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Assessment of the Versatility of Virtual Orchestra Technology as a Rehearsal Tool

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The Versatility of Virtual Orchestra Technology

An Interactive Qualifying Project by Jarrod Ratcliffe
Advised by Professor John Delorey
Terms B07, C08, D08

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Abstract

This is an assessment of the versatility of Sinfonia virtual orchestra technology for use in a technological rehearsal environment in music education.

1. Background & Introduction

This project involves virtual orchestra technology. All work with virtual orchestra technology in this project is referring to the first system originally created by the partnership of Bianchi & Smith, which developed into New York based Realtime Music Solutions and their current virtual orchestra suite, Sinfonia. The first use of virtual orchestra technology on record occurred in 1989. Frederick Bianchi and David Smith were working together as Director and Associate Director of Electronic Music at the College Conservatory of Music, University of Cinncinati. They were working with John Eaton on a movie production of a famous opera by Christoph Willibald Ritter von Gluck, entitled *Iphegenie auf Tauride*. While working to create an electronic score for the movie, Bianchi and Smith did not realize that there were also going to be two live performances of the production, as well. Working with the electronic music medium, Bianchi and Smith used an impromptu, primitive "virtual orchestra," using computer sequencers, sound modules, and sound reinforcement. It was this project that led Bianchi and Smith to work in developing further virtual orchestra technology.[1] Some of the early concepts considered in the development of the virtual orchestra which are important to understanding its functionality still today are as follows: it is a musical instrument that sounds like an orchestra. There are no recordings involved. It can follow the conductor. Musical expression and nuances can be added in real time.

The original concept of the virtual orchestra was to aid in live performance. Whether there were to be live orchestra players present at a performance or not, the virtual orchestra was designed to enhance the live performance. A small or limited pit area can mean that a theater does not really have room for a full orchestra, or perhaps the organization putting the show on cannot afford a full orchestra. The virtual orchestra can be a standalone instrument, or it can be integrated with live players. The virtual orchestra system has become extremely popular in this aspect, in many different configurations, with and without live players, with different numbers, types and qualities of speakers. Though the common use of the virtual orchestra is as a live performance enhancement, it is an incredibly versatile instrument capable of much more than just aiding live performance. It is the same qualities that make it valuable as a performing instrument that make it valuable as a rehearsal tool. A semi-permanent setup of the virtual orchestra could provide music students and ensembles with a highly versatile, realistic, and full-sounding rehearsal tool. A rehearsal tool like this would offer extremely high academic value in music education.

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[1] History, www.virtualorchestra.com

2. Presentation Preparations and Project Structure

2.1 Organizing the Project and Team

Realizing the power of the virtual orchestra as a rehearsal tool, I teamed up with Professors John Delorey and Frederick Bianchi to present the virtual orchestra at the American Choral Directors Association Eastern Division Conference in Hartford, Connecticut on February 16, 2008. Many preparations needed to be made in order to present the virtual orchestra at the conference. We planned to present excerpts from Carl Orff's *Carmina Burana* and Giuseppe Verdi's *Requiem*. Professor Delorey would conduct members of the WPI Festival Chorus through these excerpts. I would follow his baton and conduct the virtual orchestra. The first preparation step necessary was to organize the project team. When the term "project team" is used, this refers to Professor Delorey (project advisor), Professor Bianchi (virtual orchestra inventor, expert), a group of students fulfilling their Humanities and Arts sufficiency requirements, and myself (project facilitator and virtual orchestra symphonist). Once the project team was formed, we met weekly on Wednesdays at 4 pm to make decisions regarding equipment setup, troubleshooting, organization, aesthetics of presentation, and event logistics for our presentation in Hartford. Further information regarding the project team, and records of team meetings can be found in the Project Team Records, Appendix B.

2.2 Examination of Virtual Orchestra Technology

At the basic level first, we looked at the technology and equipment we would use in Hartford. Like most technology, as time has gone by, the virtual orchestra has shrunk in size and faced significant developments. When virtual orchestra technology was in its early stages, Bianchi and Smith were using all outboard analog equipment:

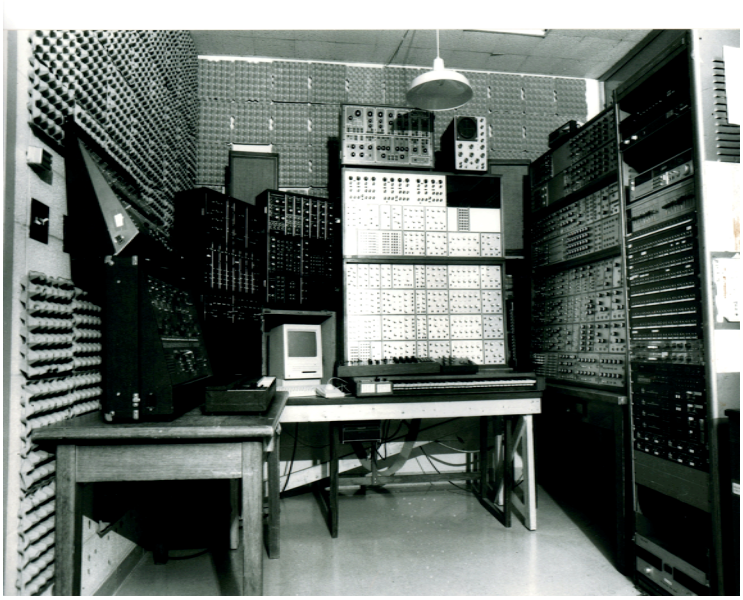

Photo 1: Early Virtual Orchestra, Bianchi & Smith, Cinncinnatti, 1989

Today, Sinfonia can be run from a single computer:

Photo 2: Modern Virtual Orchestra

Of course, to actually get the sound to travel in the space, you will need a mixer for routing purposes, speakers, and amplifiers to power the speakers. Also, to control the system, you will need an I/O box with MIDI interface and a MIDI controller/keyboard. Our setup for Hartford is below:

Photo 3: Virtual Orchestra for Presentation

In the above picture, all of the essential virtual orchestra equipment used in our Hartford presentation is found on the top of the table. There is an iMac running Sinfonia, the virtual orchestra software, an Apple Keyboard and mouse for moving around in the score, a small 2-octave MIDI controller used to control the virtual orchestra, an M-Audio Firewire 410 I/O Box with MIDI Interface which outputs to our mixer to power the primary speakers, and an M-Audio Studiophile SP-5B monitor so I can here the whole orchestra mix right in front of me, and stay with the conductor. We also had backups and redundant systems for most of our equipment, for the case of any equipment malfunctions.

For the application of this presentation, we wanted a lot of speakers to simulate an orchestra performing works with the chorus. The signal from the I/O Box on the table top was routed to our mixer and then our amps, which powered the speakers:

Photo 4: Mixer and Amplifiers for Presentation

Photo 5: Speaker Setup for Presentation

2.3 Realizing & Importing the Score

After looking at the technology on a basic level, the next preparation step was to import the score data into Sinfonia in order to be able to play the excerpts from Orff and Verdi. The scores were imported into Digital Performer, a MIDI sequencer and Digital Audio Workstation software platform. Once enetered into Digital Performer, the scores were then exported as MIDI data, and imported into Sinfonia.

