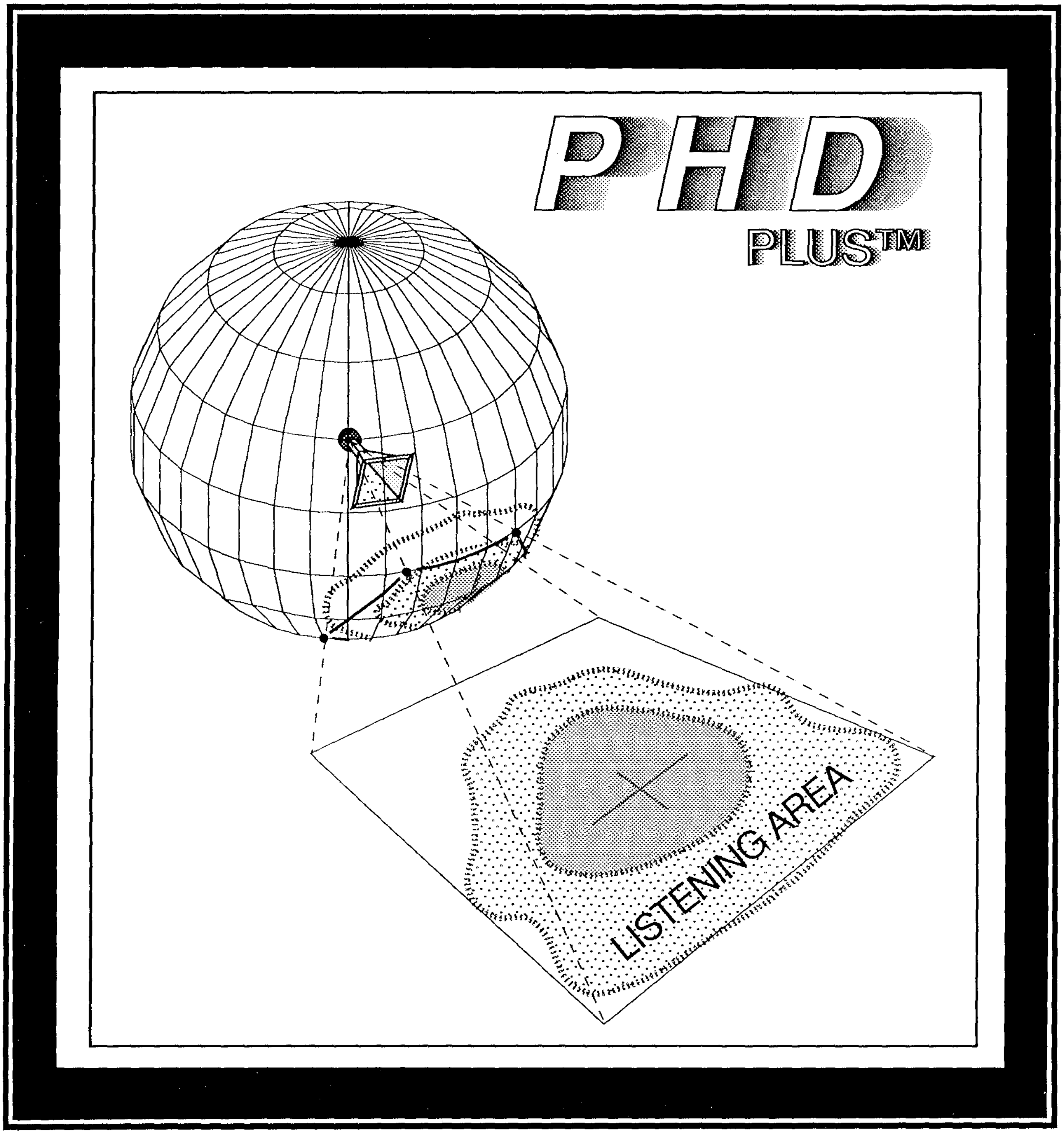
SYNERGETIC AUDIO CONCEPTS
SYN AUD CON

newsletter

Volume 20, Number 3
Spring 1993



SYNERGETIC SYN AUD CON 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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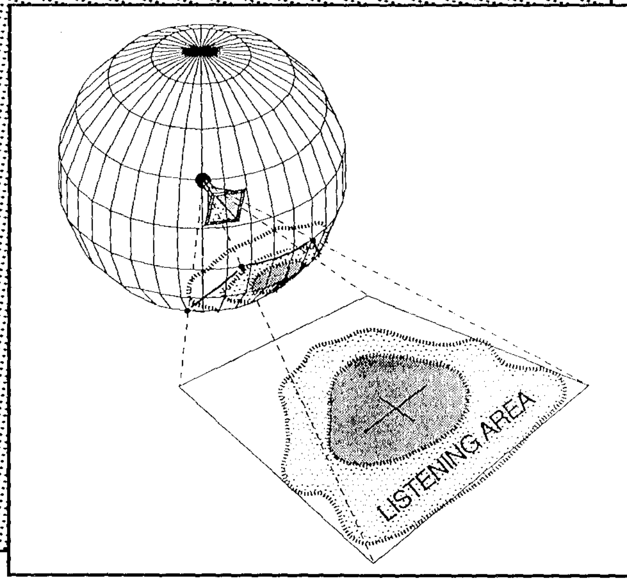
When Do I Renew?

You can check to see when your subscription will expire by checking the mailing label on the envelope in which your newsletter was mailed. In the upper righthand corner, beside the name, a date will appear (i.e. 4-93). This means that you will receive this issue and it will be the last issue sent unless you renew. Renewal notices will be sent at this time. You must renew before the next quarter's newsletter is mailed or your subscription will become inactive.

POSTMASTER: Send address changes to Synergetic Audio Concepts, 12370 W. Co. Rd. 100 N, Norman, IN 47264.

