SYNERGETIC
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newsletter

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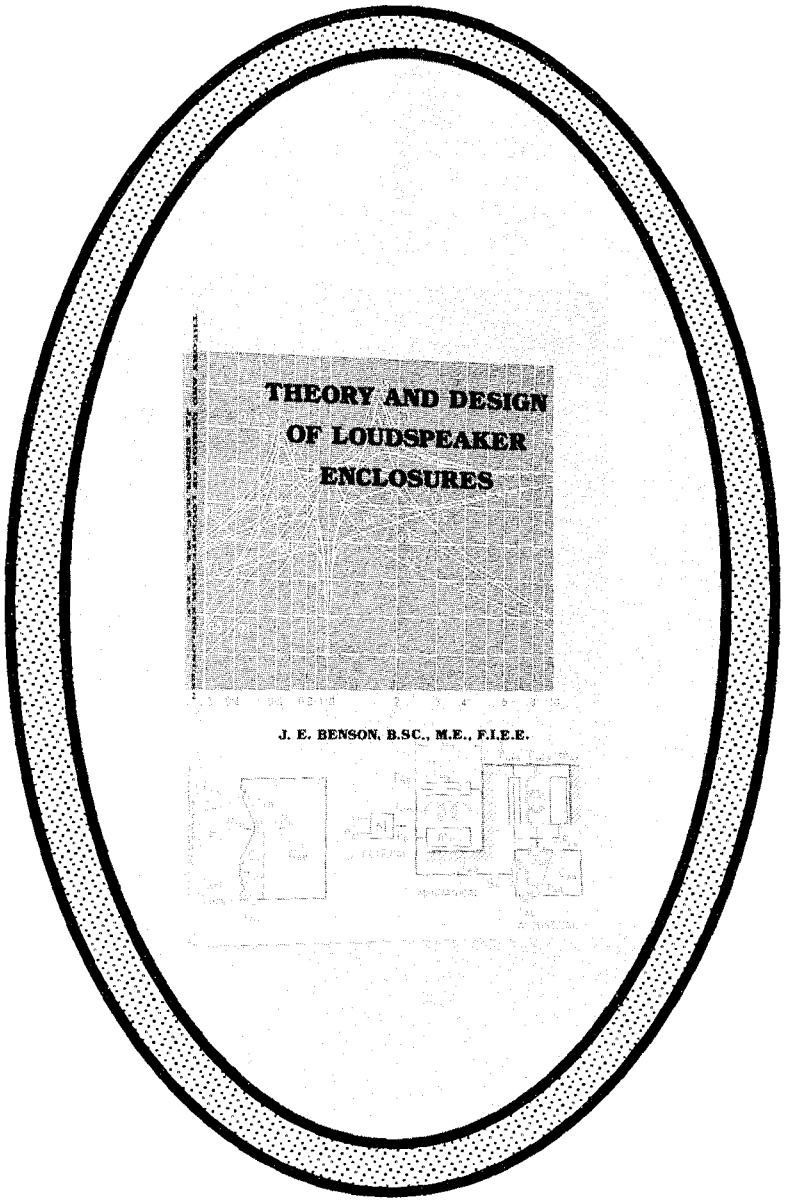
Syn-Aud-Con Publishes First Book—



Theory and Design of Loudspeaker Enclosures

by
J. E. Benson

SYNERGETIC

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AUDIO CONCEPTS

EXCHANGE OF IDEAS

I met a man with a dollar
We exchanged dollars
I still had a dollar

I met a man with an idea
We exchanged ideas
Now we each had two ideas

Synergetic: Working together; co-operating, co-operative.

Synergism: Co-operative action of discrete agencies such that the total effect is greater than the sum of the two effects taken independently.

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The information conveyed in this NEWSLETTER has been carefully reviewed and believed to be accurate and reliable; however, no responsibility is assumed for inaccuracies in calculations or statements.

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When Do I Renew?

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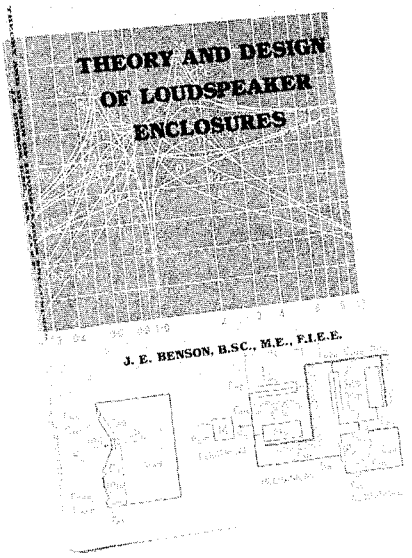
Theory and Design of Loudspeaker Enclosures

by J.E. Benson



We first met Dr. J. Ernest Benson on our 1988 trip to Australia. We made a deliberate pilgrimage to his home (he was retired) to tell him how much we respected his writing on Sound System Equalization (1969): "A Feedback-Mode Analyzer-Suppressor Unit for Auditorium Sound System Stabilization," written with co-author Donald F. Craig. In this paper he demonstrated the step function behavior of systems going into and coming out of acoustic feedback. Along with Conner and Rudmose, Benson's paper was one of the few with both correct theoretical conclusions and the illustration of actual useful hardware for carrying out the theory.

In the course of our visit we became aware that his papers, "Theory and Design of Loudspeaker Enclosures," had not been published in the United States and immediately negotiated to acquire the right to publish them - in hopes that we could interest a publisher in the United States in publishing the book.

The papers were originally published in three parts in *Amalgamated Wireless Australasis Technical Review* in 1968, 1971, and 1972. The three parts are reproduced here just as they were printed, each with its own Table of Contents.

Dr. Benson wrote us re Richard Small, "Much of Dick's work was done with an analogue simulator whereas all my results were obtained by digital computer from theoretically derived equations." In the world of audio professionals and amateurs replete with fast computers, math programs like MathCad and Mathematica, a computer approach to design rather than an analogue is an appropriate one.

Don Keele wrote about *Theory and Design of Loudspeaker Enclosures*, "It is a classic, and even more comprehensive and detailed than Thiele and Small's loudspeaker papers as published in the *ASA Journal* (if you can believe that!). He goes into an exhaustive analysis of the infinite-baffle, closed-box, damped vented-box, passive-radiator vented-box, and the acoustic-resistance controlled systems. The papers are very instructive and a *must read* for anyone seriously interested in low-frequency cabinet design.

"It includes the only complete mathematical model and formula that includes all the previously mentioned systems that I know of! It includes both analysis and synthesis of all the systems, including innumerable design tables, charts and graphs. The color graphs and tables are stunning! Its very mathematical but written in an easy-to-understand manner. I highly recommend it!"

Dr. Benson was the examiner for Richard Small's PhD thesis and truly was the Australian "Olson."

We want to thank those who encouraged us to publish the Benson papers after a fruitless search for a publisher.

Dr. Patronis Has Done It Again!

He has found a way to unwrap the driver response from the horn's response.

Gene Patronis has done it again! He has found a way to unwrap the driver response from the horn response and allow us to see the pure unadulterated horn response (i.e., what the horn does when presented with a perfect input).

Gene used his SYSid analyzer along with MATLAB, a math program, to unwrap the drivers from these horns. We'll be writing more on this later and we will be telling you about an upcoming Workshop on the subject.

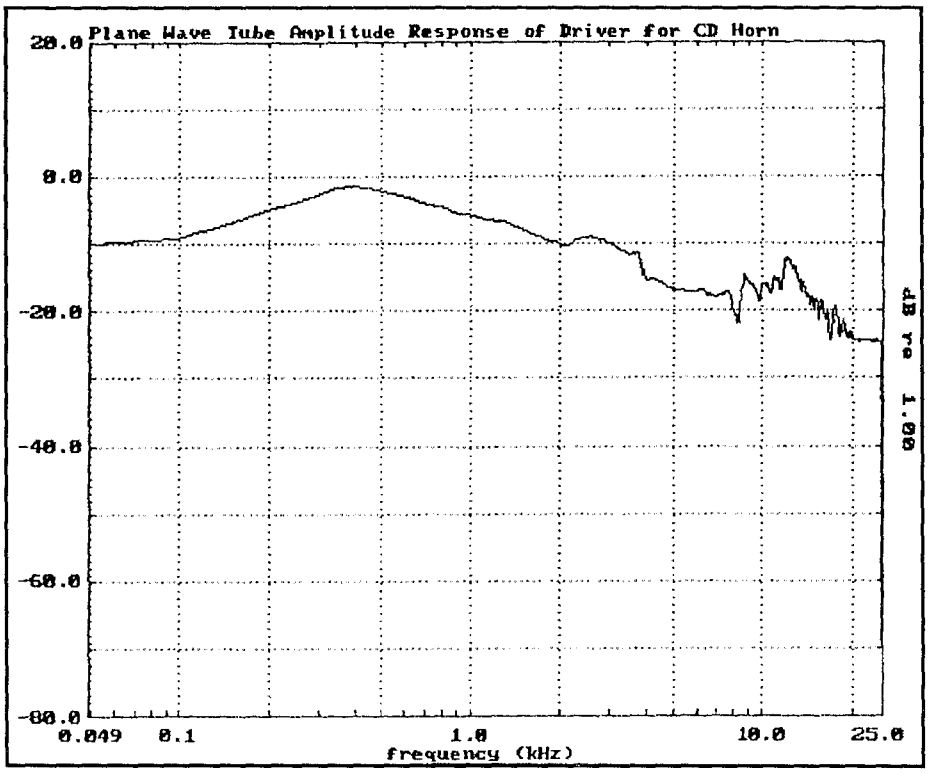


Figure 1 is of a driver on a plane wave tube that will later be mounted on a constant directivity horn. While only the magnitude is shown here the impedance is also measured.

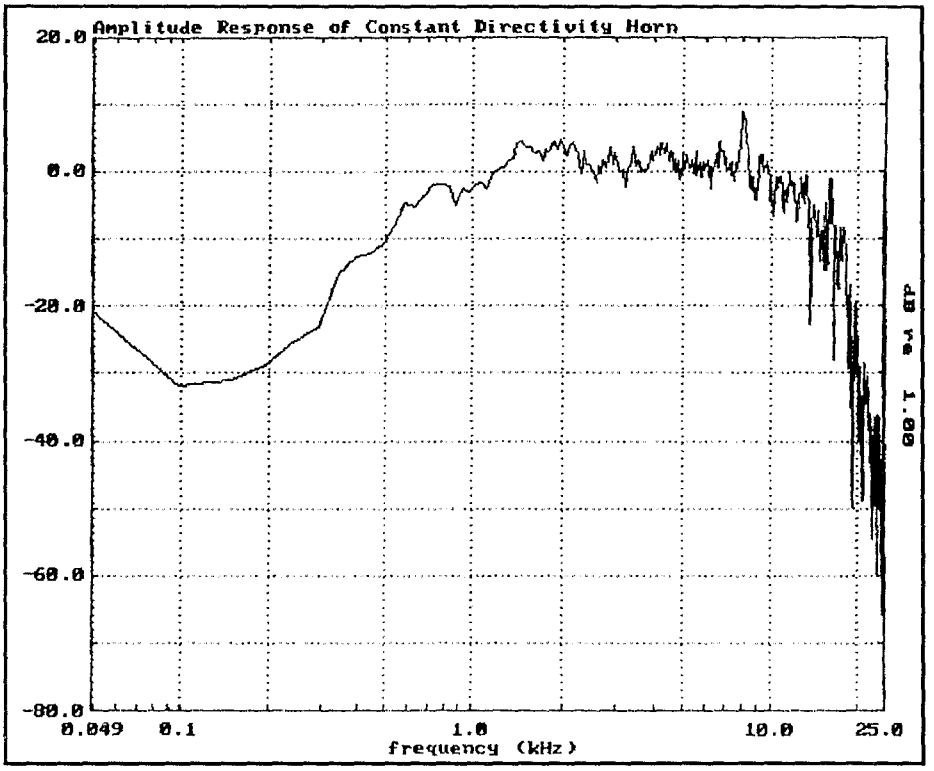


Figure 2 is the response of the horn itself minus the influence of the driver. Notice how reflective the horn is at higher, shorter wavelength frequencies.