2.4 The Art and Science of Creating the Soundscape

The next preparation task is a very significant task in all audio applications, including the virtual orchestra, is creating the right "soundscape," or "sound image." "Soundscape," or "sound image" is referring to what the listener perceives. There are many different ways to listen to audio. Audio is frequently listened to in stereo, meaning you have two channels, left and right. Common setups include stereo headphones and stereo speakers. There is also the popular term "surround sound," which is frequently used for movies and television, to project sound all around you, from multiple source speakers. What you hear sends signals to your brain and you are given the mental image that you are "surrounded" by the movie, or more realistically experiencing the movie, because it is going on around you. Professional sound engineer, producer, and teacher, Dan Gibson expresses this well: "When we imagine a sound, like a vocal, to be between the speakers, there is, in actuality, no sound there…sound is coming out of both speakers, traveling throughout the room, and we just imagine the sound to be between the speakers. The same thing happens when you listen through headphones: when you hear a sound in the middle of your head…there's no sound there. Your brain's there!"[2] In order for a realistic image to be created, there needs to be contrast and dynamic in the mix. This contrast and dynamic can be created by monitoring and adjusting volumes, equalization, panning, and effects. Like the soundscape applications just mentioned above, the idea behind the soundscape of the virtual orchestra is to give the listener a realistic mental image. In this case, that mental image, or soundscape is of a real orchestra playing right there in front of them. In order to achieve this soundscape, the project team used 22 speakers, with 12 in crossover configuration, which gives us speakers 1-16 in our speaker layout below:

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[2] The Art of Mixing; David Gibson

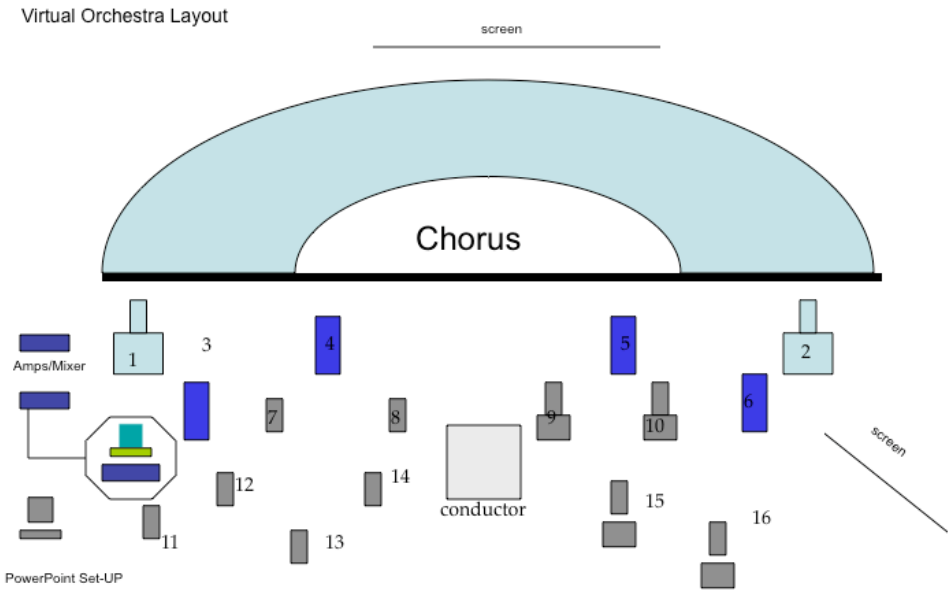


Figure 1: Speaker Layout Diagram

All of the speakers used for the project were manufactured by Eastern Acoustic Works (EAW). For the virtual orchestra, the idea was to create the realistic sound image of their being sections of the orchestra: woodwinds, strings, brass, percussion, and pianos. The speakers used in the project were all used because of their specific design attributes that matched the frequencies of their respective instrument. The most important of these attributes being frequency range.

Speakers 1 and 2 each consisted of an MM80 configuration, which is a JF80 connected to a SB150ixR in crossover mode, where the SB150ixR is a 15 inch subwoofer, and the JF80 is a three way speaker, with two 6.5 inch woofers (vented), and a 1 inch exit/44mm voice coil compression driver. Connected in crossover mode, they handle the powerful low-end frequencies of percussion, timpanis, and the tuba in our virtual orchestra, while still supporting higher end frequencies from these instruments. The speakers carrying signal from these powerful low-frequency instruments were placed far back and on the outside of our speaker configuration, because these low frequencies can often be felt as opposed to just heard, and placing them closer to walls on the outside and in the back allows the listener to experience

this realistic “feeling” of the low end frequencies of an orchestra.

Photo 6: MM80 Crossover Configuration for Powerful Low-Frequency Percussion, Timpani, Tuba

Speakers 3-6 were all of model MK2194. This model consists of a 12 inch woofer and a voice coil compression driver on a 90 x 45 constant directivity horn. This powerful and punching horn driver combined with the woofer were perfect model speakers for the rest of the brass (trumpets, horns, trombones) in our virtual orchestra. The horn drivers are very similar in functionality to the horn bell found on these brass instruments. These speakers were placed in the back row, and tiered to create the sound image of a typical horseshoe row in the orchestra.

Photo 7: MK2194 with Horn Driver Simulates Bell of Brass Instruments

Speakers 7,8, and 11-14 were all model JF60. This model consists of a 6.5 inch woofer and a 33mm tweeter. This small tweeter is great for higher frequencies, which is why we routed high woodwinds (flutes, oboes) and high strings (violins, violas) to these speakers. These speakers were placed in a cluster on the left side of our layout to simulate the a typical strings section in an orchestra. After listening to the virtual orchestra, I felt there was something lacking in the soundscape. Keeping in mind the three dimensional field of sound that the listener experiences, I decided we should not leave the JF60s on the ground. These model speakers happen to be smaller than the other speakers we used, simply because this is a common design characteristic used in creating higher frequency drivers. Due to their small design, they sit lower and flat on the floor, so I designed speaker stands for the JF60s consisting of three different heights. Two 5 foot stands were constructed from PVC pipe lengths and wooden platforms with pipe flanges. These were used for speakers 7 and 8. Two 3 foot stands were constructed in the same manner as the 5 foot stands. These were used for speakers 12 and 14. Speakers 11 and 13 were in the front row of speakers. Simple 2 inch plastic wedges were placed under these

speakers to angle the driver up. The tiered heights of the speaker stands were designed to give the impression of depth in the sound image of the listener.

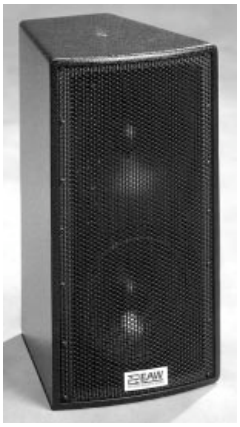


Photo 8: JF60 for High-Frequency Woodwinds & Strings

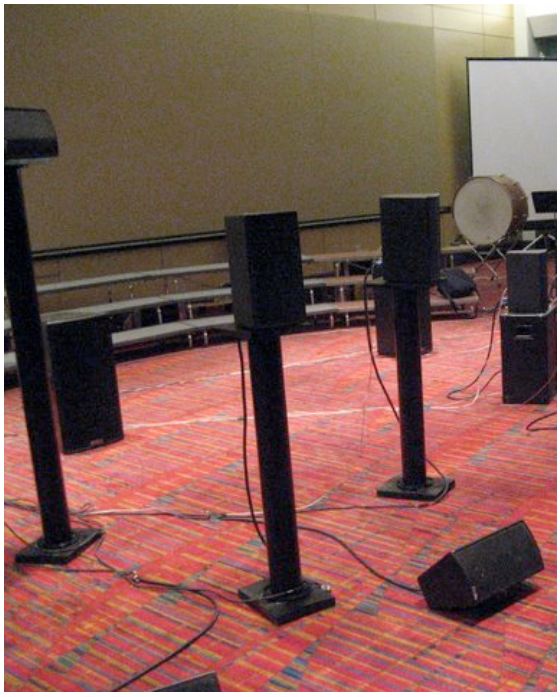


Photo 9: Speaker Stands of Different Heights Create High Frequency Instrument Depth Effect

Speakers 9, 10, 15, and 16 consisted of an MM60 configuration, which is a JF60 connected to a SB120ixR in crossover mode, where the SB120ixR is a 12 inch subwoofer, and the JF80 is full range two way speaker, with a 6.5 inch woofer and a 1.3 inch tweeter. These speakers were great for our mid-

low range strings, woodwinds, and piano. They were placed on the right/middle of our layout to simulate woodwind and lower string placement in a typical orchestra.