PHD PLUS™



There are two Loudspeaker Array design programs that are actually programmed by designers and users of sound systems: John Prohs of PHD and Dr. Wolfgang Ahnert of EASE. The relevance and accuracy of these programs reflect that involvement.

PHD Plus™ is for the sound contractor or consultant that doesn't want to spend over $500 for a design program. Kurt Graffy of Paoletti Associates in San Francisco says that he meets with a client with his portable PC with Farrel Becker's Sound System Design program and John Prohs' PHD installed. This lets him quickly enter the parameters of the client's space and sound system and tells him if he has a go/no go situation.

John Prohs and Ambassador College, have donated the income from the sale of PHD Program to the Heyser Scholarship Fund—approximately $80,000. We have encouraged John to sell the PHD Plus™ himself; therefore, you may order an update for $100 or a new program for $350.

The brand new PHD Plus™ is a faster, friendlier successor to The PHD Program™. Users say PHD Plus™ makes them much more productive and is a lot more fun to use. (And, yes, it will let users use the old Central Cluster data files from The PHD Program.)

Here is a partial list of it's many features. Loudspeakers can now be aimed visually by placing a cursor where you want each one to point. The view can be instantly toggled from the bottom to the top and back again. The additional colors on screen allow horn patterns to be easily differentiated.

A number of defaults have been changed to allow the program to come up in the most used configuration. Less entry is required for architectural input. A major improvement is in the Performance Analysis Section. The entire analysis is now performed on screen. The color graph allows the user to choose the exact point of interest for analysis. A color coded cursor remains on screen to show whether the system is above, below or within specification. This analysis may be saved and repeated later to see the effect of a change in power or other specifications. All PAG NAG parameters are now entered during performance analysis. The Power Analysis section now accommodates incomplete data. (For example, a nonexistent driver can be specified and added to the data base later.)

The Acoustics Section has now been updated to include on screen graphic aids. The manufacturers data base has been increased. Coprocessor support is provided. Speed is increased.

There are numerous other changes which improve the program's ease of use. In four words PHD Plus™ is "Much More User Friendly."

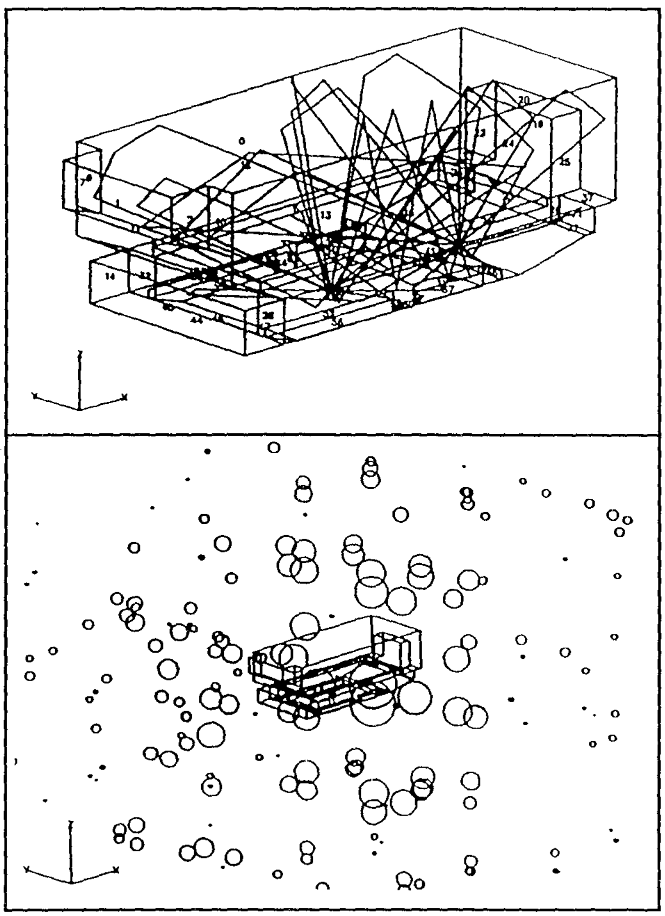
Auralization

The word "auralization" refers to creating a virtual auditory environment that possesses a high degree of perceptual authenticity. Successful auralization can allow the sound contractor, consultant, or designer to "listen to" unbuilt spaces and their potential acoustic and electroacoustic problems or virtues via computer modeling.

Sound Field Modeling

The acoustic environment at the ear drum of a human listener is complex. Acoustically, the signal at the ear drum depends upon:

1. The room geometry
2. The boundary surface materials
3. The location and directional characteristics of the sound source or sources
4. The location and orientation of the listener
5. The listener's "head transfer function," HTF.



Figures 1A and 1B

Ray Tracing or Mirror Image (Virtual Source)

The computer programmer has two choices readily available, namely ray tracing and virtual source generation.

Computer simulation of a sound field is basically a linear problem and can, generally speaking, be obtained by solving the acoustic wave equations for the complex boundary condition, which is given by the geometry and acoustic properties of the walls. Unfortunately, there are a limited number of analytic solutions available at this time.

Finite element analysis becomes too costly when it is realized that even for a relatively small room, it would require quantization into more than 10^8 elements.

Considering the above, the basic insight underlying the virtual source concept is that every (real or virtual) acoustic environment with reflections present can as well be described by means of a cloud of virtual sources surrounding the listener in a reflection free space. See Figure 1a & 1b. Note that the position of the circle signifies its location and the size of the circle indicates its energy level (1b).

By modeling each virtual source surface as to its absorption, diffusion, and reflectivity (some day its transmissivity as well) we can use it to synthesis a sound field and by editing modify one sound field into another quite different one.