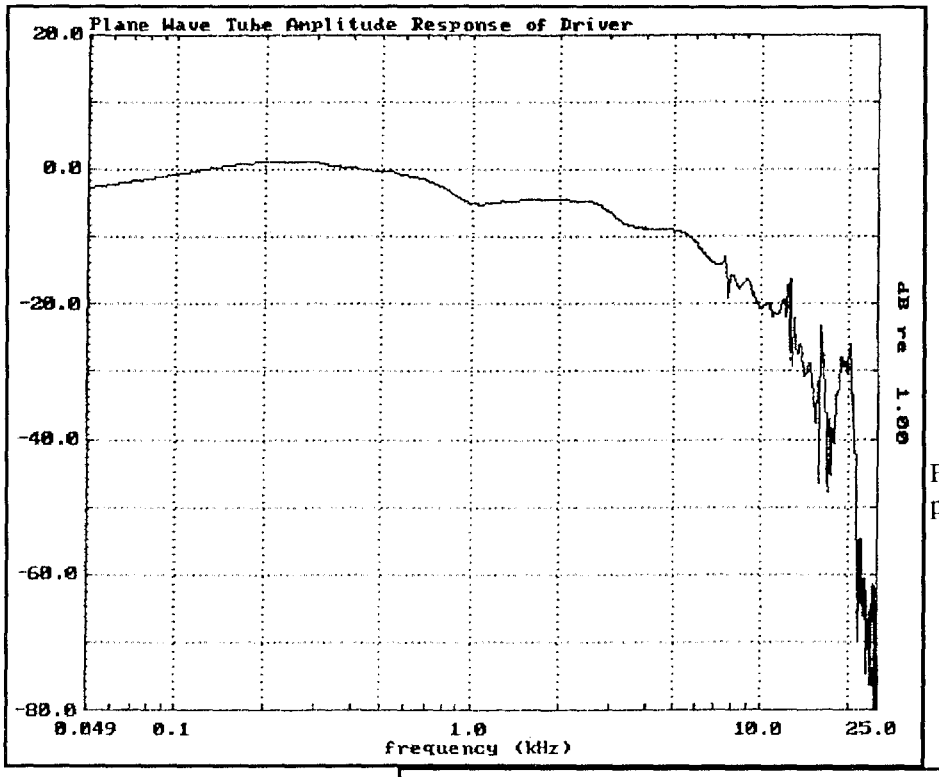


Figure 3 is another driver on the the plane wave tube (magnitude only).

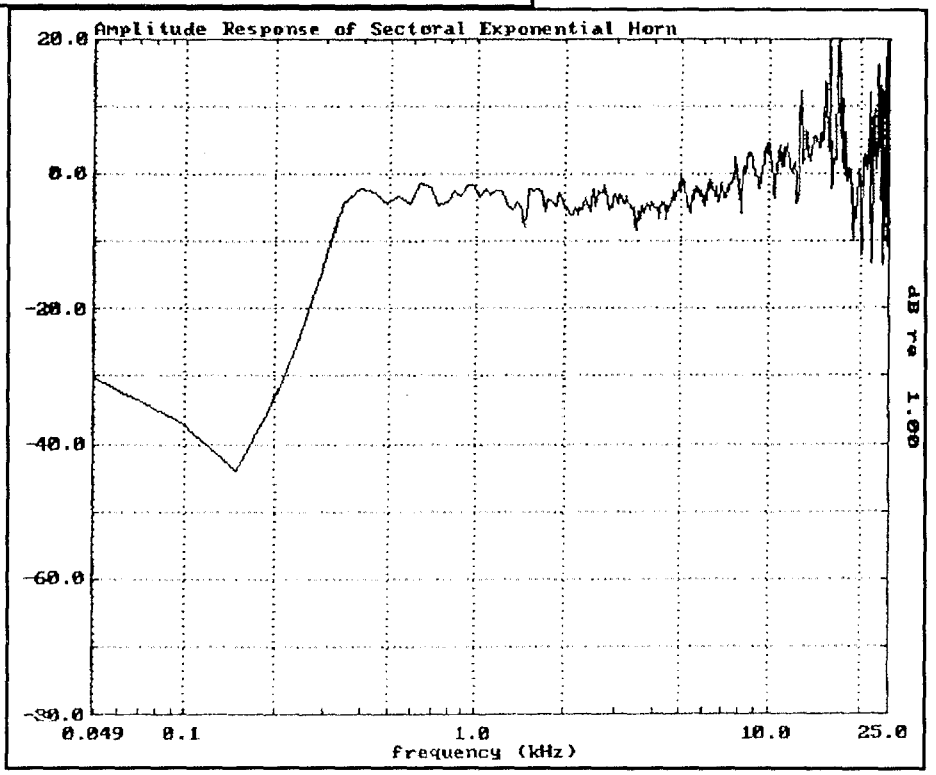


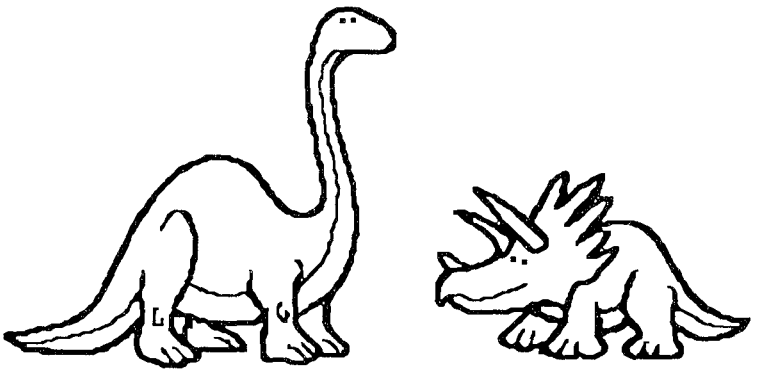
Figure 4 is a sectoral exponential horn minus the influence of the driver.

When we made the decision to publish J. E. Benson's work, *The Theory and Design of Loudspeaker Enclosures* we called Gene Patronis to tell him and to ask if he would consider letting us publish his book if we were successful in distributing Mr. Benson's book. Gene said that he would be interested. Then said that he would have to get to work on the book again.

Within days of that conversation, Dr Patronis called to say that he had measurements that he thought we would like to see. He faxed them to us and Don was very excited and said that they should go into the Newsletter. Dashia, our layout artist, reduced it all to one page. When Don proofed it he came out of his office saying that such great work should not be reduced so much. He said that he had never seen these measurements before and doubted that anyone else has!

Gene's measurements open up a whole new world of measurements - and the subject of an upcoming Workshop.

"Jurassic Park" at the Lorraine Theatre



Readers of the Newsletter know that we really like good movie theater sound, having written about Dr. Patronis' outstanding work for AMC theaters and John Allen's HPS-4000™ sound systems.

In the Summer 1992 issue of the Newsletter we wrote about the marvelous experience of hearing a John Allen HPS-4000 system in Hoopeston, IL - a very small town surrounded by corn fields. Gregory Boardman, who works at NBC in Burbank, is living out his dream by remodeling the old Lorraine Theater in his home town with the best equipment he can find.

Someone sent us a fax of another writeup on the Lorraine Theatre written by Mark Swincher that I thought would be fun to share.

"A couple of weeks ago I took my 10-year-old stepson to see *'Jurassic Park'* at the Lorraine Theatre. He was so excited about seeing it -- it was funny to watch him get worked up.

"Then we got inside, and they played that digital sound demonstration after a 'Road Runner' cartoon.

"I was totally blown away. The sound was amazing. It was the first time I had watched a movie in Lorraine, and I was really surprised. Of all the movies I have seen outside my home, 'Jurassic Park' was one of the best, and I must admit the sound system inside Lorraine helped make it as good as it was.

"I have been in at least 50 different movie theaters, and never have I heard a sound produced like that.

"In the case of 'Jurassic Park,' I can only say I hated to see it go. It was here for four weeks, and I saw it twice. But that show was made for our Lorraine Theatre.

"The dinosaurs were as alive as the people in that movie, and that sound system put them right up in your face, right beside you and right behind your. And you just couldn't escape the terrifying roar of that T Rex. Even with your eyes closed, you were going to be very scared.

"Jurassic Park" at the Lorraine Theatre: a match made in movie heaven."

If you haven't read about the Lorraine Theatre, go back to Newsletter Vol #19N4 and read about it. John Allen uses Klipsch loudspeakers for the main system and Gillum Loudspeakers for the surrounds. But there is a lot more to a John Allen system than good loudspeakers! It is said that John's two good ears hooked to an excellent analyzer between his ears is a major reason, aside from the good equipment that he uses, for the success of his theatre sound systems.

John has some interesting ideas about pink noise and equalization. We want to discuss his concepts with Dr. Patronis, then we will write more about his ideas in a future issue. cd

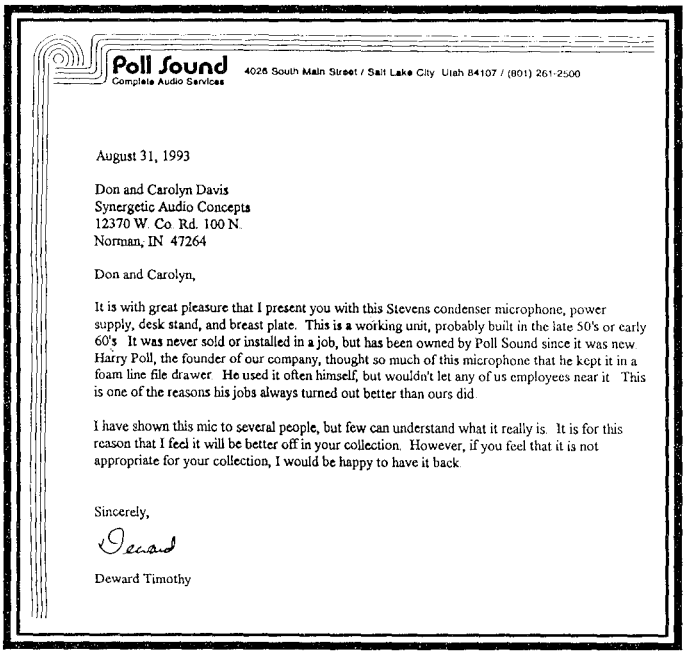
"Consciousness is beautifully complex"

"If all that exists in my brain are a chain of complex chemical processes, why do I care what those processes are?

"My chief scientific interest in the last 20 years has been to somehow extend theoretical physics into the realm of consciousness. Some scientists call consciousness a common place, and a subjective one at that. But consciousness is beautifully complex. It has never been properly described, certainly not by physics or mathematics."

Eugene P. Wigner, the great atomic physicists who still lives.

Stephens Microphone —A Treasure—



Poll Sound
Complete Audio Services
4026 South Main Street / Salt Lake City Utah 84107 / (801) 261-2500

August 31, 1993

Don and Carolyn Davis
Synergetic Audio Concepts
12370 W. Co. Rd. 100 N.
Norman, IN 47264

Don and Carolyn,

It is with great pleasure that I present you with this Stevens condenser microphone, power supply, desk stand, and breast plate. This is a working unit, probably built in the late 50's or early 60's. It was never sold or installed in a job, but has been owned by Poll Sound since it was new. Harry Poll, the founder of our company, thought so much of this microphone that he kept it in a foam line file drawer. He used it often himself, but wouldn't let any of us employees near it. This is one of the reasons his jobs always turned out better than ours did.

I have shown this mic to several people, but few can understand what it really is. It is for this reason that I feel it will be better off in your collection. However, if you feel that it is not appropriate for your collection, I would be happy to have it back.

Sincerely,

Deward

Deward Timothy

We are most grateful to Deward Timothy of Poll Sound in Salt Lake City for the addition of the Stephens microphone to our audio museum. We will treasure it. (Stephens is pronounced Stevens.)