Photo 10: MM60 Crossover Configuration for Mid-Low Frequency Woodwinds & Strings

*Note: See D Appendix for full manufacturer specifications on all speakers used.

Once the speakers were decided upon, we started molding our soundscape. As mentioned above, we looked at creating dynamic and contrast through monitoring and adjusting volumes, equalization, panning, and effects. Some of the group sessions were spent listening to the overall virtual orchestra mix to make note of any significant changes that needed to be made. For instance, on January 30 Professor Bianchi and I listened trough *Oh Fortuna* and made notes (consult Appendix B for notes from all project team meetings). Any significant changes that needed to be made were then edited back in Digital Performer, for example slight volumes can be corrected or changed in Sinfonia, but when there is a significant contrast of volume on certain parts, or an extra beat in a measure were issues most related to the score data, and thus fixed in digital performer, and imported again into Sinfonia. Once we fixed the scores to be as accurate as possible with dynamics, rhythms, and volumes, we could then add the subtle nuances of performance with Sinfonia's flexible, powerful software interface.

The main idea of equalization is not really to add to the mix, but it is rather a balance of decreasing overpowering frequencies and boosting any lacking frequencies to allow for all frequencies to coexist well in the mix. The adjustments made in equalization should represent the inverse transfer function of speakers, meaning that the ideal resultant equalization would yield a flat frequency response. With the virtual orchestra, the assumption is that Sinfonia is delivering the sounds with flat frequency response, as good as they are, right out of the line output of the I/O Box. Any minor adjustments that need to be made are typically adjusted at the board. For our presentation, we boosted a bit of the low end on percussion through the Mackie mixer.

Panning plays a very significant role in creating the desired sound image. The idea behind panning is to change the amount of signal going to each channel to make the soundscape more realistic, broad, and complex. For instance, in a stereo speaker application, if there is optimal symmetrical speaker placement, and everything is panned to the center, the resultant sound image is of everything jammed into the center of the soundscape, as if everything was happening at the same spot in the center. Adjusting the panning allows the listener to experience a more realistic soundscape. For our virtual orchestra presentation, we took advantage of the fact that we used 22 speakers and panned signals to create a realistic soundscape of an orchestra, performing in front of the choir in sections, to give the listener a realistic experience. All panning settings used for the presentation can be found in the Signal Path, Routing & Panning, Appendix C.

Effects are also important in creating the desired soundscape. In the virtual orchestra application, the only effect actually applicable is reverb. Sinfonia has a built-in functional reverb in the player which can be adjusted according to room size. The project team had a chance to see the space we would be presenting in about a month prior to the actual presentation to get an idea of room size, but we still had no way of knowing how our powerful virtual orchestra setup would perform with the acoustics of the room. We simply rehearsed with what we agreed as a realistic large room reverb, and adjusted this level minimally once we were setup in the conference room.

2.5 Troubleshooting, Organization, and Aesthetics

The final project team preparation task was to troubleshoot any problems, maintain organization, and make the virtual orchestra aesthetically pleasing. One does not need to glance at the Equipment List or

the Signal Path, Routing & Panning (Appendices A and C, respectively) to understand that there were several cables required to power 22 speakers, connect them to a mixer, and route them from an I/O Box. One project team goal was to be extremely time-efficient and organized with setup, and to showcase the virtual orchestra in an aesthetically pleasing manner. When so many cables are involved, it becomes easy for cables to be tangled and knotted, clumped together, which costs the team time to fix the kinks, and does not look very appealing aesthetically. Early in the preparation stages, there was too much time spent facing connection problems, and following cables across the room for 15 minutes+ just to find the problem. More cables mean more possible bad connections. This is partly the reason why the virtual orchestra now consists of so much less outboard equipment than it used to. Advancements in technology and the use of more built-in software has increased the accessibility and user-friendly aspects of the virtual orchestra. However, our project team still had to deal with setting up a large speaker layout. We decided that the best way to prevent these problems from happening in the future, especially once we made it to Hartford was to face the problem with an organizational approach. We used a label maker to label both ends of every cable, as well as the routing location of every channel on the mixer, labeled the mixer by orchestra section, and labeled every channel on the amplifiers with routing information. We also labeled every speaker with its corresponding number on the speaker layout (Figure 1). For aesthetics purposes, we used common cable paths and taped down all cables with gaff tape. We also painted the speaker stands for the JF60s and all of the speakers with a coat of black spray paint.

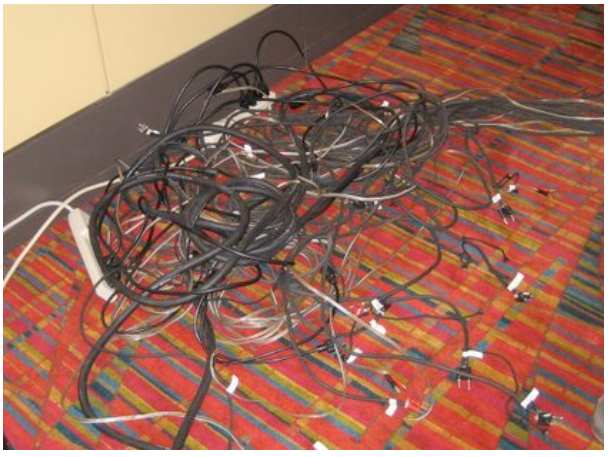
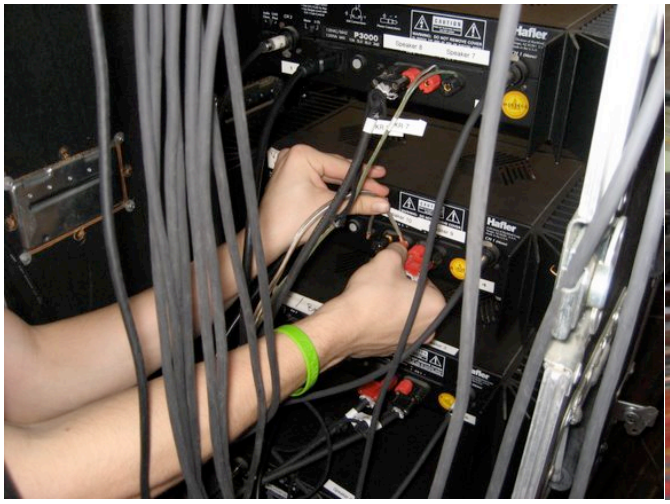


Photo 11: Troubleshooting can be a Mess



Photos 12-15: Organization and Aesthetics

2.6 Musicality of the Instrument and the Role of the Symphonist

One significant preparation that steps away from the technical, organizational and aesthetic, but is at the heart of the virtual orchestra itself is the role of the symphonist, and how the virtual orchestra performs musically. It is quite important to remember that when the first concept of the virtual orchestra was envisioned, the most important characteristic of this technology was for it to be a musical instrument, for a musician, or symphonist, to perform on. This musical instrument would sound like an orchestra (or parts of an orchestra to be accompanied by live players) and the musician would be able to add the subtle nuances of performance. Once the score has been edited and all final touches and tweaks have

been made, the symphonist must practice to get comfortable with the virtual orchestra interface. The main functionality of the virtual orchestra as an instrument is as follows:

The symphonist starts the first downbeat of the piece with the "GO" key. From there, the tap keys are used to tap along with the tempo of the song. Like in the case of live players, the symphonist must follow the beat of the conductor to stay in time. The Sinfonia Editor can be used to program in "Events" and other parameters, like the symphonists desired subdivisions. For instance, on some slower tempo passages, I may choose to tap to the eighth note. In most of *Oh Fortuna*, I chose to tap to half notes, while in all of the excerpt from *Dies Irae*, I tapped in quarter notes. Other "Events" that can be entered into the Sinfonia editor include "Vamp," and "Go To." While these Events can be programmed into the editor, there are also many possibilities for the symphonist to use in the Player, while performing. For instance, there is a "Cruise" button you can use for passages of the same tempo. I did not use cruise at all in our presentation to avoid getting off from fluctuating tempos. There are several other realtime options which all have their own keys on the MIDI controller, including "Prev Bar," "Next Bar," "slower," "faster," "a tempo," "pause," "cutoff," as well as "vamp," and "exit vamp." "Prev Bar" and "Next Bar" can be used when the symphonist gets off with the conductor (ahead or behind). If the symphonist gets significantly ahead or behind in the piece, he or she can type in a Go To Bar in the number pad of the computer and press enter on the downbeat and instantly be back in time. "Slower," "faster," and "a tempo" can be used to make small adjustments away from and back to the target tempo. "Pause" and "Cutoff" are a great combination for held notes and fermatas. Because of the nature of a fermata, there is no way to program in a variable note length for a note with a fermata. When a conductor holds a note for an unspecified amount of time, the symphonist can simply tap through the last subdivision of the note, press "pause," and after the conductor gives the cutoff, press "cutoff." The tap key is then simply pressed on the next down beat. Vamps can also be initiated and exited in real time.