When this acoustic model of the sound interaction with the room acoustic is combined with the "head transfer function" HTF, of the listener for a given location and orientation, then we have generated a binaural impulse response. See Figure 2. If we, at this point, "convolve" mathematically this impulse response with the anechoic waveform of

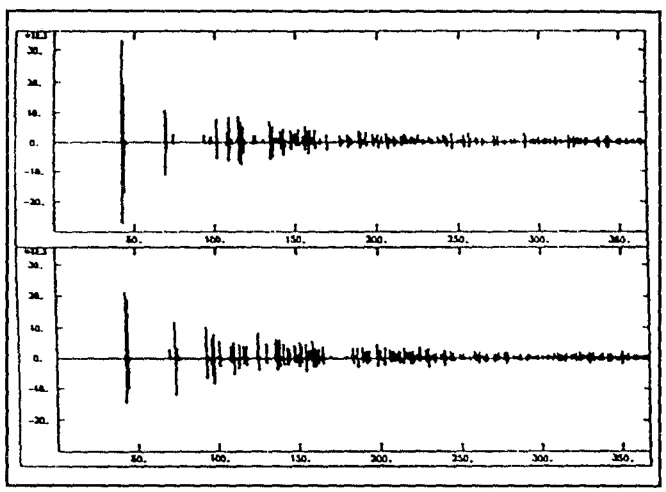


Figure 2—Binaural impulse response (left ear is upper picture).

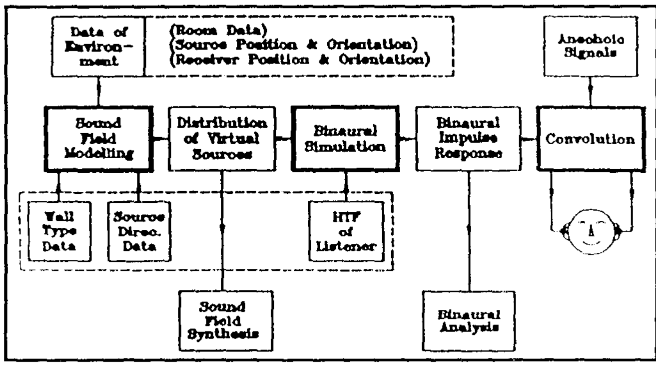


Figure 3

Glossory of Terms

Convolution: the integral of one function multiplied by another function shifted in time. A resultant of the two functions combined.

HTF: the difference between the signal sent to the head and its reponse at the eardrum. See Figure 4.

Virtual Source: The treatment of a reflection as if it were an originating source at a geometric location that would allow said source to produce a signal identical to the reflection at the observers position. See Figure 1b.

Illustrations 1, 2 and 3 are from H. Lehnert and J. Blauert "Virtual Auditory Environment."

music or speech, the result becomes auralization of that music or speech in the room model and we can listen to it. See Figure 3. Changes can then be purposed, listened to, and even its crudest major flaws avoided.

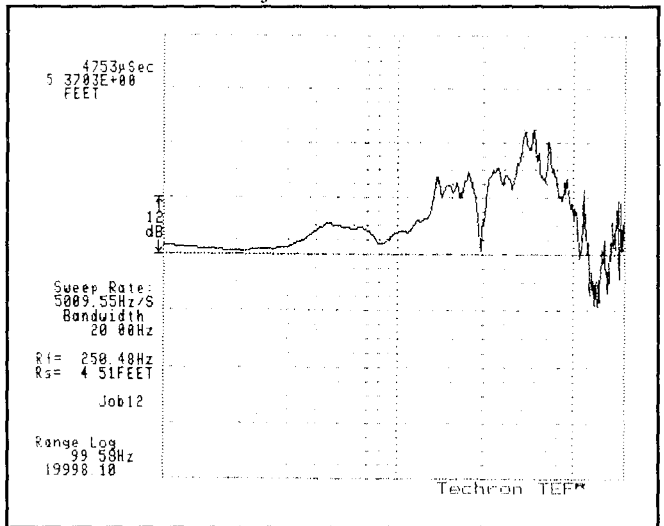


Figure 4

Our Motto in Life

"Mind set" governs most of life's experiences. Early in our young adult married life we went through a severe physical disability. A man, key to our survival, told us a story.

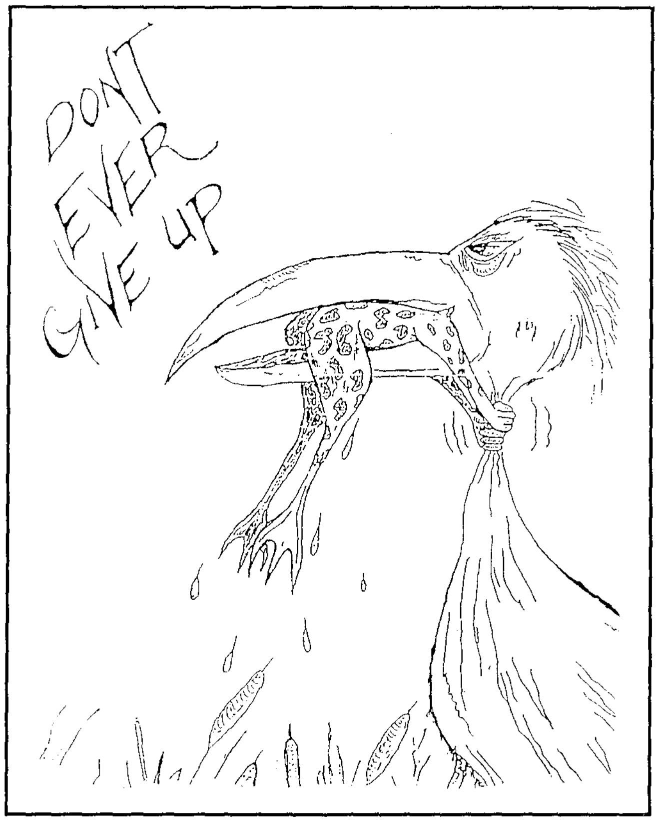
There was a frog caught in a large pothole in the road and couldn't get out because the sides were too steep. Other frogs gathered around to commiserate and offer advice. Finally, they all left, leaving the frog in the pothole to his fate. Later that evening the frog that had been in the pot hole hopped in to dinner.