I met Bob Stephens in the 1950s through Paul Klipsch who used Bob's microphones for his early stereophonic recordings. When I later went to work for Paul Klipsch, I found he used the same microphones for his measurement work. During those years, the Klipschorns used Stephens' woofers, as well.

John Hilliard, Bob Stephens, Jim Lansing and Doug Shearer all worked together at MGM the year they won the Academy Award for Sound. I believe it was 1937. John Hilliard was the engineer, Bob Stephens the draftsman, Jim Lansing the machinist, and Doug Shearer was the director of the Sound Department at MGM.

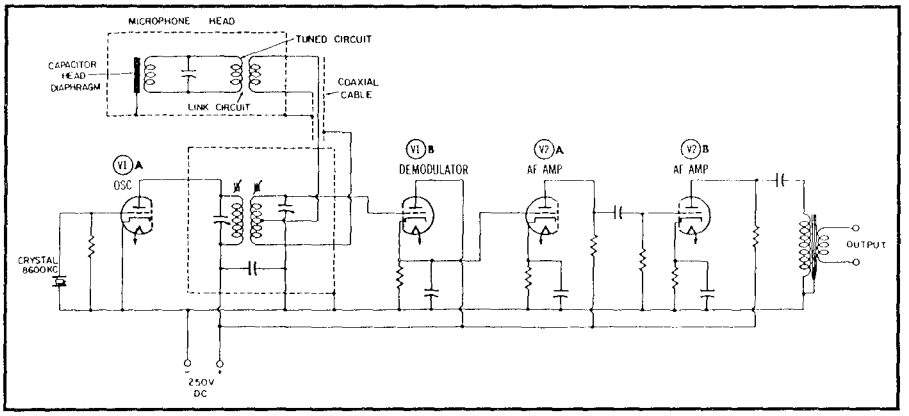
These were all remarkable men during a remarkable time and their accomplishments deserve the respect we give the artifacts they have left behind.

Deward Timothy during the Audio Measurements Workshop working with Steve Roth during a break.

The Stephens microphone is an amplitude modulated capacitor type which utilizes the advantages of the capacitor microphone in a circuit which does not require a preamplifier at the microphone itself.

This Stephens microphone requires no polarizing voltage (as does conventional condenser microphones) which allows the diaphragm to be spaced closer to the back plate, thus increasing sensitivity. The head assembly contains a resonant circuit link coupled to a crystal controlled oscillator. Tuning is provided by the capacity of the head to a frequency that is approximately that of the crystal oscillator. Pressure changes at the diaphragm causes changes in the capacity of the head and shifts the frequency. A demodulator (detector) converts the frequency changes to audio frequencies which are then amplified in the usual way. Figure 1 is the schematic diagram for this unusual microphone.

We asked Jim Hunter at Klipsch & Assoc. if they had anything in the file about the use of the C-1 Stephens microphones in the 1950s. Jim sent a photocopy of a 1955 Stephens Newsletter telling about Mr. Poll and Austin, Inc. of Salt Lake City, supplying the C-1 microphones for a 14,000 mile European tour with the Mormon Tabernacle choir. "In countries which use, almost exclusively, condenser type microphones for all their work, station engineers were literally amazed at the compact size of the microphone, the small diameter of cable required, and the outstanding performance of the C-1." Jim even found the instructions for the Stephens C-1, showing that the Klipsch files are a rare resource



Improvements in Audio During the Last Decade

In acoustics the past ten years have led to wonderful improvements in loudspeakers (the Community M-4 being an outstanding example), signal synchronization, RPG diffusors, control of unwanted reflections via vastly improved directivity control of horns, and our ability to observe the room system interaction.

The pressure zone concept has led to many successful designs in difficult environments.

The wide acceptance of TEF analysis has led to less and less frauds being sold to the users of test equipment.

Audio "sub-cultures", where flying saucer loudspeakers and other "magic" solutions abound, leave us a huge audience in need of the truth. The conversion of these audio-acoustic pagans is a born-again experience for the lucky student.

The basics of audio and acoustics —the dB, levels, impedances, circuit configurations, room acoustics and electroacoustics—remain fresh, vital subjects just as applicable today as they were ten years ago.

Raw Talent

Scott Potosky from Crown International attending our Sound System Engineering seminar at the farm, May, 1993.

"Yes, But You Had Better Try!"

We were told about an AES meeting in New York in which the subject was Signal Alignment. During the Question and Answer period some professor is supposed to have said that it is not possible to have a sound system in perfect alignment, to which someone in the audience said, "Yes, but you had better try!"

June Farm Seminar—1993

An Alternative to the Hand-Clap

by Pat Brown

The computer age has provided us with many sound system evaluation tools that our predecessors only dreamed of. The great audio practitioners of the past were, for the most part, limited to the test instrument attached to their shoulders, namely, the ear-brain system. Yet even with the advent of microprocessors and other technological advancements, the ear is still the best tool we have for sound system work. Used in conjunction with a stimulus, the ear-brain system can detect any problem that is a problem. It is only then that we can use our modern audio microscopes to take us to vantage points beyond the reach of our hearing.

When armed with a microprocessor-based test system, the first temptation is to measure something. But what do we measure? The answer to that question takes us back to the measurement system that we were born with. First, we must listen. But what do we listen to? Fortunately we have a pretty good pair of room exciters attached to the ends of our arms. A hand-clap can reveal much about the acoustics of an enclosed space, and this truth has made it a popular choice for sound system work. Let's look at the advantages:

It is cheap.

You don't have to run out to the truck to get it, and there is virtually no danger of leaving it at the shop or the last job site.

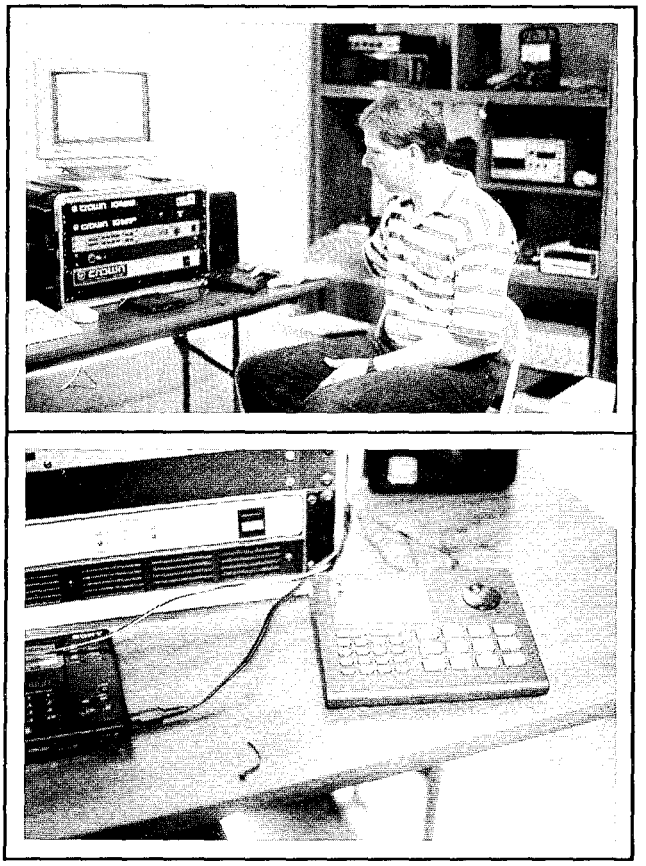
- ❖ It can be invoked at will, at any location in the room, without the need of an assistant.
- ❖ It's relatively short time duration allows echoes to be easily detected. In spite of it's merits, the hand clap method also has some serious shortcomings:
- ❖ The test stimulus is not originating from the loudspeaker location, and is therefore exciting surfaces that the sound system may not, or, is not exciting surfaces that the sound system will.
- ❖ Extended test periods can lead to equipment failure. (your hands get sore.)

Here is one method that retains many of the merits of the hand-clap, and offers a few of it's own. A small, battery-powered drum machine makes an excellent source for impulses. Used in conjunction with a wireless transmitter/receiver, it is possible to impulse the room from any location. Some benefits include:

- ❖ Full control of the test signal from the listening position.
- ❖ Excitation of the room through the sound system only. No sound emanates from the machine itself, allowing a better evaluation of the sound system/room combination.
- ❖ The availability of a variety of bandpass impulses.
- ❖ Coarse evaluation of the size of the reflecting surface, based on the impulse used. Snare drums and sticks will be reflected by relatively small surfaces (they have short wavelengths), while bass drums and floor toms require much larger surfaces for reflection.

The possibilities go on and on. I have gone a step farther and interfaced a portable CD player in the same manner. Now our portable test stimuli can include pink noise, sine waves, swept sine waves, modified rhyme tests, gun shots, and music, etc. I have placed both devices on a board with a selector switch. The headphone outputs of these devices provide us with variable output level. And since no room evaluation is complete without the phrase, "testing 1,2,3", a hand-held vocal mic/transmitter on the same frequency adds this capability. Add a piece of 4' X 4' Sonex and you now have a complete room evaluation system.

At this point we revert back to our ear-brain system, better equipped to provide it with meaningful data. The ear-brain system will then reward us with pre-qualified test positions to evaluate with our TEF or FFT analysis systems.



Controlling The Direct Sound Level L_D

As I studied John Prohs' "A Procedure for Sound System Design," I saw that it was worthwhile to share in the Newsletter; plus it started my thinking.

The two major considerations in the control of L_D are the directivity factor (Q) of the loudspeaker and its L_W (controlled by how much electrical power it receives from the power amplifier.)

When all of the audience is within or right at critical distance (D_C), the levels at the listeners' ears can be adjusted, where appropriate, by varying the electrical power to the loudspeaker or loudspeakers. The most common case being distributed systems where differing ceiling heights are compensated for by changing taps on the 70 volt transformers.

When a goodly portion of the audience is beyond D_C changing the L_W of loudspeakers becomes less attractive as the loudspeaker with the highest L_W controls the entire reverberant sound field L_R. The desired goal where a reverberant sound field is significant throughout the audience area is to insure that the ratio of D/R energy remain constant everywhere in the audience area. This is best attained by maintaining the same L_W at each loudspeaker and adjusting the required L_D by judicious selection of the loudspeakers on axis Q and its basic coverage angles.

When the correct Q for a given percentage of articulation loss of consonants (%ALcons) for a *single* loudspeaker, as audited at the furthest seat from the loudspeaker (D_2), is obtained by calculation or by test,you can then design for all the audience locations. While coverage angles don't define Q (because -6dB points don't describe how large or small their side and/or back lobes are) the ratio of D/R varies directly with variations in coverage. Expressed in decibels the ratio D/R becomes $L_D - L_R$.

Finally the N factor has to be kept track of. This is one of the most neglected parameters in electroacoustic design programs. N can be defined as the ratio of acoustic power (W_a) generated by the sound sources providing the listener L_D to the total acoustic power W_t of the entire system

$$10\left(\frac{L_{WD} - L_{WT}}{10}\right) = N$$

Reverberation Time RT_{60} vs Reverberation Level L_R

The reverberation time for 60dB of decay RT_{60} is the traditional tool of acousticans. It is the measurement of the time it takes the *reverberant sound field* L_R to decay 60 dB once the sound source has been turned off. Typical practice is to measure 20 to 30 dB of decay and extrapolate the data to 60 dB (this is due to the fact that most reverberant spaces are noisy and to go more than 30 dB above the noise is to take a chance of damaging the test source).