According to the Sinfonia manual, in order to perform as symphonist on the virtual orchestra, one must be a musician and have some knowledge of working with technology. As long as one understands musical concepts like meter, tempo, and be able to follow a score, developing and improving as symphonist is very much like practicing with other musical instruments: a direct relation to how much

you practice.[3] The concepts can be grasped rather quickly, but honing the craft can take longer. Over the period of about a month I had to really practice on the Sinfonia, I was able to grasp the instrument fairly well.

[3] Sinfonia Manual, Realtime Music Solutions

3. Virtual Orchestra as a Rehearsal Tool

In live performance there will always be mistakes. The nature of live performance is imperfection. Because the virtual orchestra was first developed as an instrument to be used in live theatre performance, all of its versatile functionality was programmed in to allow it to be integrated into the live performance environment. However it is this same functionality that has now been integrated into over 45,000 shows worldwide, including some of the most complex vamp and go to schemes of *Cirque du Soleil* productions, that also allows it to function as a great rehearsal tool. Movement within the score can be incredibly helpful not only if the symphonist gets lost in the score, but also if the conductor wants to rehearse a particular section, then jump to another section. The same "Vamp" event that can assure an actor comes in at the correct time can also be a great way to repeat sections to listen for diction or pitch. While the virtual orchestra has been a great way for many productions to integrate with and enhance live performance, if the virtual orchestra had a setup in a rehearsal space, ensembles and musicians could experience a realistic advanced technological rehearsal environment. A tenor preparing to sing in the glee club's performance of Carl Orff's Carmina Burana and struggling with one part of a particular movement could set a vamp on bars 37-41 of movement 9 and practice with a full orchestra, repeating the passage until he feels comfortable. A tenor saxaphonist in the jazz band preparing for a performance of Duke Ellington's Sacred Songs, and not hearing her part fitting into the song could mute all other parts and hear the virtual orchestra play just her part. She could then add (unmute) instruments one by one to layer on top of her sound, until she felt comfortable with her part. Musicians could even learn to run Sinfonia, and rehearse with the virtual orchestra by themselves in this kind of rehearsal space.

4. The Presentation

4.1 Presentation Breakdown

The presentation at the ACDA Conference started with brief history and explanation of the virtual orchestra by Professor Frederick Bianchi. This then continued on to a live performance of *Oh Fortuna* from Carl Orff's *Carmina Burana*, with Professor John Delorey conducting the singers and live players, and myself performing on the virtual orchestra. After performing the movement in its entirety, Professor Delorey would point out sections of the piece that needed to be rehearsed further for the singers. In this rehearsal, he was moving around in the score, conducting at different tempos, repeating (or vamping) on certain passages to listen for pitch and diction, and muting orchestra parts to give reference pitches. All of these helpful rehearsal techniques were handled beautifully by the virtual orchestra. After completing the rehearsal of Carmina Burana, we went on to perform an excerpt of *Dies Irae*, from Giuseppe Verdi's *Requiem*. Upon completion of the excerpt, guest conductors in the audience from the ACDA were given the opportunity to conduct the ensemble with the virtual orchestra, and listeners were given the opportunity to watch me conduct the virtual orchestra from a closer view, and to ask me questions on the virtual orchestra as well. A video of the presentation is attached to the e-submission of this project.

4.2 Questions

During and after the presentation, there were many questions asked of me regarding the functionality of the virtual orchestra. Some of these questions, along with my best current answers can be found below:

Q. How do you stay with the conductor?
A. The tap keys on the MIDI keyboard are tapped along with the tempo being kept by the conductor.

Q. Is there a lag issue between the response time of the Virtual Orchestra performer and the signal going through the speakers?

A. No more than the case of live players. If I look down at the score or the Sinfonia display for too long and get off tempo slightly, it is just like a trumpet player keeping his head in the score for too long and needing to look up to get back on tempo. This is a musical instrument being performed by a musician.

Q. How do union musicians feel about this concept?

A. There have been numerous protests against the Bianchi & Smith team, where union musicians feel that they are being replaced. New York Musicians are still trying to ban Sinfonia. There were strikes in London as well, when Les Miserables went up in the West End. Many musicians see this as man vs. machine, however Realtime Music Solutions sees it as an enhancement of performance, not as a replacement of live players. Claude-Michel Schonberg, composer of Les Miserables put it like this, "When sets and lights are operated by computer and not manually, it seems unthinkable that we should not be able to use the most up-to-date technology to create the best sound possible."[4] In an article for *WPI Transformations*, "[Professor Frederick Bianchi] recalls a rehearsal of the national Broadway tour of *Titanic* in 2001, which used the Sinfonia alongside an ensemble of live musicians. 'The orchestra sounded great,' he says, 'until Sinfonia sat out for one song.' Bianchi immediately heard the difference—instruments went flat and musicians missed rhythms."[5] The virtual orchestra can really help and reinforce the overall sound of the orchestra.

Q. How do you change volumes/mute parts?

A. Going into the Sinfonia editor lets you change volumes for entire songs and entire shows, as well as mute parts if a live player is present. The editor has many other useful functions as well.

Q. Is there a copy of the score that you are following on the computer, or is it just the physical score on the stand beside you?

A. Well, technically the score is in the computer, however not in the traditional manner that a musician would read and follow along with a score. The score exists as MIDI data, allowing it to be realized and performed in real time. I follow along with a paper score on a music stand as a reference…and because it's easier for me to follow along that way…it's difficult for me to read MIDI data up to tempo, too.

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4 The Virtual Orchestra; Realtime Music Solutions

5 Virtually There; Charna Westervelt, WPI Transformations: Winter 2005

5. Conclusions

A few aspects of the virtual orchestra not covered by this project that I would like to work more with include the conductor interface. This is referring to getting the virtual orchestra to run based on the conductor's movements, instead of being required to have a symphonist watching the conductor and performing on the virtual orchestra. I would like to look into some of the research that has already been done on this, including Realtime Music Solutions' work with Lucent Technologies using cameras, as well as the use of accelerometers and gyroscopes, like the functionality of a Nintendo Wii remote as a conductor's baton. I would also like to see the implementation of a "solo" button in the Sinfonia platform, similar to the solo button found on a mixer. If someone wanted to hear their part in rehearsal, it would be much easier and more quickly accessible to solo out a part, as opposed to muting all of the other parts.

After working with the Sinfonia virtual orchestra technology for a couple months, I have been able to experience firsthand some of its amazing capabilities. Seeing as the virtual orchestra was designed to be a musical instrument intended to enhance live performance, it was programmed with the ability to handle the imperfections as well as the subtle nuances of human performance. These same valuable features that help live shows go off smoothly could truly revolutionize the way that ensembles rehearse. Individual music students could go over parts at any desired tempo, focus on trouble spots by repeating them, or even muting other parts to hear smaller groups of instruments play together. Ensembles could rehearse with an integrated virtual orchestra as well. Because this technology was pioneered by a current WPI Professor, it would be very easy to setup a permanent space for the virtual orchestra to reside on campus, and allow music students to rehearse with it. If students learned how to run Sinfonia, and a database of music to be performed by campus ensembles was created and imported into Sinfonia, music students could rehearse by themselves at any tempo, repeat passages, and mute parts, as well as make music with an entire ensemble all by themselves. This kind of rehearsal environment would be zealously utilized and appreciated by campus ensembles, and would keep WPI on the forefront of technology in music education.