"How did you get out?" asked the other frogs.

"Well," he replied, "a ten ton truck was heading straight for the pothole and I had to get out."

There's an old poem I've always liked:

So give me a strong right arm for
a wrong's swift righting
Stave of a song on my lips as
my sword is smiting
Death in my boots - may be
but fighting, fighting
Anon



Shared by Bob Reim, Acromedia

Bob Reim of Acromedia in Los Angeles area shared this cartoon with us. It illustrates our life motto.

A European Update from Hellmuth Kolbe

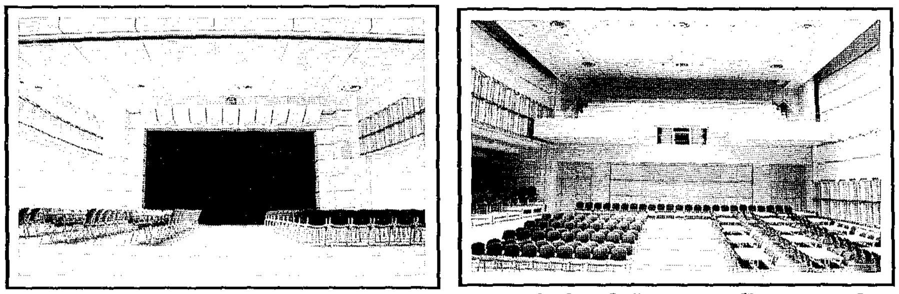


Fig. 1A-1B—Two views of the auditorium. Note right hand diffusor wall first up, then down. Hellmuth Kolbe reports that the German company that fabricated this design for him did a superb job.

Hellmuth Kolbe of Wallisellen (a suburb of Zurich) Switzerland sent us a package of some of his latest consulting work. "In May 1992," he writes, "we opened a new concert/ multipurpose hall at CHAM on the lake of Zug (between Zurich and Lucerne) where I did the building and room acoustics, the sound system design, and where I was for the first time able to get through *all the three important stages of acoustic design:*

(1) model measurements 1:20 (1:16) for setting the important design parameters
(2) auralization to verify and control the global design
(3) 1.1 TDS measurements and in-the-ear recordings to verify and prove the results.

The hall seems to be a success and musicians claim it to be among the three best sounding halls in Switzerland."

Hellmuth used literally tons of QRD-type diffussors to make his moveable sound proof walls between the main auditorium and the two side estrades.

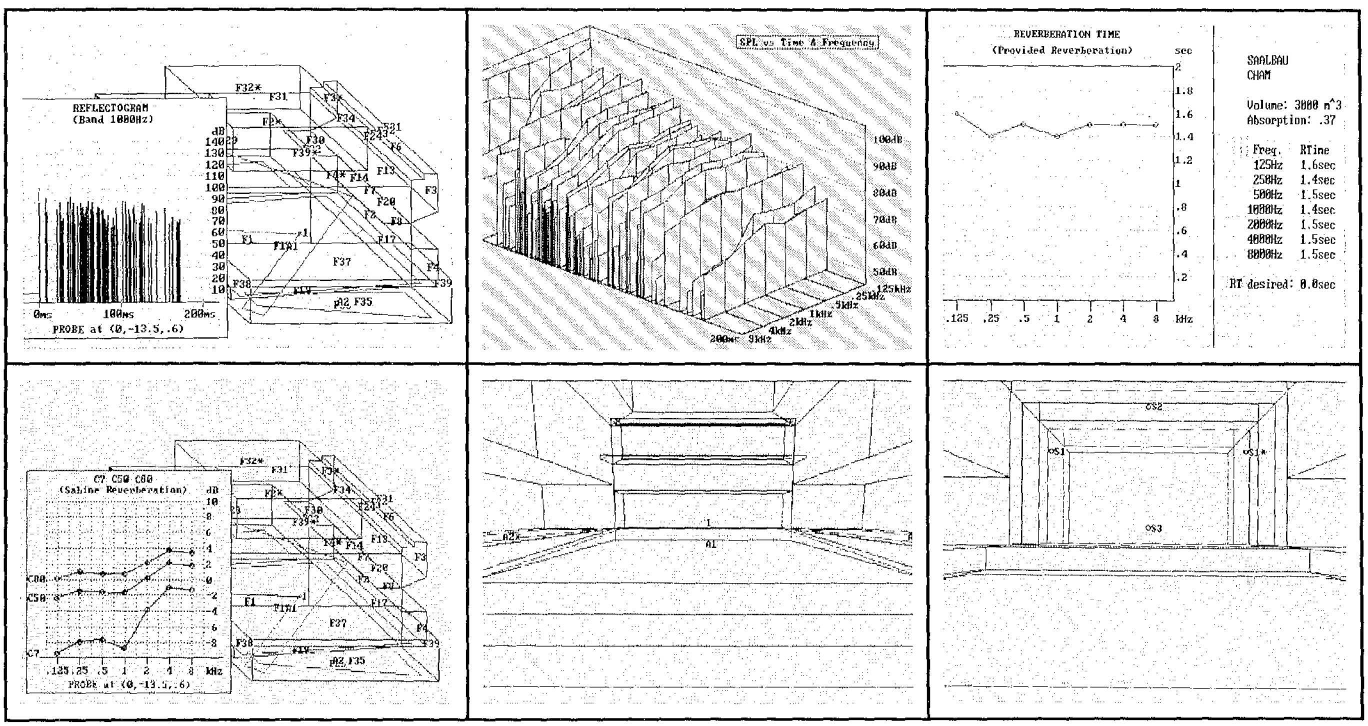
While Hellmuth states he is semi-retired, he has an active schedule. He is a Beta-tester for Dr. Ahnert's EARS program, thus his reference to working with Binaural-Auralization.