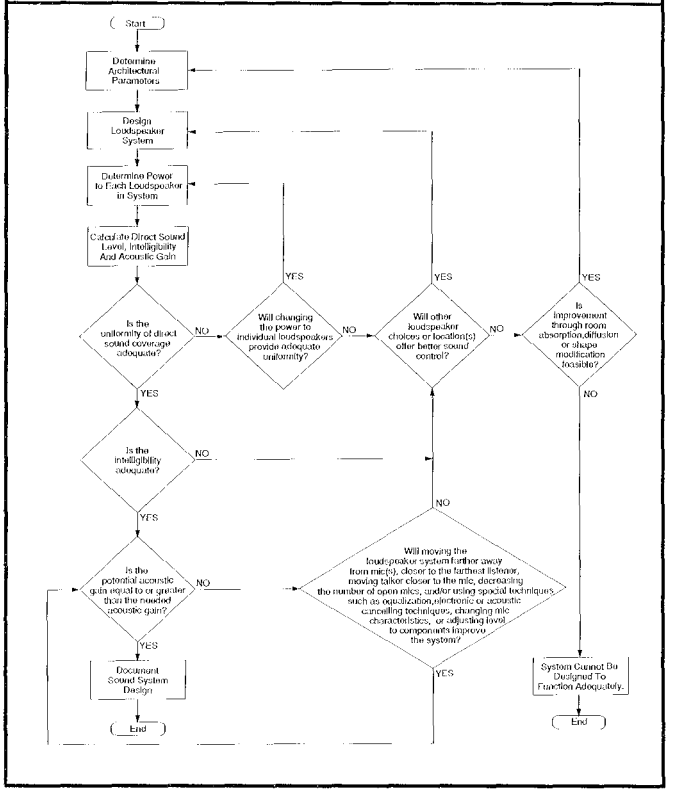
What is of far greater importance to sound system designers is the level of the reverberant sound field L_R. In many venues the ambient noise level L_{AMB} at the 2000 Hz one octave band is from 40 to 50 dB. Anytime the designer can lower the L_R to within a few dB of the L_{AMB} it ceases to have the same significance as an identical L_R 30 dB above L_{amb}. A very common solution is to raise LD by increasing Q followed by a reduction of L_D back to its original value by lowering L_W. This in turn lowers L_R closer to L_{AMB} and the listener subjectively feels the environment is less reverberant (even though the theoretical RT_{60} has remained unchanged).

On your next system take a moment to review these basics and hear the results.

A Procedure For Sound System Design
by John Prohs

NOM is the number of open microphones and 6 dB is the feedback stability margin (FSM). If PAG's is less than NAG then several solutions are possible for increasing PAG and/or decreasing NAG. The cluster can be moved farther from the microphone (D_1) or closer to the farthest point (D_2), the talker can be required to speak closer to the microphone (D_2), the number of open microphones can be decreased (NOM), or you can compromise intelligibility and increase the equivalent acoustic distance (EAD).

By calculating the direct sound level, intelligibility and acoustic gain at various locations in the room a performance analysis of the sound system is complete.



EAW Acoustical Performance Partnership Program

by Pat Brown

The advent of computer-based measurement systems has raised the awareness of both consultant and contractor alike. Modern measurement tools have identified the loudspeaker as the "weak link" in the audio chain. Used individually, the loudspeaker is the only part of the signal chain (aside from the microphone) who's specifications are guaranteed to vary widely with frequency and input power. Array them in a cluster and the problem gets worse. A great deal of data is required to choose the right loudspeaker for a given application.

Manufacturers are often asked to provide very simple answers to very complex questions. Most quoted loudspeaker specifications are gross oversimplifications of very complex answers.

Suppose a prospective tourist asked the question, "What is the temperature in the United States?" An accurate one-word answer is an impossibility. At best, an average could be taken and provided as a guideline, although our prospective tourist is in for some real surprises upon their arrival.

It is equally difficult to answer questions that pertain to loudspeakers. Every question requires another question. For instance:

What is it's frequency response? - At what power rating?
What is it's Q? - At what frequency?
What is it's impedance? - At what frequency?
What is it's power rating? - With whose amplifier?

The point is, that to provide meaningful specifications for a loudspeaker product, a wealth of information is necessary. Eastern Acoustic Works has introduced a solution to this problem with the introduction of the Acoustical Performance Partnership program. The APP is designed to provide dealers and consultants with a more complete look at the performance of their loudspeaker products.

A few of the measurements include:

-Horizontal polars at 1/3-octave intervals
-Vertical polars at 1/3 octave intervals
-Axial frequency response
-Off-axis response normalized to axial response
-Full-range impedance plots
-Beamwidth vs. frequency (Graph and tabular)
-Q vs. Frequency (Horizontal and vertical, Graph and tabular)
-Efficiency vs. Frequency
-THD vs. Frequency (at 1% and 10% power input)
-Energy-Time curves are promised with the next release

In addition to the measurements, EAW also includes a variety of mechanical drawings in the .DXF format, for importation into CAD programs. Depicted in the drawings are:

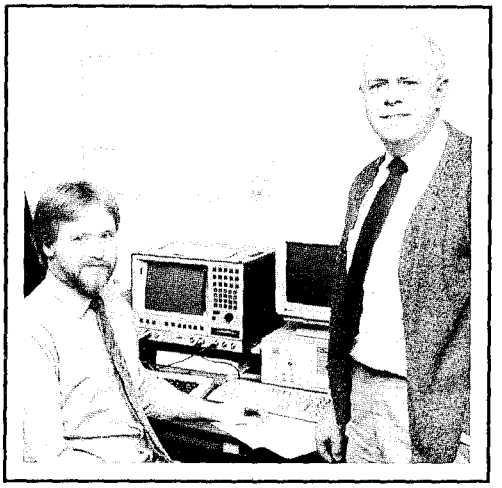
-Cabinet dimensions
-Front and side views
-Location of fly-points
-Location of input jacks
-Input panel layouts
-Hanging hardware

The architectural specifications are provided in text format for importation into your word processor. The measured data is provided in formats compatible with EASE, CADP2, and Modeler. I imported the data for the KF300 loudspeaker into Quatro Pro for Windows and was immediately presented with the performance data in both tabular and graph format. All equipment drawings are provided in a variety of file formats including EPS and Vellum-Metafile.

The disk-based specifications and drawings are a welcome development, since most of us have more paper than we know what to do with. Hard disk drives are about as cheap as file cabinets, and they certainly occupy less space. Add a laser printer and you can have presentation quality spec sheets at the touch of a button.

EAW is to be commended for their insight into the needs of consultants and contractors, and we hope that this type of program will be emulated by other manufacturers.

For more information on the Acoustical Performance Partnership Program, contact Eastern Acoustic Works.



EAW Vice President of Engineering, Kenton G. Forsythe, & Senior Design Engineer, Michael Chamness

IRP Progress Report

Editor's Note:

As we walk the aisles at NSCA, we meet with a lot of audio manufacturers and we spend the time to get a product update. When we got to the IRP booth, Brian Benn, General Manager, and the IRP crew were covered over with customers so we asked Brian to send us a progress report when they got time. Norm Kinnaugh sent us the following, and we found it so interesting we thought we would share it with you just as it came to us.

IRP Professional Sound Products prides itself as a company who listens to the many good ideas from both the audio/acoustics consulting community and its widely varied customer base. In response to their many excellent suggestions, IRP has been involved in a complete re-engineering of their entire product line over the past few years. The modules in the System 41 family are in an evolution toward greatly enhanced "Installer Friendliness" and "User Friendliness". As an example of the project, when each module is redesigned, simple pin-jumpers are used for all user programmable features in the product. These pin-jumpers replace all "programmable" solder jumpers in the original product architecture. Simultaneous to the re-engineering, the product literature is thoroughly reviewed and revised for clarity, simplicity and accuracy.

The newly released model DE-4024E standalone 4-channel Voice-Matic Mixer with DE-209E Remote Control also follows the identical re-engineering philosophy. The mixer features simple DIP switches for phantom power, 14dB input pad, and low-cut filter bypass for each automatic input channel. One channel is convertible to line input levels for use with a wireless microphone receiver. All audio inputs and outputs used fast, reliable, pheonix connectors. Specifically for connection to teleconferencing hybrid devices, one of the Auxiliary inputs is defeatable from the Auxiliary Output mix. Under these conditions, the telephone hybrid output signal to this Aux input will route to the Main (Automix) Output and to the conference room loudspeakers. The Aux Output signal is used for the input to the telephone hybrid. Since the Aux Output doesn't contain the Aux Input, this "Mix-Minus" connection prevents an electrical feedback path between the DE-4024E and the telephone hybrid. The DE-4024E also includes "Last Mic Hold" capability for the continuity of room ambience in tape recordings or other media distribution, plus a clearly written and organized data/installation manual.

In other IRP product news, the DJ-4135 and DJ-4136 precision delay modules for the System 41 are now in regular production. *These modules feature 3.9 microsecond resolution* and are available with optional fourth-order Linkwitz-Riley output filters, implementing the crossover filter function after the signals are delayed. The DJ-4135 includes a Time = Zero Reference Output compensated for the internal 24 microsecond A/D/A conversion delay. These precision delay modules are also available with an option of 4 presets for each output. The presets are individually addressable, and have resolution of 1 millisecond each. The delay value of each preset is added to the (3.9 microsecond resolution) precision adjustments. This allows multiple clusters to be individually TEF aligned, and then Haas effect compensated for various microphone source locations.

In October 1992, Dr. Jacek Figwer contacted IRP about using IRP signal delay modules for the public address in the January 1993 Presidential Inauguration Ceremony. Ten outputs were used, ranging from 40 milliseconds to 1652 milliseconds. After the ceremony, IRP was informed that everything worked perfectly. No further readjustments were necessary, with the exception of revising the setting of a loudspeaker which was moved to a different location. Dr. Figwer very favorably compared this to a negative experience during a previous inauguration where he had used delays from a different manufacturer, and had found that the displayed value of delay was not correct. The incorrect delay indications forced him to work all night that year to set the system correctly.

These modules feature 3.9 microsecond resolution. The DJ-4135 includes a Time = Zero Reference Output compensated for the internal 24 microsecond A/D/A conversion delay.

Gayle Campbell, Field Sales Manager, represented IRP at the PRO AUDIO ASIA trade show last July in Singapore. During the 4th Australian Regional Audio Engineering Society Convention in Melbourne last August, Norm Kinnaugh, Systems Design Engineer, presented duplicate sessions of a workshop/seminar on Sound System Design and Routing Techniques. These seminars started from the "Design System" point in figure 18-2 of Sound System Engineering, 2nd edition, proceeded through all the signal processing devices in a system designer's "toolbox," then discussed questions to ask when designing systems for the most commonly occurring venues. The first question to ask is: "What is the purpose of the facility for the end user?" This leads to the further questions which define the signal routing, signal processing, and switching needed to fulfill the sound system requirements of the facility - and a nearly completed system design.

Note that the September 1993 Journal of the Audio Engineering Society will contain a friendly letter exchange with an author who thought that all analog equalizers were based on tuned filters; and wasn't aware that the IRP TEQ Transversal Equalizer works without resonant circuits.

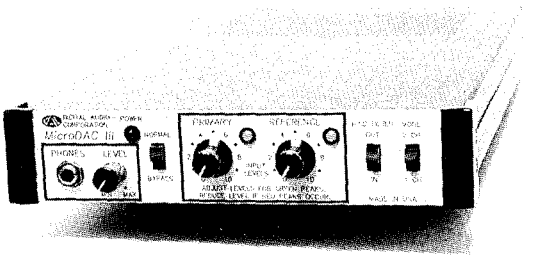
MicroDAC III
Dual-Processor
Adaptive Filter System

Digital Audio Corporation has introduced a rugged, usable in the field, dual adaptive filter, The specifications are outstanding (processor speed 59,000,000 filter sections per second), dual channels. Made for law enforcement work by non-technical personnel.

The MicroDAC III works with the DAC ENHANCER which they say "vigorously attacks bar and restaurant noises, background music, AC hum, voice muffling, and reverberations."

We have a lot of respect for the DAC organization, having first been introduced to Dr. Paul in the 1970s when he introduced his first digital adaptive filter for Rockwell.

We have an interesting story to tell about Dr. Paul. Don was addressing a local AES section meeting in D.C. on equalization. When the meeting was opened for questions, a man stood and asked a question about adaptive filters. Don told him that he wasn't equipped to answer his question and that he should contact Dr. Paul of DAC in North Carolina. The man said, "I am Dr. Paul." Like Don says, never fake it. If you don't know, say so and say that you will find someone who does have the answer. Often someone in the class does know the answer and we all learn.



