes of resonance in a 20 Hz band centered at 80 Hz, (70 Hz - 90 Hz) than there would be between 20 Hz and 40 Hz.

The high frequency region has wavelengths much smaller than room dimensions. In this range sound behaves as rays. Sound reflects from hard objects in the same fashion as light from a mirror. This region is above a few hundred Hz, the precise lower limit depends on room geometry and losses within the room.

The diffusion region is the range between these two extremes. Sound in this frequency region has modes of resonance that are too densely packed to be considered individually. The wavelengths of sound in this region are too long to model sound behaviour as rays as done in the high frequency model. The diffusion region is the "no mans land" between the low frequency region and the high frequency region.

Virtually nothing is carved in stone with regard to these three model regions. Any formulas that enable one to differentiate these regions should be considered only as an approximation.

Passive devices for room treatments are often used in high performance environments. The primary disadvantage of passive room treatments such as foam absorbers and various resonators or diffusers is that many are required. People often make the mistake of assuming that a small passive device will produce a difference. For passive treatments to work, a large area or volume must be in contact with the actual sound. A single 2 foot x 2 foot absorber arbitrarily placed will not likely make much of an audible difference. Likewise, a foam absorber panel that is only a few inches thick is likely to be effective only over a very high frequency band, above approximately 1 - 2 kHz. To be effective, foam absorbers must be thick, normally 6 inches or more to be effective across the entire high frequency region. Often times one or two inch thick panel absorbers are specified as being effective to as low as a few hundred Hz. The specification is derived using the a absorber in a completely different manner using test conditions far removed from a typical listening room. These thin absorbers are not effective for lower frequencies and the discrete reflections found in a typical studio monitoring or domestic listening environment.

Passive treatments do have an advantage over electronic processing. The room actually sounds better without the audio system even turned on. A wider range of desirable listening positions become possible. If electronic equalization is applied, particularly at high frequencies, the size of the desirable listening area will likely decrease. Electronic equalization can be difficult and dangerous in terms of equipment overuse when implemented carelessly. Low frequency treatments often consist of wave traps or Helmholtz resonators. Our experience has been that Helmholtz resonators are much more effective for a fixed volume allocated for the device. There are certain size restrictions on Helmholtz resonators, no dimension of the device should be larger than approximately 1/10 of the wavelength of the design frequency. Helmholtz resonator construction is not recommended for the amateur. Testing of these devices can be tricky and many are often required for large listening spaces.

Electronic equalization can take the place of a passive device used to control an over excited room mode. Careful and correct electronic equalizers can reduce ringing as well as a properly placed set of Helmholtz resonators. Electronic equalization can be used in a very limited way to control deep nulls in the frequency response. It can be dangerous to loudspeakers if electronic correction is applied to correct deep nulls in frequency response at low frequencies. Woofer cone excursion limits can be easily reached with low frequency EQ boost.

Before any attempt at passive or active room correction is made, loudspeakers should be optimally placed. An advantage of subwoofers is that they can be placed to optimize low

Achieving this level of respect for Bryston product on the world stage is a great honour indeed.

frequency performance while main speakers can be independently placed to optimize performance over their respective operating range.

There are many published formulas and recipes to place subwoofers correctly. Many work well, but it is better to actually measure results, as any particular setting may have a feature not considered when the formulas for optimal placement were found. ETF software permits fast easy comparison of many possible positions using measurement overlays to find the best response. Room treatment at high frequencies most often consists of foam absorption strategically placed using the mirror trick. Electronic equalization (digital room correction) may be employed to cancel reflections, but when this method is used the ideal seating area for listeners decreases in size. This equalization is complex and expensive. It is normally both easier, better, and cheaper to control high frequency room reflections with absorption.

Absorber thickness required is often underestimated. A two inch thick absorber is effective above approximately 1200 Hz - 2000 Hz. A 6 inch absorber is often required to be effective throughout most of the high frequency range and to effectively control discrete reflections. Absorbers are the only treatment that we recommend for amateurs using ETF software as an aid to improving small room acoustics. The diffusion region could be called the difficult region. Wavelengths of frequencies spanning this region are such that response is strongly dependent upon listener position. Passive devices such as panel type Helmholtz resonators can be used to help control this region of behaviour.

Absorbers required are simply too thick to be practical in most environments. We recommend careful monitor positioning using multiple measurements with ETF software overlays used to compare response. Overall best loudspeaker position can be chosen from an array of measurements made at a specific listener location.

My thanks to Doug for this informative overview on small room acoustics. In our next newsletter we will discuss a sample project we are currently working on which will show step by step how we optimally position loudspeakers in the Bryston Listening Room.

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