"I'm concentrating on auralization, more recently Binaural Auralization. That's a quite exciting new field and a big step forward in room and electroacoustics. On my last four major projects of concert and multipurpose halls and theaters (one finished and three in progress) I was able to work with auralization and *I wouldn't go without it into any major project."*

We have always been an admirer of Hellmuth's work and especially his detailed approach to all phases of it.

His P.S. to his letter is a heart warming one.

"It is absolutely necessary to mention that, without being a Syn-Aud-



Figures 2a -2f—Various printouts from EASE on this auditorium. We were particularly impressed with the plots of the SPL vs distance (time) vs frequency.

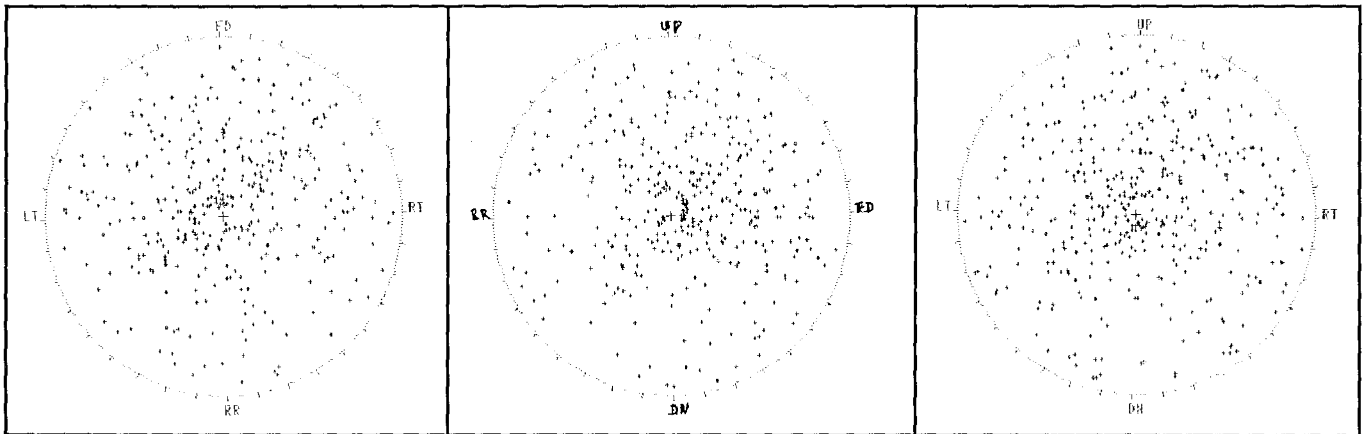


Figure 3a—Mike at Mpt. #1-Polar ETC/ Front—center hall/horizontal

Figure 3b—Same as before, but Polar ETC/Up—Median

Figure 3c—Same as before, but Polar ETC/Up—Lateral

Figure 3a-3c—Hellmuth used Farrel Becker's directional ETC to show good diffusion

Con graduate (no Dick Heyser etc.,etc.,etc.), it would simply be impossible to do acoustics in such a high grade and advanced way."

It is interesting to see that the new Renkus-Heinz EASE and EARS programs are being tested by Hellmuth before they are introduced over here. These programs are the only ones we are aware of that have *originated* from professional acoustic consultants.

There is an old saying, "The hand open to give is open to receive."

The sharing Syn-Aud-Con has done over the years with men like Kolbe and Ahnert have returned a hundredfold to us and all our grads. That's Synergy.

Columbia College in Chicago Has a New Audio Technology Center

Doug Jones, program director at Columbia College in Chicago, can be very proud of his accomplishments.

Columbia College Chicago has acquired more than $1 million in production and recording equipment from the Zenith/dB recording complex in Chicago. The college has also agreed to a long-term lease on the entire recording facility and will convert it into classroom and lab space for the college's sound program.

The 14,000 sq. ft. facility, which will be renamed the Columbia College Audio Technology Center, houses two complete film mix suites, a video post production suite which is one of the most advanced in the city, a 24-track music recording studio, two voice-over and production rooms, and full transfer and dubbing facilities. The classes will now house all the sound classes under one roof.

Columbia College students will be able to do post-production work, explore a wide range of acoustical problems and solutions and learn how to do maintenance on the most sophisticated machines.

According to Doug Jones, "Our sound program is one of the largest in the country. Now it will be one of the best equipped and most versatile. "

Columbia College has several TEF analyzers which is a valuable learning tool.

Columbia College Chicago has 7,133 students and 794 full and part-time faculty members.

We get so many phone calls asking where they can get a degree in audio engineering. If you are one of those people looking for such a college, call up Doug Jones and talk to him about it:

Doug Jones
Columbia College Chicago
600 South Michigan Ave
Chicago, IL 60605
312/663-1600

Columbia College Chicago sound engineering majors, Lily Masco and Mike Kravchuk, use the new 24-track music recording studio in the college's new Audio Technology center in Downtown Chicago.

Hearing Mysteries

The July 1992 issue of Physics Today has an article by Jont B. Allen of Bell Telephone Laboratories and Stephen T. Neely of Boys Town National Research Hospital entitled, "Micromechanical Models of the Cochlea."

Statements made in this article are fascinating; such as, "We now know from direct measurements within the cochlea that the tuning of auditory nerve fibers is entirely mechanical." And further on:

"The cochlea is a nonlinear signal processing system that is able to compress the dynamic range of input signals (from 10^5 to 10^3) without significant degradation of the signal content."