If you want to learn more about digital noise filtering and tape enhancement, get in touch with DAC at Ph 919-782-6767, FAX 782-6766.

The Year 2000 and Syn-Aud-Con

Syn-Aud-Con starts its 22nd year in December 1993. During those years our audio industry has gradually explored and entered the digital era. Digital equipment is becoming more common but not yet dominant. In acoustics a fascinating duality has occurred. TEF analysis has literally dominated measurements by those of us involved in electroacoustics. Much of academia and various theorists have explored the FFT measurement system. Interestingly the sound contractors and the acoustic consultants using TEF analysis have a clearer view of real life room acoustics than do the theorists using their tools. The everyday use by TEF owners of ETCs, polar ETCs, acoustic phase adjustment of systems and vastly improved equalization techniques (such as highlighting non-minimum phase areas on response plots) has led to distinguished scholars and researchers being totally unaware of the advancements being used daily by all of us.

As we start our 22nd year with the memory of the advances made, it supercharges our interest in what is yet to come. We plan, God willing and if the creek doesn't rise, to continue reporting on and witnessing these advancements to at least the year 2000. We hope all of you will be with us then.

Syn-Aud-Con 1993/94 Seminar & Workshop Schedule

Workshops

Live Sound Reinforcement

When: January 17-19, 1994
Where: Chapman University, Orange, CA
Fee: $650
Staff: Will Parry, SPL, Workshop Chairman
Albert Leccese, Audio Anaysts
M. L. Procise, Showco
Dave Scheirman, Concert Sound Con.

Special Guests:

Kenton Forsythe, Eastern Acoustic Works will conduct sessions on "Design Considerations of Loudspeaker Arrays"

Mick Whelan will hold sessions on "Power Distribution Systems"

The 1994 Live Sound Workshop is the 5th one sponsored by Syn-Aud-Con and the 3rd one jointly sponsored by Syn-Aud-Con and ProSound News. (The workshops plainly got too big for a little company like Syn-Aud-Con to handle solo.)

This year the workshop will be more technical. There will be increased emphasis on the technical "why" behind the hands-on "how." During the first two days, the afternoon sessions will be divided into advanced and less advanced sessions.

Much of the operation of Live Sound equipment is more artistic-based than engineering-based, but the equipment being operated is, in the case of successful companies, very carefully engineered by very knowledgeable people.

The Workshop goal is to make those attending meaningfully aware of both sides of the coin called Expertise.

We are trying to hold on to all the good from the past 4 workshops and make the new information valuable and exciting.

❖ 3—Day Seminars—$550 ❖
Farm—Norman, IN
Sound Engineering Seminars

May 18-20, 1994
June 23-25
July 21-23
August 18-20
September 15-17
October 13-15

2-Day On-the-Road Seminars

New York/Orlando Classes-$550

It is Syn-Aud-Con's desire to provide 2-day "on-the-road" classes for those unable to attend the more complete 3-day classes in Indiana. Pat Brown and John Royer have been helping us with our farm classes. We want to encourage them to take the show on the road, so we, Don & Carolyn, will travel with John and Pat to New York (actually Secaucus, NJ) for a class November 8-9, 1993 and Orlando February 24-25, 1994. We want them to gain the experience to offer such classes elsewhere around the country.

Pat Brown is an experienced sound contractor/consultant with extensive experience helping teach Syn-Aud-Con farm classes. John Royer is a master electrician who runs the sound and broadcasting systems at the Indianapolis Motor Speedway as well as the audio systems at the Indiana State Fairgrounds. John helps teach the Crown IQ classes in Elkhart.

These two men have unique audio backgrounds rich in both theory and practice and a passion for sharing it with you.

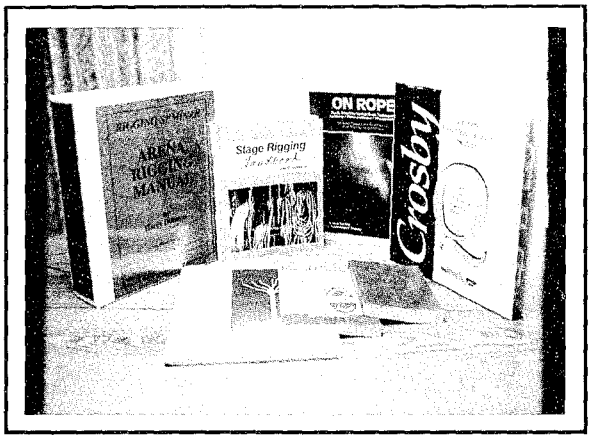
For those unable to make the trip to "the farm" for the more detailed treatment of the same subjects, these special classes with Don, Carolyn, Pat and John represent a unique opportunity to participate in a Syn-Aud-Con class.

If Pat and John like the "on the road" classes and the classes like them, there will be 2 or 3 classes a year. We will write more about these classes after the New York/Orlando classes. We, Don and Carolyn, will not be present for future classes but will concentrate our energies on the much loved farm classes.

❖ Schedule of Rigging Seminars, 1994 ❖

Anaheim, CA—Jan. 17-19
Orlando, FL—Feb. 14-16
Las Vegas, NV—April 4-6
Chicago —June 6-8
Minneapolis (1 day)—July 28, 1994
Specifically for Venue Managers as well as Technical Directors and company administrators
Secuacus, NJ—Oct. 10-12, 1994
San Francisco, CA—Nov. 7-9, 1994

Rigging Seminars



Harry Donovan tells members of the class to bring an extra suitcase to class to carry home a library on rigging. We have had as our motto for Syn-Aud-Con, "The class doesn't end when you walk out the door of the seminar." Neither does it at Harry Donovan's Rigging Seminar.

"I'm glad I attended this seminar. I will tell all of my staff to try to attend one. Thanks again."

"All the material was great and on time."

"Good instructors, good material, good examples and math work."

"This seminar was exactly what I had hoped it would be."

These are words from professionals who have attended the Rigging Seminars by Harry Donovan in the Spring of 1993. We are very pleased to be associated with seminars that are providing life-saving important information to our industry.

"Loners Don't Band Together To Set Standards!"

This was a remark made by a professional rigger during the class discussion on training required to be a rigger. There are no standards. There are no qualifications. All that is required is to say, "I am a rigger."

Think of all the rigging going on in the United States. There are reported to be over 1,000,000 facilities; 1,200 tours each year; how many television studios? How many movie studios? How many hotels with live entertainment? How many theme parks with live entertainment? Yet no standards. The only way to learn is on the job, study and seminars.

Harry Donovan has written a manual for the class, and continues to add to the manual after each seminar as questions come up that gives him insights into better ways to explain a subject.

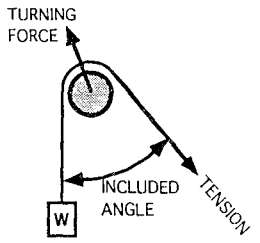
Jay Glerum, the other permanent member of the teaching staff, has published the *Stage Rigging Handbook.*

Arena Rigging Manual

We are sharing two pages from the manual to give you a feeling for Mr. Donovan's teaching style.

Turning Force

When a rope or wire is turned around a bend, force is applied to the bend. The force on the bend depends on the rope tension and the angle of the bend.



FORCE = TENSION X TURNING FACTOR

TURNING FACTOR TABLE

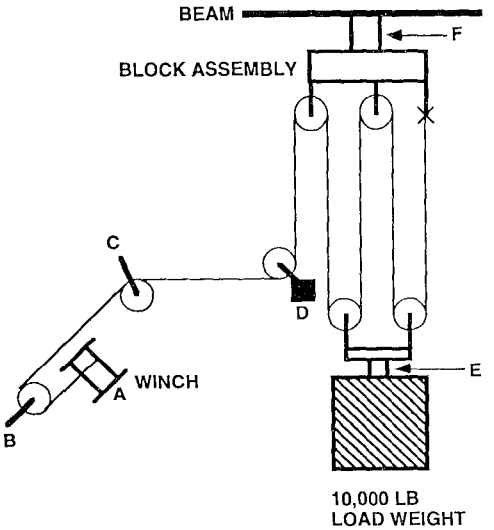
ANGLE	FACTOR
0	2.00
10	1.99
20	1.97
30	1.93
40	1.88
50	1.81
60	1.73
70	1.64
80	1.53
90	1.41

ANGLE	FACTOR
100	1.29
110	1.15
120	1.00
130	0.85
140	0.68
150	0.52
160	0.35
170	0.17
180	0.00

Example: A rope carrying 4000 pounds goes over a pulley. The included and between rope parts is 20 degrees. The force on the pulley is 4000 X 1.97 = 7,880 pounds.

A cable with 2000 pounds tension is bent at a right angle over a beam. The force on the beam is 2000 X 1.41 = 2,828 pounds.

TURNING FORCE PROBLEM 1



What are the approximate loads at points

A

B

C

D

D

E

F

Impulse Response and Minimum Phase

The term "minimum phase" crops up again and again in serious literature on audio subjects. People in acoustics lavish similar regard on the impulse response of rooms (which are not minimum phase by any stretch of the imagination but can transfer minimum phase signals from a transducer to a listener).

The simplest definition of minimum phase is that the relative phase response (starting at T_O for the arrival of the signal) has the minimum signal delay allowed by the amplitude change being measured.

Minimum phase systems allow the observer to find phase from magnitude or magnitude from phase since they are related by the Hilbert Transform.

What brought all this to mind again was the ideal "flat" magnitude response of a system with a very lengthy time response shown by Sam Berkow at the instrumentation class. Note that in the "time response" plot it is 50 msecs per division. See Figure 1.

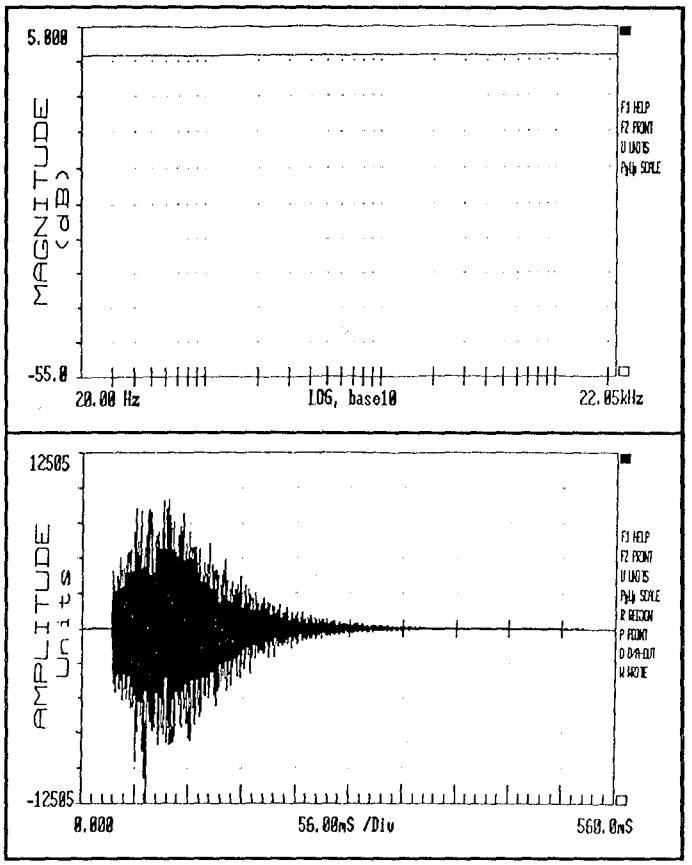
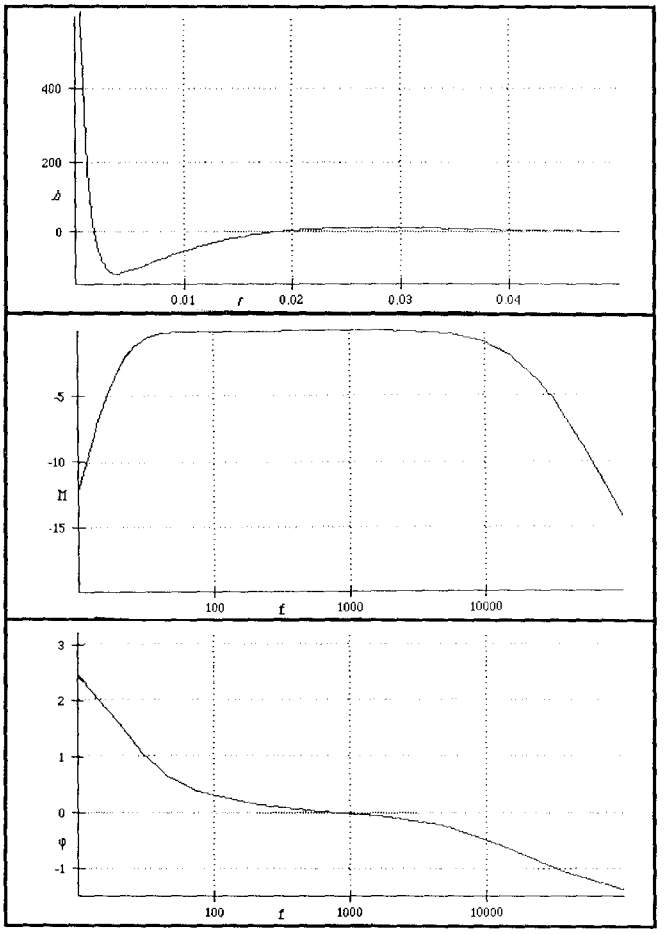


Figure 1a,b: #1a Is this the perfect loudspeaker??, #1b the time domain representation of the impulse response which generated the frequency response in #1a.