A Appendix: Equipment List

(3) - ¼ inch cable (25 ft)
(20) - ¼ inch cable (6 ft)
(6) - ¼ inch cable (3 ft)
(1) - ¼ inch cable (45 ft)
(5) - speak-on cable (5ft)
(2) - speak-on to bare wire (12ft)
(1) - speak-on to bare wire (25ft)
(1) – speak-on to bare wire (30 ft)
(4) - speak-on to banana (25ft)
(4) – speak-on to banana (30 ft)
(7) - banana to bare wire (35ft)
(1) - banana to bare wire (30ft)
(1) - banana to bare wire (60ft)
(1) - banana to bare wire (25ft)
(3) - bare speaker wire (15ft)
(1) - bare speaker wire (18ft)
(1) - bare speaker wire (35ft)
(1) - bare speaker wire (12ft)
(1) - bare speaker wire (9ft)
(1) - bare speaker wire (5ft)
(10) – EAW Model JF60
(2) – EAW Model JF80
(2) – EAW Model SB150ixR
(4) – EAW Model SB120ixR
(4) – EAW Model MK2194
(6) - Hafler Transnova Amplifier
(2) – Hafler Transnova P7000 Amplifier
(1) - Mackie CR1604 VLZ 16-channel mic/line mixer
(2) - Yamaha Rev 100 Digital Reverb Units
(1) - M-Audio Studiophile SP-5B monitor
(3) – iMac loaded with Sinfonia and show
(1) – MacBook loaded with Sinfonia and show
(2) - M-Audio Firewire 410 I/O Box with MIDI Interface
(1) - M-Audio O2 USB MIDI Controller
(1) - Roland PC-200 MK II MIDI Keyboard Controller
(2) – 5’ Speaker stands

(2) – 3’ Speaker stands

(2) – 4” speaker wedge stands

Assorted MIDI cables, IEC cables, and Edison cables

B Appendix: Project Team Records

ACDA East – Hartford

Presentation Room - CC 24

Specs:

Meeting Room 14-15 / 24-25 61 ft 59 ft 15 ft 3547 sq ft
Meeting Room 14-16 / 24-26 61 ft 92 ft 15 ft 5350 sq ft

Meeting Room 14-15 / 24-25 330 200 169 529
Meeting Room 14-16 / 24-26 510 340 255 1019

Presumed about 50 singers, need risers

Ask Bianchi: do you want acoustic shell? May be bringing own risers.

Excerpts:

Verdi – Dies Irae to letter C
Tempo Adjustment (2:12)

Orff - Carmina Burana – Oh Fortuna
-recording obtained

iMac in studio?

Meeting with Suff Students 10/31

Matt Murdy
Dan Christianson
Dan Cianfrocco
Briana Lorenzo

Roster:
Dan Christianson
John Folliard
Briana Lorenzo
Matt Murdy
Shikhar Saxena (ISP)
Andrew Tremblay

ACDA mailing list will be just IQP students
Emilia and I will be excused from Wednesday meetings

Full Roster:

Christianson, Daniel
Cianfrocco, Daniel
Lorenzo, Briana
Murdy, Matthew
Saxena, Shikhar (ISP)
Tremblay, Andrew

1/16/2008

Meeting with Bianchi and Suff Students

Prior knowledge of absences:

Briana Lorenzo – family emergency
Matt Murdy leaving early

Attendance:

Matt Murdy (left early)
The Dans

need to extend speak-on

swap amps to other side to alot for enough distance with speak-on (swap sides for computer, too)

1/23/2008 4 pm

A few scheduling issues known, reflected in attendance

Attendance:

Briana Lorenzo (left early)

Dan Cianfrocco

Matt Murdy

Andrew Tremblay (came late ~5)

Dan Christianson (came late ~5:15)

Look into speaker stands for JF 60s

Look into crossover settings for JF60s with SB120ixR and JF80s with SB150ixR

1/30/2008 – 4 pm

Updated full roster:

Christianson, Daniel
Cianfrocco, Daniel
Lorenzo, Briana
Murdy, Matthew

Attendance:

Dan Cianfrocco (4 pm, left at 5 pm for LNL elections meeting)

Matt Murdy (4:30 pm)

Carmina Run-through:

Measure 6:

String pizzicato down
Low freq in perc and low strings up
Low woodwinds up

Measure 22:

Tam-Tam up

Measure 46:

More Tam-Tam

Measure 62:

Look at high strings, might be too loud

Measure 68ish on:

More mid and low brass needed

Piano:

Pulled back in general

2/2/2008

Attendance:

Dan Christianson

Dan Cianfrocco

Work Session:

Degreased, cleaned, and painted all speakers.
Degreased and cleaned PVC.
Removed caps from capped flanges.
Cleaned and tightened amps and amp racks.

Work left to do:

Dremel boards

Paint boards

Screw on flanges to painted boards

Paint PVC

Attach PVC to flanges with PVC cement

Degrease and clean PVC

Once bottoms are attached to PVC, it's quickrete time

2/6/2008

Attendance:

Dan Christianson
Dan Cianfrocco
Matt Murdy (left early)

Missing Briana

Setup much quicker and easier with the efficient label/cable setup from last week

2/13/2008

Attendance:

Dan Cianfrocco
Dan Christianson
Matt Murdy

Equipment hauled to Alden sub-basement for overnight storage
Speaker stands finished (thanks for the help, Meghan!)

2/14/2008

Setup for rehearsal:

Attendance:

Dan Christianson
Dan Cianfrocco
Briana Lorenzo
Matt Murdy

Take down and haul to sub-basement

Attendance

Dan Cianfrocco
Dan Christianson
Matt Murdy

C Appendix: Signal Path, Routing, & Panning

MIDI Channel	Instrument	410 OUT	Pan	Mixer-In	Mixer-Out	Mixer Split	Speaker Assign
B_1	WW High1	A	15	Channel 1 and Channel 2	Direct Out 1 and Direct Out 2 to Amp 1	AUX1 Out and Aux2 Out to AMP 2	Amp 1 -1 to speaker 7 Amp 1 -2 to speaker 8 Amp 2 -1 to speaker 9 Amp 2 -2 to speaker 10
B_2	WW High2	A	30				
B_3	WW Med1	A	45				
B_4	WW Med2	A	60				
B_5	WW Med3	A	65				
B_6	WW Med4	A	75				
B_7	WW Low1	A	90				
B_8	WW Low2	A	105				
B_9	Horn1	B	15	Channel 3 and Channel 4	Direct Out 3 and Direct Out 4 to Amp 3	AUX3 Out and Aux4 Out to AMP 4	Amp 3 -1 to speaker 3 Amp 3 -2 to speaker 4 Amp 4 -1 to speaker 5 Amp 4 -2 to speaker 6
B_10	Horn2	B	30				
B_11	Horn3	B	45				
B_12	Trumpet1	B	65				
B_13	Trumpet2	B	60				
B-14	Trumpet3	B	70				
B_15	Trombone1	B	75				
B_16	Trombone2	B	90				
C-1	Trombone3	B	105	Channel 7 and Channel 8	Direct Out 7 and Direct Out 8 to Amp 8		Amp 8 -1 to speaker 1 Amp 8 -2 to speaker 2
C-2	Tuba	B	120				
C_3	Timpani	D	64				
C_4	Perc1	D	30				
C_5	Perc2	D	90				
C-6	Piano 1	D	40	Channel 5 and Channel 6	Direct Out 5 and Direct Out 6 to Amp 5	SUB 1 to Amp 6 SUB 2 and Amp 6	Amp 5 -1 speaker 11,12 Amp 5 -2 to speaker 13, 14 Amp 6 -1 to speaker 16 Amp 6 -2 to speaker 16
C-7	Piano 2	D	80				
C-8	violin	C	30				
C_9	Violin1	C	40				
C_10	Violin1B	C	30				
C_11	Violin2	C	80				
C_12	Violin2B	C	90				
C_13	Viola	C	60				
C_14	ViolaB	C	70				
C_15	Cello	D	70		C OUTS/reverbed Left/Right Yamahas		
C_16	Bass	D	90				

D Appendix: Speaker Specifications

TECHNICAL SPECIFICATIONS MM80

DESCRIPTION

A 2-channel 3-way extended range system combining 2x JF80 2-way full range systems and 2x SB150ixR subwoofers. Each JF80 includes 2x 6.5-in woofer (vented), a 1-in exit/44mm voice coil compression driver on a Wave Guide Plate™ and a passive LF/HF crossover. Each SB150ixR includes a 15-in woofer in a vented enclosure and a passive sub/fullrange crossover. Powering is switchable: passive (3-way crossover) or biamplified (active sub/full range with passive LF/HF crossover).