Anyone with an interest in the hearing process will find these authors succinct, and straightforward in their discussion of inherently very difficult problems. We recommend the article without reservation.

Critical Bandwidths

Critical bandwidths keep coming to my attention both because many workers in psychoacoustics publish new investigations into them as well as my present experiences with precision equalization processes and devices.

When we use our hearing to listen, we can focus on tonality, balance, bandwidth, anomalies, polar characteristics, spatial reality, level, or a myriad of other choices. Which one we fasten on will depend on past experiences, training, and present motivation.

In equalization work, we know that the region from 350 to 5800 Hz (to be generous) are very important to speech. This includes 17 critical bands. Note that in using precision equalizers you probably can and ought to ignore minor (1 to 2 dB) variations that are narrower than critical bandwidth. Within the intelligibility region about 1/6 octave would probably be an ideal minimum bandwidth for the correction filter. Certainly you wouldn't start your equalization on anything narrower than a critical bandwidth.

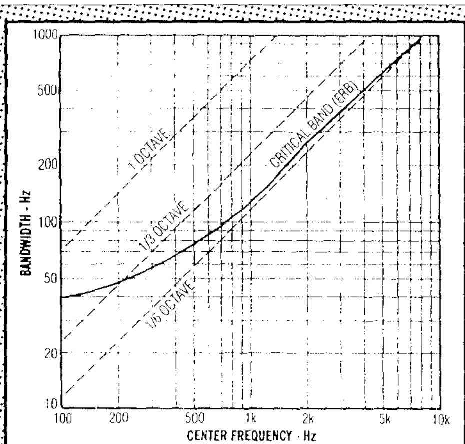
This is also why we consider 1/12 octave real time analysis that point of diminishing return for viewing what should be equalized.

In an industry where the unscrupulous tell the uninformed about L_P's of 180 dB at concerts and 1 Hz resolution in analysis, we can only point out that incompetence convicts itself out of its own mouth.

B. Conversion: critical band rate ↔ frequency

Critical band	Limit frequency	Centre frequency	Critical band width
Tonality z bark	f_q Hz	f_m Hz	Δf_G Hz
1	20-100	50	100
2	200	150	100
3	300	250	100
4	400	350	100
5	510	450	110
6	630	570	120
7	770	700	140
8	920	840	150
9	1080	1000	160
10	1270	1170	190
11	1480	1370	210
12	1720	1600	240
13	2000	1850	280
14	2320	2150	320
15	2700	2500	380
16	3150	2900	450
17	3700	3400	550
18	4400	4000	700
19	5300	4800	900
20	6400	5800	1100
21	7700	7000	1300
22	9500	8500	1800
23	12000	10500	2500
24	15500	13500	3500

We suggest that the charts shown here are worth some study and that familiarity with them will allow you to use signal processing tools more intelligently.



Critical Bandwidths of the Human Ear

Critical Band No.	Center Frequency	Classical Bandwidth (Hz)	Classical Bandwidth %	Equivalent Rectangular Band (ERB), Hz
1	50	100	200	33
2	150	100	67	43
3	250	100	40	52
4	350	100	29	62
5	450	110	24	72
6	570	120	21	84
7	700	140	20	97
8	840	150	18	111
9	1000	160	16	130
10	1170	190	16	150
11	1370	210	15	170
12	1600	240	15	200
13	1850	280	15	220
14	2150	320	15	260
15	2500	380	15	300
16	2900	450	16	350
17	3400	550	16	420
18	4000	700	18	500
19	4800	900	19	620
20	5800	1100	19	780
21	7000	1300	19	990
22	8500	1800	21	1300
23	10500	2500	24	1700
24	13500	3500	26	2400

IED Training Classes

#1 The IED class right after break. It was a full class with a couple of people sitting in the aisle
#2 Hardy Martin during a refreshment break
#3 Wanda Martin in a fun pose for the camera.
#4 Tom Roseberry
#5-6 Class members during break

When we use the word "system", Innovative Electronic Designs, IED, is what we envision. IED has approached the problem of providing audio in complex installations such as airports, convention centers, and other large, spread-out venues in a global manner akin to Mother Bell. This means that conventional knowledge of components is not much help in planning an IED system.

IED management has taken this problem by the throat and designed a class that introduces their equipment to consultants, sound contractors, and end users; instructs in its application, and tests their comprehension of both.

What's unique is the dedication of the teaching personnel, the exceptionally well-equipped teaching facility, and the warm southern hospitality and commitment both to the student and to their business. This commitment is manifest in every part of the class.

Tom Roseberry's role in the growth of this company has been fundamental and reflects the really excellent training in system's design he received from his father - an early Altec sound contractor from the 50s.

When we visit many of our sponsors, and especially IED, the continuity of key personnel is impressive. Putting teams together and keeping them together while maintaining a vigorous growth reveals leadership at work, and the Martins clearly have leadership. We enjoy reading the books on management that have attracted wide attention, but truly successful managers aren't the result of training, but the result of a life long "mind set" that won't settle for less than the best. You can't train people to think this way - you can only select the ones that do.

Invention

In the words of Alexander Graham Bell:

"An inventor is a man who looks around upon the world, and is not content with things as they are; he wants to improve whatever he sees; he wants to benefit the world; he is haunted by an idea, seeking materialization."

George Bernard Shaw said it a little differently:

"A reasonable man attempts to conform to the world as it is; an unreasonable man tries to make the world conform to him; therefore, all progress is made by unreasonable men."