Gene Patronis supplied us with the impulse, magnitude, and phase responses for a minimum phase bandpass system. See Figures 2a, b and c.



One of the lessons indelibly written in my mind, after 40 plus years in this business, is that there is a satisfied customer for every product. Time domain smearing of signals is widely available in the market place, sometimes justified as psychoacoustics and sometimes just through the belief that all their customers don't know any better. For a loudspeaker to sound good all of the bases have to be covered.

Smooth magnitude response,
Smooth phase response,
Fast transient response,
Controlled polar response,
Low distortion components.

I suspect that the least controlled of the above list, polar responses is probably the cause of most of the differences we hear in contemporary home loudspeakers.

Sam's example is an "all pass" filter.

TEF News

Recent classes at the farm have used our new 486-66 computer. It is sufficiently fast that some of our TEF modules (notably our NC curves) would not function properly. Techron picked a remedy we really like, namely supplying us with a Beta version of TEF-2.0 software.

WOW

We now bounce from menu to menu *via a mouse*. We can now go directly (flash) from the Heyser spiral in the time domain to the Heyser spiral in the frequency domain. Measurements now stay in the chosen display mode for measurement after measurement. A new full view Nyquist display is available - a precursor to polar measurements. We now demonstrate in classes the TDS module.

Time Domain
Heyser Spiral
Magnitude of energy time (ETC)
RT_{60}
%ALcons

Frequency Domain
Heyser spiral
Nyquist
Phase
Phase vs magnitude
Magnitude
STI & RASTI

Plug in separate modules:
Dual channel RTA
Noise level analysis NLA
Noise criteria NC

The speed of access now is phenomenal within the TDS module. We are told all modules will soon get the same treatment.

Maximum Length Sequence MLS

We repeat once again that those who have TEF and SYSid have today's state-of-the-art measurement capability. Nothing else is needed, you just add software such as Hypersignal, Mathcad, etc.

We are repeatedly told by those who have attended farm classes that they would have misbought their analysis equipment if they hadn't come to the farm. Most say that their not knowing what they really needed to measure would have led them to the wrong equipment. Learning what to measure makes them individually capable of understanding which analysis system is best for them.

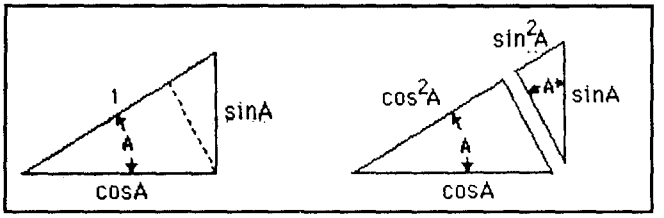
A Matter of Perspective

The story is told about a professor who, when a graduate student would bring him a brand new idea, would pull open a file drawer, pick through the files, and then say, "Yes, your solution is correct according to my notes."

Dr. Sidney Bertram included the following in a letter to us commenting on our Newsletters.

"Your description of the motional impedance is a bit loose. In an ideal loudspeaker the voice coil would have no resistance and the cone would have no mass or spring constant. The motion of the cone in the magnetic field couples the acoustic impedance acting on the cone into the voice coil as a constant motional resistance (of, perhaps, 8Ω). The cone does have its own mechanical impedance that modifies the effective loading and can reflect a large motional impedance into the voice coil at its resonance. Unless the cone is blocked there will be a motional impedance at all frequencies that the speaker responds to; it adds to the impedance (mostly the dc resistance) of the voice coil. The speaker operates much like a transformer that couples its secondary load into the primary.

"I didn't like geometry, so I favor my trigonometric approach to the Pythagorean theorem: The figure shows a right triangle with a hypotenuse of unit length and angle 'A', so its base and height are cosA and sinA.



"A dotted line is drawn normal to the hypotenuse through the right angle dividing the triangle into two parts that are shown separated in 'b'. The upper right triangle has the angle 'A' as shown. The original hypotenuse is seen in 'b' as made up of two parts: the lower part is cosA times the base, so it is $\cos^2 A$; the upper part is sinA times the height of the original triangle, so it is $\sin^2 A$. Since the original hypotenuse was of unit length this leads to $\cos^2 A + \sin^2 A = 1$."

One of the greatest satisfactions of my life is the "guilt by association" with men like Dick Heyser, VMA Peutz, Dr. Bertram, Dr. Patronis, and the many many others who have cared enough to steer us out of error into insights.

In the movie *Fat Man and Little Boy* which is about the development of the atom bomb from the perspective of General Leslie Groves, Robert Oppenheimer, and the Los Alamos effort, there is a scene at the end of the film where the countdown to the first atomic explosion is occurring and they can't get the interference out of the audio systems. It just goes to prove we are in a tough game.

Acoustic Fundamentals

When sound is emitted by a sound source, its spread is spherical or some segment of a spherical surface depending upon its directivity.

The arrival of that sound energy at a listener's ears can be divided into:

1. The sound that came directly from the source without encountering any surfaces (direct sound)
2. The sound that has been reflected once by a nearby surface. (early reflected sound)
3. The sound that has undergone multiple reflections (the reverberant sound).

In order to cope with this multiplicity of arrivals, the listener comes equipped with two channel signal analysis capability that discriminates in both the time domain and the frequency domain comparatively between the two channels of reception. Which cerebral hemisphere processes which sound has been shown to be both frequency dependent and time based.

Direct Sound

Direct sound arrives at the ear first. Total processing time into the brain is believed to be on the order of 35 to 40 milliseconds. In large acoustic spaces this means that the direct sound is received and perceived prior to any other sound arrivals. In small acoustic spaces it would appear that part of the early reflected sound fuses with the direct sound in the brain. About the only changes direct sound can suffer on its way from the source to the receiver is air absorption (at high frequencies significant for long distances) and bending by temperature differentials. Please note that these are not factors correctable by an electronic signal processor.

Early Reflected Sound

When sound encounters a surface, the following can happen either singularly or in combination

1. It can be reflected R = (1-a); the absorption coefficient of the surface material subtracted from unity provides the reflected ratio.
2. It can be absorbed.
3. It can be transmitted through the surface.
4. It can be diffused.
5. It can be sent on a flanking path.
6. It can be focused.

The early reflected sound is usually the culprit in what is labelled a "bad" acoustic. The "liveness" or "deadness" of an acoustic space is determined largely be the amplitude of the first reflections compared to the direct sound (also the size of the room can be judged aurally by first reflections). A focused set of first reflections at a long enough signal delay can directly interfere with speech intelligibility.

The use of "cupped" ears and panels of Sonex absorption can assist in discriminating between direct sound and early reflected sound. It is usually possible to detect the loss of high frequency information in early reflections as compared to the direct sound.

Reverberant Sound

In a truly reverberant acoustic space reverberation is the ambient noise. It is a highly mixed set of multiple path reflections that provide a reasonably steady noise source in the room. The length of time it takes such a sound field to decay 60dB is described by the justly famous Sabine Equation.

This has been a classic way to

$$RT_{60} = \frac{55.26V}{c\,\bar{S}a}$$

think about reverberation but for the electroacoustician a more useful way is to think about the "level" of the reverberant sound.

The Hopkins-Stryker equation can provide us this information where:

$$L_r = L_w + 10\mathrm{Log}\left(\frac{4}{\bar{S}a}\right) + 10.5\mathrm{dB}$$

is the level of the reverberant sound field

L_r

is the sound power level.

L_w

is the number of sabines (i.e., square feet

$\bar{S}a$

of absorption).

The level of the reverberant sound minus the level of ambient noise is the measure of the perceived reverberation. For example, in a room with an
but with a

$RT_{60} = 4.5$ secs.

of 30 dB the sound decay can be heard

L_R of 40dB and an L_{AMB}

for only 10 dB of decay instead of 60 dB and at a decay rate of 13.33 dB/sec.
the perceived decay time would be less

$$\left(\frac{60\mathrm{dB}}{4.5\ \mathrm{secs.}}\right)$$

than 1 sec (0.75 secs.)

$$\left(\frac{13.33\mathrm{dB}}{1\mathrm{sec}} = \frac{10\mathrm{dB}}{X\mathrm{secs}} = 10/13.33 = 0.75\mathrm{secs}\right)$$

What Can Be Equalized?

Many have either forgotten or never have thought about the fact that boundary surfaces, objects and audience can have no effect on the direct sound. All of the above does have an affect on is the total sound which consists of the early reflected sound and reverberant sound, added *after* the direct sound arrives plus whatever ambient noise is present. These do cause the listener to perceive a quite different total sound. If we wish to change the listener's perception, we have two choices.

1. Correct the problems at these sources (i.e. room, machinery etc.)
2. Distort the direct sound in some manner that masks the effects or distracts the listener from them.

This distortion of direct sound is the basis behind "program" equalization and

is best performed by gifted, trained ears.

This kind of equalization if supplied by instrumentation (i.e. source dependent measurements SDM wherein the measurements validity is dependent upon the frequency range over which the source can generate sufficiant power) needs a large time sample of the total sound since that is what we are trying to observe and adjust, via distortion of the uniform direct sound already established. Ideal, in our opinion, is the 1/12th octave dual channel real time analyzer which is sampling continuously thereby giving a good picture of the total sound transfer function.

Q - A Powerful Tool

The most powerful *sound system tool* that can let us interface the system to a difficult acoustic environment is the loudspeaker directivity factor Q. Raising Q allows higher direct sound energy to be put into the room *without raising sound power* to do so. The early reflected sound can be substantially influenced by proper aiming of directional devices. Employing a higher Q source will not alter the reverberation time of a room but does measurable *alter the level* of reverberant sound when coupled with the appropriate power change. The fundamentals of room acoustics has changed little from W.C. Sabine's day. A desirable acoustic space has:

1. Low ambient noise
2. Good diffusion
3. No detrimental reflections
4. A proper reverberation

New Thoughts on Old Theories of Reverberation

There are limits on the use of statistical equations. Both Sabine's equation and the Hopkins-Stryker equation are statistical in nature. (i.e. they depend upon a mixing homogeneous sound field). These conditions are not satisfied in small very dead acoustic spaces or in extraordinary monumentally sized spaces such as the Astrodome or Superdome.

In very small dead spaces the reverberant sound field is so low in level as to be obscured by the ambient noise. In large monumental spaces, the delay interval between reflections is so great as to make any return at an audible level a specific problem, not a statistical one. (i.e. an echo rather than a reverberation.)

Where there is a statistical sound field - Gymnasiums, Auditoriums Arenas, Churches - the classic equations work very well. Where the classic equations do not work well, ray tracing quite often is the most useful tool and the geometry of energy concentration are of more interest than their numerical values.