APPLICATIONS

The MM80 delivers extended range output at surprisingly high levels with flat response. Simple to set up and power with each subwoofer housing an internal passive crossover/filter network. Switch allows choice of passive or biamp powering. Despite the small size, an MM80 can fill medium sized venues with high definition, extended range sound. Six year warranty.

Applications include:

Band PA	MultiMedia
Ballroom Events	Boardrooms

DESCRIPTIVE DATA

Part Number	999099
Product Group	J, G
Subwoofer Subsystem & Loading	1x 15-in, Vented (per SB150)
LF Subsystem & Loading	2x 6.5-in, Vented (per JF80)
HF Subsystem & Loading	1x 1-in Exit/44mm Voice Coil Compression Driver on WGP Waveguide (per JF80)
System Configuration	2 Channel, 3-way, Extended Range, 4 enclosures
Powering Configuration(s)	Switchable: Extended Range (passive sub/LF/HF crossover) or Biamplified (passive LF/HF crossover)
Controls (switches, knobs)	Powering Mode Switch (per sub)
Biamplified Crossover	100Hz
Recommended High-Pass Frequency (24 dB/Octave)	25Hz
Cabinet Type (shape)	Trapezoidal (JF80) Rectangular (SB150)
Enclosure Materials	Baltic Birch Plywood
Finish	Black Catalyzed Polyurethane
Connectors	Per SB150ixR: 3x Neutrik NL4 Speakon (1 input, 1 loop-through, 1 output to JF80) Per JF80: 2x Neutrik NL4 Speakon
Suspension Hardware	JF80: (6) 1/4"-20 Threaded Points (1 each top and bottom, 4 on back for Omnimount Series 100), (2) 5/16"-18 threaded points for external stand mount adapter.
Grill	Vinyl Coated Perforated Steel
Mounting Bracket	JF80 980002 Wallmount Bracket

Shown as one channel of an MM80 package.

NOMINAL DATA

(data reflect per channel, passive crossover mode performance)

Frequency Response (Hz)		
±3 db	43Hz to 19kHz	
-10 dB	32Hz	
Axial Sensitivity (dB SPL/1 Watt/1m)		
Extended Range	94	
Impedance (Ohms)		
Extended Range	8	
Power Handling, AES Standard (Watts)		
Extended Range	500	
Calculated Maximum Output (dB SPL, @ 1m)		
Extended Range Peak	127.0	
Extended Range Long Term	121.0	
Special		
Biamped Performance	See JF80 and SB150 datasheets	
Nominal Coverage Angle / -6 dB points (degrees)		
Horizontal	100	
Vertical	80	
Dimensions	**inches**	**millimeters**
Height: JF80	20.94	532
Width (Front): JF80	7.81	198
Width (Rear): JF80	4.5	114
Depth: JF80	9.75	25
Height: SB150	24.63	626
Width: SB150	19.69	500
Depth: SB150	19.59	498
Trapezoid Angle: JF80	10 degrees per side	
Weights	**pounds**	**kilograms**
Net Wt: each JF80	25	11.4
Shipping Wt: each JF80	29	13.1
Net Wt: each SB150	83	37.8
Shipping Wt: each SB150	90	41.0
Shipping Wt: Total MM80	238	107.1

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SERVICE ITEMS

LF: Complete Cone Driver	
EAW Part No.	804052
MF: Complete Cone Driver	
EAW Part No.	804003
HF: Complete Compression Driver/Tweeter	
EAW Part No.	803005
Filter/Crossover Network: Complete Assembly	
EAW Part No.	225004 (JF80) / 225046 (SB150)

ARCHITECTURAL SPECIFICATIONS

The three-way, two channel extended range loudspeaker system shall incorporate (per channel): a 15-in sub bass transducer, 2x 6.5-in LF transducers and a 1-in exit/44mm voice coil compression driver HF transducer. The total system shall incorporate two full range enclosures and two sub bass enclosures.

Each sub bass driver shall be mounted in a vented enclosure tuned for optimum low frequency response. Each sub bass enclosure shall house an internal passive filter network providing sub bass/full range crossover. Each pair of LF drivers shall be mounted in a vented enclosure which also houses a HF driver. Each full range enclosure shall house an internal passive filter network providing LF/HF crossover. Each HF driver shall be mounted on an axis-symmetrical wave guide plate. The total system's nominal coverage shall be 100° (h) x 80° (v).

System frequency response shall vary no more than ±3 dB from 43 Hz to 19 kHz measured on axis. In passive mode, the loudspeaker shall produce a Sound Pressure Level (SPL) of 94 dB SPL on axis at 1 meter with a power input of 1 Watt, and shall be capable of producing a peak output of 127 SPL on axis at 1 meter. It shall handle 500 Watts of amplifier power (AES Standard) and shall have a nominal impedance of 8 Ohms.

The sub bass enclosures shall be rectangular in shape. The full range enclosures shall be trapezoidal in shape. All enclosures shall be constructed of 15mm thickness void-free cross-grain-laminated Baltic birch plywood and shall employ extensive internal bracing. They shall be finished in black catalyzed polyurethane. A switch allowing the user to choose between passive and biamped powering modes shall be installed on the back of each sub bass enclosure.

Input connectors on each sub bass enclosure shall be 3x Neutrik NL4 Speakon (1 input, 1 loop-through, 1 output to full range satelite). Input connectors on each full range enclosure shall be 2x Neutrik NL4 Speakon. (1 input, 1 loop-through). A total of six 1/4"-20 threaded mounting/suspension points (1 each top and bottom, plus 4 on back to accept an Omnimount Series 100) shall be provided on each full range enclosure as well as two 5/16"-18 threaded mounting/suspension points designed to accomodate an external standmount adapter. The front of each enclosure shall be covered with a vinyl coated perforated steel grill backed with open cell foam to protect against dust.

The three-way, two channel extended range loudspeaker shall be the EAW model MM80.

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SPECIFICATIONS MM60

FEATURES

- Multi-enclosure, dual-channel extended range multimedia system
- 2x JF60 full range satellites plus 2x SB120 subwoofers
- Per JF60: 6.5-in LF/1.3-in tweeter
- Per SB120: 12-in LF/internal passive crossover/filter network
- Switchable powering: full range passive or biamp (passive MF/HF)
- For portable use or permanent installation

DESCRIPTION

A 2-channel 3-way extended range system combining 2x JF60 2-way full range systems and 2x SB120ixR subwoofers. Each JF60 includes a 6.5-in woofer, a 1.3-in tweeter on a Wave Guide Plate™ and a passive LF/HF crossover. Each SB120ixR includes a 12-in woofer in a vented enclosure and a passive sub/full range crossover. Powering mode is switchable: passive (3-way crossover) or bi-amplified (active sub/full range with passive LF/HF crossover).