Syn-Aud-Con 1993
Seminar & Workshop Schedule

Theatrical Sound Design Applications Workshop

Where: Purdue University, Lafayette, IN

When: August 10-12, 1993

Fee: $650

Program Chairman: Mark Miceli, University of Arizona

Workshop Coordinator: Rick Thomas, Purdue University

Staff: Abe Jacob, Sound Designer, New York City, along with Mark Miceli and Rick Thomas.

The Workshop is constructed to serve the needs of sound designers, technicians and board operators in regional and academic theaters, and others who design, specify or install systems for use in live theaters.

Program to be developed from the following topics:

* Sound system engineering principles
* Microphone selection and applications of the pit orchestra
* Theatrical mixing techniques
* Sound effect scoring and editing processes
* System design, equalization, processing and MIDI applications
* Examination of surround sound systems and future technologies
* System flow charting and documentation for designers
* Computer modeling and simulation

We hope you will join the top professionals in the Theatrical Sound industry for a hands-on learning and networking experience. Open discussions and small group sessions will put you in touch with the latest developments in an exciting and dynamic industry.

Call or write for more information. A brochure will be sent to you telling you about the qualifcations of the instructors and about the program content.

❖ 3—Day Seminars—$550
Farm—Norman, IN

Sound Engineering Seminars

May 18-20	*September 16-18*
June 17-19	*October 7-9 (New Date)*
July 15-17	

Audio Measurements & Instrumentation Workshop

Where: Indiana University, Bloomington, IN

When: August 18-20, 1993

Fee: $650

Program Chairman: Mike Klasco, Menlo Scientific

Workshop Staff:

Jont Allen, PhD, Bell Labs
Sunil Puria, PhD, Ariel SYSid
Eugene Patronis, PhD, Georgia Tech
Sam Berkow, SIA Consultants

The workshop will concentrate on discussions, demonstrations, and hands-on work in analysis of speakers, audio components, sound systems, acoustics and auralization. Full characterization of devices and systems under test will be explored - frequency and time response, three dimensional analysis as well as distortion characteristics including harmonic, intermodulation, and spectral contamination. Selection of optimum measurement parameters, avoidance of prevalent measurement errors and understanding of when and where FFT technology is the preferred tool will be the focus of this workshop.

Instrumentation will be the Bell Laboratories SYSid (for "system identification") and the Signalogic Hypersignal Acoustic running on the Ariel DSP-16 and an IBM compatible computer. SYSid is an integrated dual-channel FFT analysis tool using swept sine wave, MLS, impulses, or user-defined test signals, and a comprehensive distortion analyzer. In conjunction with Hypersignal Acoustic, the system can provide Auralization for a number of sound system design programs. Other capabilities include dual-channel real-time 3D waterfalls, color spectrograms, arbitrary waveform generation, source-independent response equalization.

Jont Allen, a distinguished member of the technical staff at Bell Laboratories, will discuss SYSid's operational concepts and recent experimental measurements in hall acoustics.

Sunil Puria, a protege of Dr. Allen and responsible for continuing the development of SYSid, will demonstrate SYSid's design, loudspeaker power compression testing, sound system optimization, distortion testing of audio components, characterization of signal processing devices, and more will also be demonstrated.

The third day of the workshop will be dedicated to Hypersignal Acoustic and Auralization. Eugene Patronis of Georgia Tech, Jeff Brower of Signalogic and Sam Berkow of SIA Consulting will explore their uses of these powerful analysis tools in audio engineering applications.

Anyone who is engaged in electronic or acoustic measurements, but has not yet fully explored the dual-channel FFT techniques will find this an extremely important workshop at attend.

The Ins and Outs of Audio

Audio circuitry is the circuitry having signals in the frequency range of 20 to 20,000 Hz and that is electromagnetically propagated. In sound system work we treat differing devices as "Black Boxes" that provide differing treatment of the transfer function such as providing overall gain or loss, frequency filtering, signal delay, and various forms of frequency equalization. The system's engineer is interested in the input and output parameters of these "black boxes". The component engineer is interested in what goes on inside the "black boxes".

Input-Output Parameters

1. Levels
2. Impedances
3. Polarities
4. Phase
5. Signal delay

Normally the system's engineer is dealing with devices that fall into a class of acceptable distortions for the work at hand and is not engaged in the design or redesign of the individual components but only with their optimum employment. When a faulty "black box" appears, it is replaced.

Transducer Input

Audio systems interface with acoustic systems. Acoustic systems are those having signals in the frequency range of 20 to 20,000 Hz and that is acoustically propagated, (i.e., slower velocities in a material media.)

Microphones represent one type of interface. The sound pressure squared level from a performer is imposed on the microphone's diaphragm and is converted from mechanical motion of the voice coil in a magnetic field into an electrical varying voltage.

If that varying voltage is converted into an available power level by a system that utilizes a zero reference having meaning to both the electrical and the acoustical signal, we can then obtain electrical input levels by merely adding the performer's acoustic level to the electrical sensitivity measurement of the microphone. The reference level for the microphones that has proven to be most successful is an L_P = 0 dB, then, since dBs are dBs, the acoustic level of a performer, which is referenced to the same 0 dB, can be directly added to the sensitivity figure in order to obtain the available input power level.

Transducer Output

The same kind of scheme can be utilized at the output end of the system, but this time using the reference of zero dBm. The loudspeaker's sensitivity level acoustically is found by inputting it with a 0.001W (1 mW electrical input and ascertaining its acoustic output). One mW is a level of zero dBm.

The Reference Levels

By definition, the electrical reference power is 0.001 W or 1/1000th of a watt). By definition, the acoustic reference sound pressure is 0.00002 Pa (20 uPa or 20 micropascals).