There are few more interesting studies than the sea of sound that we live in. Nor is there more perpetual challenge to the thinking individual than the intellect's dependence upon hearing vs visual stimulus.

Man's complexity certainly reflects a creator of infinite ingenuity As Orley's law states, "It requires at least as much intelligence to build a model of the universe as it took to build the original." Put another way, "This life must surely be a practice session for the real thing later."

Construction Definitions

CONTRACTOR ---------- A gambler who never gets to shuffle, cut or deal.

BID OPENING ---------- A poker game in which the losing hand wins.

BID ---------- A wild guess carried out to two decimal places.

LOW BIDDER ---------- A contractor who is wondering what he left out.

ENGINEER'S ESTIMATE -------- The cost of construction in Heaven.

PROJECT MANAGER ---------- The conductor of an orchestra in which every musician is in a different union.

CRITICAL PATH METHOD ----- A management technique for losing your shirt under perfect control.

STRIKE ---------- An effort to increase egg productions by strangling the chicken.

DELAYED PAYMENT ---------- A tourniquet applied at the pockets.

COMPLETION DATE---------- The point at which liquidated damages begin.

LIQUIDATED DAMAGES -------- A penalty for failing to achieve the impossible.

AUDITOR---------- People who go in after the war is lost and bayonet the wounded.

LAWYER ---------- People who go in after the auditors and strip the bodies.

MEMO

Report from Dr. Diffusor

Buyer Beware

Legitimate manufacturers welcome true competition but they don't welcome competition based on imitation, false claims and inferior products which confuse legitimate customers.

A product has appeared on the market which claims to do what the very successful RPG diffusors do so well. The ads for the Art Diffusor distributed by Systems Development Group (SDG) make specific reference to RPG products and pricing.

Peter D'Antonio, who is celebrating 10 years at RPG Diffusor Systems and tens of thousands of diffusor systems installed, made a very detailed study of SDG and has a 4-page report available for the asking. Peter summarized his report:

"SDG is claiming their product is an inexpensive true 2-dimensional diffusor, with similar polar responses in both horizontal and vertical planes, over a frequency bandwidth of 125-16,000 Hz. A technical evaluation has revealed that none of these claims is substantiated. Quite frankly, in light of the extensive theoretical and experimental verification of the benefits of number theoretic scattering surfaces, it is surprising that SDG would try to market a product with no mathematical justification for the depth variation and no experimental data to verify performance. It is our hope that this information will prove useful in evaluating potential diffusing surfaces and also confirm our commitment to provide accurate specifications for all of our products."

DISC Project

Peter is deeply involved in a project that he feels will captivate him for life. Peter is the Chairman of the joint AES/ASA Working Group SC 4-2 for the Characterization of Acoustical Materials - DISC Project. The DISC Project has expanded its scope to include Characterization of Acoustical Materials, finding ways to incorporate this directional experimental and theoretical information into room simulation programs and finally finding ways to verify the accuracy of the room impulse responses generated. Dr. D'Antonio presented for the first time at this year's AES in New York a new algorithm based on wave acoustics to handle diffusive surfaces and real room surface irregularities such as balcony fronts, stage canopies, etc. Dr. D'Antonio said "we can now begin to turn the corner and progress from the geometrical acoustics models the sound programs have been based on. This new wave acoustics approach will allow us to model real rooms."

Future Workshop

Recently we asked Peter if he would consider a workshop for the audio industry. He wrote: "I believe it should revolve around auralization and whatever measurement instrumentation we have on hand. This would mean the later the better, so we can have something set up. We can focus on small room modeling instead of the large rooms people currently consider. As you know no one really takes phase into consideration in theoretical impulse calculation. I believe we have discovered a way to do it and this is especially important in small rooms. I am exceedingly pleased to hear that Techron is now going to implement MLS with Paul Kovits as a consultant and Farrel doing the programing. This is a major significance to my DISC research and it can't come too soon."

RPG has now built a semi-anechoic measurement area using the new MLS prototype technology he and Paul Kovitz have been adapting for the DISC Project. The measurement technique provides 70 dB dynamic range and the software is programmed in MatLab. In addition, he has constructed a 10'x14'x10' reverberation chamber to conduct auralization verification measurements.

It is Peter's hope that they will soon have a comparison between the experimental measurements in the Auralization Lab and theoretical simulation impulse response. A key factor will then be to determine the psychoacoustical importance of the lack of perfect correlation.

Transfer Functions & Signal Delays

The mechanics of obtaining the transfer function of a system (i.e., its amplitude and phase) is to compare the input to the output and plot the difference. Ideally we would like to take both measurements with the system having a signal at both ports (input & output). The acquisition time for the two measurements can be small or large depending upon the analysis equipment used. The signal delay through some contemporary devices is up to 30 milliseconds and any analyzer desiring to compare input to output must have a measurement window at least as long as twice the signal delay of the system.

Good practice is to always take a "Global" look at the time domain behavior of any unfamiliar device before shortening the window for a detailed look. Also, the time domain record provides the necessary frequency domain parameters by taking the inverse of the total time domain record. If the total time record is 15 milliseconds, then 67 Hz of resolution should sufficiently characterize the frequency domain behavior.

Installer's Corner

Which Pair Goes Where?

by Pat Brown

No matter what size the installation job, the common denominator is wire. The installer is often faced with a maze of cables and pairs. Here are a few techniques for dealing with wire on the job:

Multi-Pair Mic Cable - The individual pairs in snake cables are sometimes numbered, but more often they are not. Also, they are sometimes color-coded, and sometimes not. A sure way to properly connect point A to point B is to check each pair individually.

When you strip back the outer jacket from a snake cable, you will expose the individual shielded pairs. These pairs are usually wrapped in cellophane, to isolate them from each other. **It is very important to maintain this isolation.** Since the cellophane falls off easily, use a piece of heatshrink tubing on each pair. If long runs are necessary, there are two solutions:

1. Buy snake cable with individually jacketed pairs. You can then strip back the outer jacket and run the individual pairs anywhere you wish.
2. Using a splice, switch over to jacketed cable in a junction box. I know, you're not supposed to splice mic lines since they are prone to interference! While this is true, a good splice is a much better compromise than long lengths of mic cable that the shield has fallen off of. Remember that every time you plug in a mic cable, you are performing a splice.

Perform the splice in a metal electrical box with a removable cover. Use terminal strips and crimp lugs to connect the pairs. Tie the shield on *one-pair* to the box and keep the others isolated from it! Mount the box permanently, and ensure that it is isolated from any other boxes or conduits. When you replace the cover, use an ohmmeter to ensure continuity to the box. Scrape the paint if necessary. A splice made in this manner will not compromise the integrity of the shielding, and will even serve as a convenient test point for troubleshooting.

Identifying pairs is a quick and simple process. A signal source is required, preferable with an output of at least one volt. It is sometimes advantageous to perform all connections on one end of the snake, for instance, on a church platform with distributed mic inputs. Use the method above to distribute the pairs to their destinations. Go ahead and connect them to the floor jacks. Plug a signal source (a TOA impedance meter works great for this) into each mic jack. Make sure that it is connected to pins 2 and 3. To find the pair at the other end, use an inductive tracer to "sniff" each pair. The pair that you are hooked to with the generator is easily located. Mark it and go on to the next, continuing until all pairs are identified. Be sure not to invert the polarity when you hook things up. When all connections are completed, go back and check each pair with the Farrel Becker Cable Tester. (The schematic is in *Sound System Engineering*). This will verify proper polarity and identify any shorts to ground. Finally, make a diagram of your work, and leave a copy on-site for future reference. Engrave it in metal and bolt it to the wall (just kidding). Better yet, keep a copy in your files.

Does the Law of Physics "Still" Apply?

The November 1992 issue of Audio Magazine had an interesting interview with Jack Pfeiffer, "RCA's Prince Charming."

Jack Pfeiffer has been with RCA for 43 years, having produced the original recordings for Arthur Rubinstein, Vladimir Horowitz, Jascha Heifetz, Arturo Toscanini - to name only a few. He is now overseeing the reissue onto CD.

The whole article is interesting, but I want to reproduce here two questions and one answer:

How did those first stereo recordings turn out to be "fantastic"?

Out of sheer ignorance. I had only used a couple of microphones - literally, one for each track. I set up two in front of the Chicago Symphony in Orchestra Hall in Chicago. And the clarity and the definition that we got - of course, a lot if had to do with the acoustics of the hall, the quality of the musicians. Reiner's balances, and so forth, were so dramatic. It was completely different from anything we had ever heard before.

I think the early stereo experiment proved the point, that the fewer microphones you have, the more likely you are to get a really first-class recording. Microphones are stupid. They pick up everything that comes their way. So the more mikes you have, the more phase differences you get, plus you pick up all the reflections from the acoustical environment. It all adds up to a mess. I've always tried to limit the number of microphones.

Still?

End of Quote: Now you see why I said two questions and one answer. The interviewer seemed to be saying, "Does the law of physics ***still*** apply in this modern age when we know so much and we have so much sophisticated processing equipment?"

Yes, it still does!

"Electronics Contractor" Not Sound Contractor!

Acromedia is an outstanding "Electronics Contractor" based in Los Angeles. Bob Reim thinks that the term "Electronics Contractor" explains the scope of our industry much better than Sound Contractor, and we think that he is getting his associates to accept the concept.

I would like to reproduce part of his letter here because he explains it much better than I could.

From Bob Reim, Acromedia

The simple fact facing today's business world is that you can seldom be in business purely as a Sound Contractor.

We have many different disciplines that we now must deal with i.e. television systems, computers, satellite transmission systems, multi-media systems, fiber optics, security, life safety systems, telephone systems. (In our area the schools use sophisticated computer based telephone systems - the era of electro-mechanical systems is dead - which require computer literate engineers to make them operational). You can appreciate that we need a word which better describes our business capabilities.

This year I am the Los Angeles Chairman of the National Electrical Contractors Association (Electronics Section) and accordingly, we have spent a great deal of time trying to position our members in relation to the conventional power-type Electrical Contractors. Generally speaking, Electrical Contractors who form the majority of the Los Angeles N.E.C.A. Chapter.

Over the years, most Electrical Contractors have gotten used to referring to us as "Sound Contractors". Last year our N.E.C.A. Electronics group presented a Multi-Media presentation ("Portrait of an Electronics Contractor") to the general membership of the N.E.C.A. Electrical Contractors. We endeavored to explain to them the many things that we now do which are unique to the broad scope definition of today's Electronics Contractors.

Our program stressed the many common points of our contracting business relationships, but then by picture and spoken work showed how we were uniquely different. The Electrical Contractors in attendance at this meeting were truly surprised and impressed at the diversity and engineering complexity of our business. Accordingly, our power-type Electrical Contractors have now come to accept the definition of Electronics Contractor in lieu of Sound Contractor. Additionally, we recently changed the wording in our bylaws to reflect the theme of the Electronics Contractor.

The Architect, the Consultant and the Electronics Contractor

Bob also wrote us about our War Zone article in the last issue of the Newsletter. Remember, I said we would hear from Bob.

In the War Zone article, the consultant generated tongue-in-cheek comments about the short comings of the Electronics Contractor, alias Sound Contractor.

As Bob explained, over the years the staff members have compiled some interesting experiences in dealing with both domestic and international consultant specifications, thus over the years the "tongue-in-cheek" specification has evolved into a multi-page humorous document. An Electronics Contractor can best appreciate the extent of wit drawn from these experiences.

It is not practical for us to publish the complete document, but I thought I would draw out a few paragraphs so as to give you a flavor of these "tongue-in-cheek" mythical specifications:

"It must be understood by the Contractor that the Consultant's estimate of cost to do this project is the cost to do this work in Heaven. The contractor must complete the absurdly long unit price bid form, otherwise the Consultant will not have a knowledgeable reference of what things cost in the real world."