APPLICATIONS

The MM60 delivers extended range output at surprisingly high levels with flat response. Simple to set up and power with each subwoofer housing an internal passive crossover/filter network. Switch allows choice of passive or bi-amp powering. Six year warranty.

Applications include:

Band PA	MultiMedia
Ballroom Events	Boardrooms
Restaurants	Large Retail

PERFORMANCE

(data reflect per channel, passive crossover mode performance)

Frequency Response (1 Watt @ 1m)	
±3 db	55Hz to 19kHz
-10 dB	44Hz
Axial Sensitivity (dB SPL, 1 Watt @ 1m)	
Extended Range	90
Impedance (Ohms)	
Extended Range	5
Power Handling, AES Standard (Watts)	
Extended Range	200
Calculated Maximum Output (dB SPL @ 1m)	
Extended Range Peak	119.0
Extended Range Long Term	113.0
Recommended High-Pass Frequency	
24 dB/Octave	35Hz
Special	
Biamped Performance	See JF60 and SB120 Datasheets
Nominal Coverage Angle, -6 dB Points (degrees)	
Conical	110

Shown as one channel of an MM60 package.

PHYSICAL

Subwoofer Subsystem	1x 12-in, vented (per SB120)
LF Subsystem	1x 6.5-in cone, sealed (per JF60
HF Subsystem	1x 1.3-in soft dome driver on WGP Waveguide (per JF60)
Configuration	2 channel, 3-way, extended range, 4 enclosures
Powering	Switchable: extended range (passive sub/LF/HF crossover) or bi-amplified (passive LF/HF crossover)
Controls (switches, knobs)	Powering mode switch (per sub)
Biamplified Crossover	100Hz
Cabinet Type (shape)	JF 60:Trapezoidal SB120: Rectangular
Enclosure Materials	Baltic birch plywood
Finish	Black catalyzed polyurethane
Connectors	Per JF60:1x Neutrik NL4 Speakon and 2-terminal barrier strip / per SB120ixR: 2x Neutrik NL4 Speakon (1 input, 1 output)
Suspension Hardware	JF60: (6) 1/4"-20 threaded mounting points (1 each top and bottom, 4 on back for Omnimount Series 75)/(2) 5/16"-18 threaded mounting points on bottom for external ultimate brand support sstand
Grille	Vinyl coated perforated steel
Mounting Bracket	JF60 980001 wallmount bracket

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SPECIFICATIONS MM60

PHYSICAL

Dimensions	Inches	Millimeters
Height: JF60	14.625	371
Width (Front): JF60	7.875	200
Width (Rear): JF60	4.75	121
Depth: JF60	9.75	248
Height: SB120	22.5	572
Width: SB120	14.34	364
Depth: SB120	11.75	298
Trapezoid Angle: JF60	10 Degrees per Side	
Weights	**Pounds**	**Kilograms**
Net Wt: each JF60	17	7.7
Shipping Wt: each JF60	19.5	8.9
Net Wt: each SB120	53	24.1
Shipping Wt: each SB120	60	27.3
Shipping Wt: MM60	159	71.6

A & E SPECIFICATIONS

The three-way, two channel extended range loudspeaker system shall incorporate (per channel): a 12-in sub bass transducer, a 6.5-in LF transducer and a 1.3-in soft dome tweeter HF transducer. The total system shall incorporate two full range enclosures and two sub bass enclosures.

Each sub bass driver shall be mounted in a vented enclosure tuned for optimum low frequency response. Each LF driver shall be mounted in a sealed enclosure which also houses a HF driver. Each HF driver shall be mounted on an axis-symmetrical wave guide plate with a nominal coverage pattern of 110° (conical).

Each sub bass enclosure shall house an internal passive filter network providing sub bass/full range crossover. Each full range enclosure shall house an internal passive filter network providing LF/HF crossover.

System frequency response shall vary no more than ±3 dB from 55 Hz to 19 kHz measured on axis. In passive mode, the loudspeaker shall produce a Sound Pressure Level (SPL) of 90 dB SPL on axis at 1 meter with a power input of 1 Watt (per channel), and shall be capable of producing a peak output of 119 SPL on axis at 1 meter (per channel). It shall handle 200 Watts of amplifier power (AES Standard per channel) and shall have a nominal impedance of 8 Ohms (per channel).

The sub bass enclosures shall be rectangular in shape. The full range enclosures shall be trapezoidal in shape. All enclosures shall be constructed of 1/2-in thickness void-free cross-grain-laminated Baltic birch plywood and shall employ extensive internal bracing. They shall be finished in black catalyzed polyurethane. A switch allowing the user to choose between passive and bi-amped powering modes shall be installed on the back of each sub bass enclosure.

Input connectors on each LF enclosure shall be dual Neutrik NL4 Speakon (1 input, 1 output to full range satelite). Input connectors on each full range enclosure shall be a 2-terminal barrier strip and one Neutrik NL4 Speakon. A total of six 1/4"-20 threaded mounting points (1 each top and bottom, plus 4x on back configured to accept an Omnimount Series 75) shall be provided on each full range enclosure as well as two 5/16”-18 threaded mounting points designed to accomodate an external standmount adapter. The front of each enclosure shall be covered with a vinyl coated perforated steel grille backed with open cell foam to protect against dust.

The three-way, two channel extended range loudspeaker shall be the EAW model MM60.

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TECHNICAL SPECIFICATIONS JF60

DESCRIPTION

A 2-way full range system (passive LF/HF crossover) in a vented trapezoidal enclosure. Includes a 6.5-in woofer and a 33mm tweeter on a Wave Guide Plate™.

APPLICATIONS

The JF60 is engineered for exceptional performance in the nearfield from a compact enclosure. Surprisingly high output, exceptional fidelity. Very effective as a fill/delay elements in larger overall systems or for foreground/background music reproduction. Six year warranty.

Applications include:

Band PA	MultiMedia
Small Retail Spaces	Presentation Suite
Small HOW's	Theaters

DESCRIPTIVE DATA

Part Number	999051
Product Group	J
LF Subsystem & Loading	1x 6.5-in Cone
HF Subsystem & Loading	1x 33mm Soft Dome Tweeter on Wave Guide Plate™
System Configuration	2-way, Full Range
Powering Configuration(s)	Passive LF/HF Crossover
Recommended High-Pass Frequency (24 dB/Octave)	70Hz
Cabinet Type (shape)	Trapezoidal
Enclosure Materials	Baltic Birch Plywood
Finish	Black Catalyzed Polyurethane
Connectors	1x Neutrik NL4 Speakon 2-Terminal Barrier Strip
Suspension Hardware	(6) 1/4"-20 Threaded Mounting/ Suspension Points (1 each top and bottom plus 4 back for Omnimount Series 75), (2) 5/16"-18 Threaded Mounting/Suspension Points for external Ultimate Brand standmount adapter
Grill	Vinyl Coated Perforated Steel
Options	980007 Wallmount Bracket

NOMINAL DATA

Frequency Response (Hz)		
±3 db	84Hz to 18kHz	
-10 dB	55Hz	
Axial Sensitivity (dB SPL/1 Watt/1m)		
	90	
Impedance (Ohms)		
	5	
Power Handling (Watts)		
AES Standard	200	
Calculated Maximum Output (dB SPL, @ 1m)		
	119.0	
Long Term	113.0	
Nominal Coverage Angle / -6 dB points (degrees)		
Conical	110	
Recommended Complementary Systems		
Sub	SB120 / SB150	
Dimensions	**inches**	**millimeters**
Height	14.625	371
Width	7.875	200
Depth	9.75	248
Back Width	4.75	121
Trapezoid Angle	10 degrees per side	
Weights	**pounds**	**kilograms**
Net Weight	17	7.7
Shipping Weight	19.5	8.9