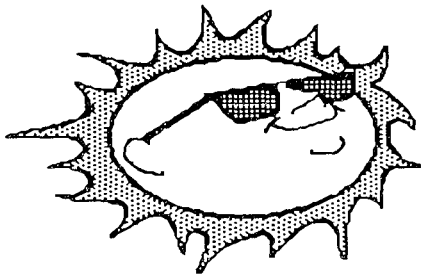
"Mistakes shall be coordinated with all trades even if its no concern to the Contractor. If you do not coordinate.

"All equipment used on the project must be U.L. listed. All equipment listed as acceptable in this specification is probably not U.L. listed thus it is up to the Contractor to get it U.L. listed."

"All equipment shall be provided in a color other than what is available as standard from the equipment manufacturer."

"If the work is accomplished without extra expense to the Client, then the work will be done over again until the extra expense to the Contractor is satisfactory to the Consultant. Do not bother the Consultant with silly questions about the system because he is working on another project. Besides, the only person who understood the system just quit."

If you want a copy of the full specification, write Bob Reim, Acromedia Corp., 5600 W Centinela Ave., Los Angeles, CA 90045. Tel 310-410-4141. Fax 310-410-9593.



Hot Summer Days

Summer 1993 in Indiana has existed in a special exemption from the excessive rains to our West and the excessive drought to our Southeast. As a result we have had regular rains for our crops and only in August have we experienced heat threatening to our livestock. Carolyn's careful planning of new corrals at the new barn and regular training of the horses, llamas and goats in coming each morning to be fed and restricted has led to being able to hose them down and keep them cool. The llamas even have their own sandbox to lay in (well soaked with water) and occasionally look like a couple at the beach. The dog house now has a dual fan for keeping its well insulated interior cool and the humans have air conditioning.

The combined heat and moisture has resulted in mowing the yard every six days (a six hour job) which has resulted further in Don's weight approaching (from the upward side) 200 pounds even.

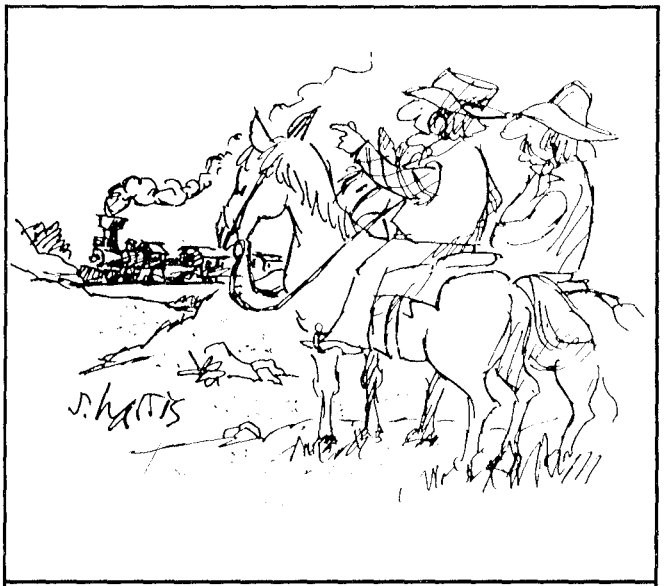
The nights cool off enough to open up all the windows and sleep without air conditioning. The early mornings are times to pick blackberries (the wild berries are prolific this year), beans, corn, tomatoes, cucumbers, and melons. In the evening we dig new potatoes for a potato, bean, tomato, corn, cucumber and onion dinner.

Hot summer days: when the perspiration makes you look like you've already jumped into the swimming pool, the hard muscles become young again under the Lord's heat lamp, and the swirling beauty of the morning mist looks like a Japanese print as it flows along the front fields low spots into the woods at the head of the ravine where the spring is located.

We've reactivated the old spring and when tested by the county, proved to be a pristine water source of exceptional quality. Crystal clear, cold and totally chemical free, it's proof again that really good drinking water is the most luxurious beverage there is.

Progress apace in the old farm house as well. The farm is now a historical farm officially recognized by the State of Indiana as a "homestead farm in the same family for over one hundred years."

Inside the old house, now 114 years old, is the future of audio circa 2000 AD as well as the history of the best of the 20th century.



"I love hearing that lonesome wail of the train whistle as the magnitude of the frequency of the wave changes due to the Doppler effect."

From *Chalk Up Another One: The Best of Sidney Harris* by Sidney Harris. Copyright c 1992 by Sidney Harris. Published by AAAS Press, Washington, DC p. 72. Used with permission.

Zero Level

The original meaning of zero level was 0 dBm (i.e., 0.001 watt). If a voltage is desired as a zero level, we suggest 1.0 volt as appropriate. Zero on a Volume Indicating Instrument (VI) is a zero indication until you know its calibration.

Levels in dBm should be calculated by the sound system designer. Said designer should then calculate the desired E_{IN} for each link circuit for use by the installing technician who can then use any reliable high input impedance voltmeter to set the system's level by merely bridging across each link circuit.

Professional Services

Acoustical Consultants may list their cards on this page. There is no charge. The only requirements are that you are a full-time consultant, that you have attended a Syn-Aud-Con seminar, and have an active subscription to the Syn-Aud-Con Newsletter. If you would like to be on our Consultants page, send in four (4) business cards for our file.

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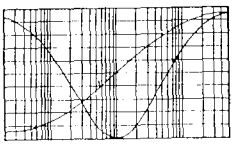

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SUMMER VISITORS

Ken as we are more used to seeing him—smiling and sharing with his good friends. L to R-David Andrews, Craig Janssen, Ken & Jim Brown during a break at the Theatrical Sound Design Workshop at Purdue.

Ken and Arline Wahrenbrock came to the farm on their way to see daughter Sandi in Pensacola, FL (Sandi's husband Ray is a pilot with the Navy).

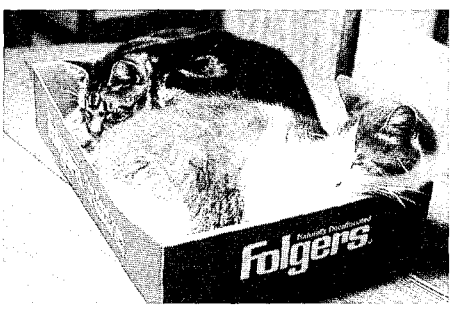
Ken, fully outfitted with radio equipped helmet, worked his ham radio as he rode the back roads of Jackson County on his bicycle. Ken is still capable of covering 100 miles a day on his cycle - just not everyday. We regard the Wahrenbrock's friendship as a special gift from God.

A second summer (or rather late spring) visitor was **Vic and Mary Hall,** who stopped to be with us on their way to attend the Indianapolis 500. To get in trim for the race Vic drove our pickup while Don and David Reynolds "picked up" 70 lb. bales of hay (about 200 of them). While Don can still pick them up and swing them on board, young David throws them to the top of the stack like a basketball. The young farm boys aren't large from overeating - they're large from honest hard work.

Vic handled the driving chores with the calm steady hand of an A.J. Foyt of the hayfield.

The Best Part is Sleeping

Our two male cats, Tilly and Pete, occasionally have at it and the fur flies. On the other hand, a really cozy box can lead to detente as exhibited here. The box declares "The best part of waking up" is Folgers. We suspect in this case it is a warm fellow creature on a cool day.



FOR SALE:

I have the following Bruel & Kjaer equipment for sale. Most of it has never been used, and includes manuals and calabration certificates.

Qty.	Type	Description	Asking Price
1	2204	Impulse Precision Sound Level Meter	1700.00
1	1613	Octave Filter Set	700.00
1	2306	Level Recorder	1700.00
1	2635	Charge Amplifier	2000.00
1	4220	Pistonphone with UZ 0001 Barometer & adapters	900.00
1	4134	1/2" Condenser Microphone Cartridge	700.00
1	4145	1" Condenser Microphone Cartridge	700.00
1	4366	Accelerometer	400.00
1	4332	Accelerometer	400.00
1	UA 0196	Flexible Extension Rod @ dB 0375,	100.00
1	UA 0055	Random Incidence Corrector	400.00
1	UA 0051	Nose Cone	60.00
1	UA 0052	Nose Cone	60.00
1	JJ 2614	Input Adaptor	60.00
1	ZR 0015	25 dB Log Pot	100.00
1	ZR 0020	Integrator	350.00
1	AO 0033	Microphone Extension Cable	40.00
		Carrying Case for Sound Level Meter and acc. like a Type 3511	
			10,370.00

Take it all for 9,500.00 or make an offer. Contact Brian E. Flinn, 58051 CR. 13, Elkhart, IN 46516, Ph. 219-875-5256 leave a message.

Wanted: Schematic/Literature for RCA M1-12154-A 30 watt tube-type PA amplifier. Will reimburse for copying/mailing expenses. Contact N.C.S. Ltd, P O Box 976, Ossining, NY 10562. Ph/Fax 914-762-1322

July Farm Seminar—1993

MERCY & GRACE
by Jim Carey

While out for a walk an Angel took my hand,
And gave me a glimpse of the Promised Land.
Words can not express all the beauty there;
I saw saints of God rejoicing everywhere.

He showed me where my "works" were collected;
I beamed with pride, few of mine would by rejected.
He then stacked these works, both recent and old
On the refiners fire, which produced pure gold.

As I stood and watched with nothing to say,
The wood, hay, and stubble were all burned away.
From that that remained, the Angel made for me
A gold crown of my works for Jesus to see.

With my heart in my throat, I began to tremble,
As he handed me a crown the size of a thimble.
I was shocked; I was stunned; I was sick inside;
How could I have been so motivated by pride?

From there this Angel took me to meet
Thousands of people lined up along a street.
They were waving their arms and shouting out loud.
What could be happening to draw such a crowd?

As I stood there wondering just what to behold,
I looked down and saw a street of pure gold.
Off in the distance someone was walking toward me;
He wore a robe and a crown. Could this possibly be?

Yes! It is Jesus! And He is coming this way.
What can I do? What should I say?
As He got closer I could see those up the street
Were throwing their crowns at the Savior's feet.

My joy was shattered as I remembered my crown.
I was broken inside as the tears flooded down.
As He passed nearby, I sobbed, "Lord, you must know
I love you more that this," as my crown I did throw.

He walked over, picked me up, and to my surprise,
He held me close and wiped the tears from my eyes.
It was then that I looked full into His face
And first understood His mercy and grace.

Two Useful Shortcuts in Making Measurements

In reviewing a laboratory manual from Purdue University written by Tony Mitre, a study under the supervision of Rick Thomas, we encountered two useful shortcuts in making measurements.

We will be writing more about Tony Mitre's work as we are encouraging him to make the manual available to sound contractors.

Direct Reading Impedance Meter

A direct reading impedance meter for loudspeaker measurements is easily accomplished by using a 1000Ω buildout resistor in series with a low output Z amplifier. Make the E_0 of the amplifier, as read on the load side of the 1000 resistor, 1.0 volt. Then Z can be directly read on the millivolt scales.

This is because

$$1 = \frac{E}{Z} \text{ and } \frac{1V}{(1000\Omega + 8\Omega)} \approx \frac{1}{1000} = 1Ma$$

and

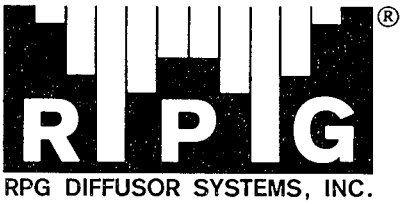
$$Z = \frac{E_{meas}}{1Ma}$$

Sensitivity Shortcut

For 1 watt, 1 meter measurements remembering that

$$E = \sqrt{WR}$$

and that W = 1.0 watt, then the required $E = \sqrt{R}$.



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Syn-Aud-Con receives tangible support from the audio industry. Nineteen manufacturing firms presently help underwrite the expense of providing sound engineering seminars. Such support makes it possible to provide the very latest in audio technology while maintaining reasonable prices relative to today's economy and to provide all the materials and continuing support to all graduates of Syn-Aud-Con.

Personnel from these manufacturers receive Syn-Aud-Con training which provides still another link in the communications circuit between the ultimate user and the designer-manufacturer of audio equipment. They are "in tune" with what a Syn-Aud-Con grad needs.

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