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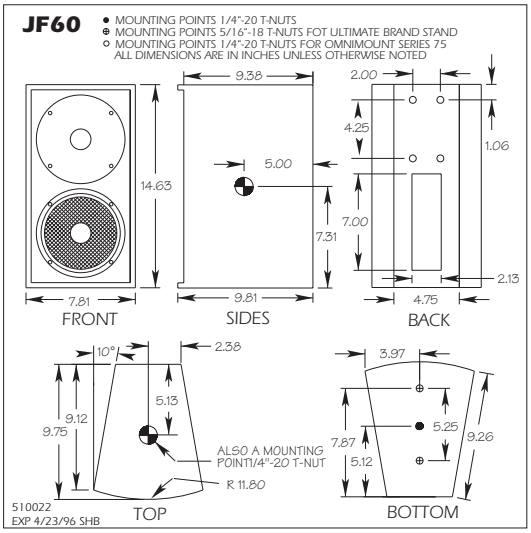
DIMENSIONAL DRAWING



SERVICE ITEMS

LF: Complete Cone Driver	
EAW Part No.	804003
HF: Complete Compression Driver/Tweeter	
EAW Part No.	805004
HF: Diaphragm Assembly	
EAW Part No.	806022
Filter/Crossover Network: Complete Assembly	
EAW Part No.	201315

ARCHITECTURAL SPECIFICATIONS

The two-way full range loudspeaker systems shall incorporate a 6.5-in LF transducer and a 35mm softdome tweeter HF transducer.

The system shall have a nominal coverage pattern of 110° (conical). An internal passive filter network shall provide fourth order acoustical crossover and system equalization.

System frequency response shall vary no more than ±3 dB from 84 Hz to 18 kHz measured on axis. The loudspeaker shall produce a Sound Pressure Level (SPL) of 90 dB SPL on axis at 1 meter with a power input of 1 Watt, and shall be capable of producing a peak output of 119 SPL on axis at 1 meter. The loudspeaker shall handle 200 Watts of amplifier power (AES Standard) and shall have a nominal impedance of 5 Ohms.

The loudspeaker enclosure shall be trapezoidal in shape. It shall be constructed of 15mm thickness void-free cross-grain-laminated Baltic birch plywood and shall employ extensive internal bracing. It shall be finished in black catalyzed polyurethane. Input connectors shall be a 2-terminal barrier strip and one Neutrik NL4 Speakon. The following mounting/suspension shall be provided: two 1/4"-20 threaded mounting/suspension points (1 each top and bottom); four 1/4"-20 threaded mounting/suspension points (back) to mount an Omnimount Series 75; two 5/16"-18 threaded mounting/suspension points mount an external Ultimate Brand standmount adapter. The front of the loudspeaker shall be covered with a vinyl coated perforated steel grill.

The two-way full range loudspeaker shall be the EAW model JF60.

TECHNICAL SPECIFICATIONS MK2194

DESCRIPTION

A 2-way full range system (passive LF/HF crossover) in a vented trapezoidal enclosure. Includes a 12-in woofer and a 1.4-in exit/44mm voice coil compression driver on a user-rotatable 90 x 45 constant directivity horn.

APPLICATIONS

The proprietary beamwidth matching design employed in the MK2194 provides even off-axis frequency response (smooth power response) in a cost-effective 2-way system. The versatile, compact enclosure features a comprehensive system of 3/8"-16 threaded mounting/suspension points, letting it be mounted horizontally or vertically. Simply rotate the horn to maintain the desired coverage pattern. All MK2000 Series loudspeakers are of identical dimensions and the entire MK Series is 30-in high, creating a uniform look throughout a large installation. Six Year Warranty.

Application include:

Stadiums
Arenas
Large HOW's
Small HOW's
Dance Clubs
Live Music Clubs

DESCRIPTIVE DATA

Part Number	999534
Product Group	I
LF Subsystem & Loading	1x 12-in vented
HF Subsystem & Loading	1x 1.4-in exit/44mm voice coil compression driver on a constant directivity horn
System Configuration	2-way, Full range
Powering Configuration	Passive LF/HF crossover
Recommended High-Pass Frequency (24 dB/Octave)	50 Hz
Cabinet Type (shape)	Trapezoidal
Enclosure Materials	Baltic Birch plywood
Finish	Black catalyzed polyurethane
Connectors	2-terminal barrier strip
Suspension Hardware	(13) 3/8"-16 threaded mounting/ suspension points (3 each on top and bottom, 2 per side, 3 on rear)
Grill	Powdercoated perforated steel
Options	WP - weatherproof version White - white polyurethane finish

NOMINAL DATA

Frequency Response		
	±3 db	70 Hz - 17 kHz
	-10 dB	60 Hz
Efficiency / Axial Sensitivity (dB SPL/1 Watt/1m)		
		97
Impedance (Ohms)		
		8
Power Handling (Watts) AES Standard		
		400
Calculated Maximum Output (dB SPL)		
	Peak	129.0
	Long Term	123.0
Nominal Coverage Angle / -6 dB points (degrees)		
	Horizontal	90
	Vertical	45
Dimensions	**inches**	**millimeters**
	Height	30.00 762
	Width	15.54 395
	Depth	14.75 375
	Back Width	8.23 209
	Trapezoid Angle	15 degrees per side
Weights	**pounds**	**kilograms**
	Net Weight	55 25.0
	Shipping Weight	67 30.4

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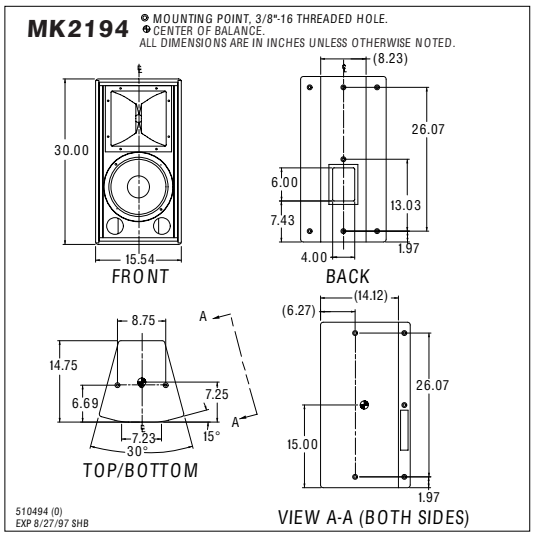
TECHNICAL SPECIFICATIONS MK2194

DIMENSIONAL DRAWING



SERVICE ITEMS

LF: Complete Cone Driver	
EAW Part No.	804051
HF: Complete Compression Driver/Tweeter	
EAW Part No.	803041
Filter/Crossover Network: Complete Assembly	
EAW Part No.	202325/202326

ARCHITECTURAL SPECIFICATIONS

The two-way full range loudspeaker systems shall incorporate 12-in LF transducer and a 1.4-in exit/44mm voice coil compression driver HF transducer.

The LF driver shall be mounted in a vented enclosure tuned for optimum low frequency response. The HF driver shall be loaded on constant directivity horn with a nominal coverage pattern of 90° (h) x 45° (v). An internal passive filter network shall provide fourth order acoustical crossover and system equalization.

System frequency response shall vary no more than ±3 dB from 70 Hz to 17 kHz measured on axis. The loudspeaker shall produce a Sound Pressure Level (SPL) of 98 dB SPL on axis at 1 meter with a power input of 1 Watt, and shall be capable of producing a peak output of 130 SPL on axis at 1 meter. It shall handle 400 Watts of amplifier power (AES Standard) and shall have a nominal impedance of 8 Ohms.

The loudspeaker enclosure shall be trapezoidal in shape. It shall be constructed of 15mm thickness void-free cross-grain-laminated Baltic Birch plywood and shall employ extensive internal bracing. It shall be finished in black catalyzed polyurethane. Input connector shall be a two-terminal barrier strip. The following mounting/suspension hardware shall be provided: A total of thirteen 3/8"-16 threaded mounting/suspension points (three each on top and bottom, two per side, three on rear) shall be provided. The front of the loudspeaker shall be covered with a powerdercoated perforated steel grill.

The two-way full range loudspeaker shall be the EAW model MK2194.

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