The electrical reference level is:

$$L_{dBm} = 10 \log \left(\frac{0.001W}{0.001W} \right) = 0 \text{ dBm}$$

The acoustic reference level is:

$$L_P = 20 \log \left(\frac{0.00002pa}{0.00002pa} \right) = 0 \text{ dB}$$

EIA Sensitivities

The EIA (Electronic Industrial Assoc) standard for microphones is:

$$10 \log \left(\frac{(E_S)^2}{0.001 R_S} \right) - 6.02 \text{ dB} - \text{test } L_P$$

$$= \text{sensitivity in dBm for an input of } L_P = 0$$

The EIA standard for loudspeakers is: "The acoustic L_P at 30; when the electrical input power is 1 mW"

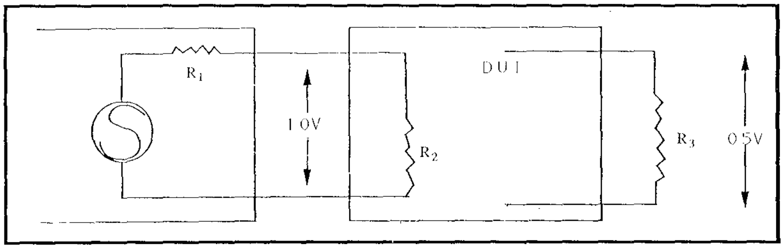
dB / 0.001W / 30'

(Note that 30' and 10M are 0.78 dB apart -- 30' = 9.17M. So subtract 0.8 dB from the 30' rating to obtain the 10M rating.)

The Ins and Outs of Audio

At the input of the system, we go from an acoustic level L_P to an electrical level in dBm. At the output of the system, we go from an electrical level in dBm back to an acoustic L_P. Since the dBm system is obviously so handy and useful, why is it resisted occasionally by those who need it the most? In my opinion, the difficulty springs from ignorance of the difference between available power and dissipated power.

Sound systems are designed, installed and operated to increase the intensity level at the listener's ears over which would have been present without the system. The only measure of the performance of a sound system is what happens at the listener.



As an example, if the device under test D.U.T. has an input voltage of one volt from a line amplifier with a source impedance of one hundred and fifty Ohms R1 into an input impedance of 10,000 Ω R2, and the output of the D.U.T. has an 8 Ω R3 loudspeaker attached as a load. Is the black box amplifying or attenuating the signal as it passes through the box? This question can be broken down into four parts.

1. The voltage amplification = $20 \log\left(\frac{E_{OUT}}{E_S}\right)$
2. The coupling factor = $20 \log\left(\frac{R_{IN}}{R_S + R_{IN}}\right)$
3. The impedance mismatch = $10 \log\left(\frac{R_S}{R_L}\right)$
4. The difference between a matched circuit and an open circuit = +6.02 dB

$$20 \log\left(\frac{0.5}{1.0}\right) + 20 \log\left(\frac{10{,}000}{[150]+[10{,}000]}\right) + 10 \log\left(\frac{150}{8}\right) + 6.02 \text{ dB}$$

$$(-6.02) + (-0.13) + (+12.73) + 6.02 \text{ dB} = +12.6 \text{ dB (Gain)}$$

Now, let's apply this to the D.U.T. It's easy to see that a voltmeter with a decibel scale is useless in measuring the gain or loss of this quite common power amplifier situation.

Another Path

We can look at this same situation using our standard dBm system. The output power is dissipated power level

$$10 \log\left(\frac{(0.5)^2}{0.001\,(8)}\right) = 14.95 \text{ dBm}$$

The available input power level requires that we find the sources E

$$E_S = E_{IN}\left(\frac{R_S + R_{IN}}{R_{IN}}\right)$$

$$E_S = 1\left(\frac{(150) + (10{,}000)}{10{,}000}\right) = 1.015\text{V}$$

and

$$10 \log\left(\frac{(1.015)^2}{0.001\,(150)}\right) - 6.02 \text{ dB} = 2.35 \text{ dBm}$$

If 14.95 dBm is the output power, then the D.U.T. has a gain of 14.95 dBm = 12.6 dB

Note that two absolute levels subtracted provide any signal above its noise floor 12 dB of gain until that amount of gain exceeds the power level available.

EASE Evolution

When Dr. Ahnert was visiting us in Indiana last Spring he was put out by my insistence that EASE, while my choice as a superb program, was just plainly not easy to use, yea difficult. I challenged him to make it easy to operate and understand by someone like myself that wants to use the program to get an acoustical job done rather than practice being a computer expert.

EASE 2.0, which I have just had a preview of, answers my requests to a truly remarkable degree. EASE 2.0 is almost entirely mouse driven with pull down menus at the top of the screen and push button choices at the bottom of the screen along with highlighted available functions vs unhighlighted functions not available at that step. It quickly leads the operator to all available choices and the next step to take.

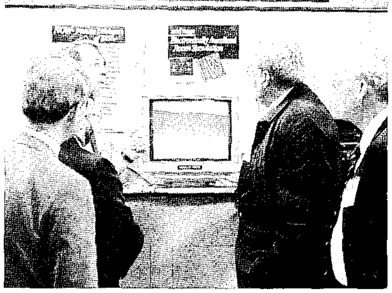
Probably the most notable change is the improved graphics over what had been the best graphics available. Click and drag, click and zoom, click and rotate, click and remove surfaces, and much, much more. Anyone using AutoCad would find EASE a natural for the acoustics part of the work.

EARS

Available with and dependent upon EASE 2.0 is EARS - the most advanced auralization program in audio today. EARS software is programmed to generate Binaural Auralization complete with pinnae transfer functions, directionality, and a synthesized reverberant "tail" on the early reflected data. These features lift EARS completely out of the "toy" category of their competition and becomes a very serious working tool for the professional acoustic engineer.

Both of these new programs were introduced at the Berlin AES meeting in March. For further details contact Ron Sauro, Renkus Heinz, 17191 Armstrong Ave, Irvine, CA 92714.

NAMM 1993



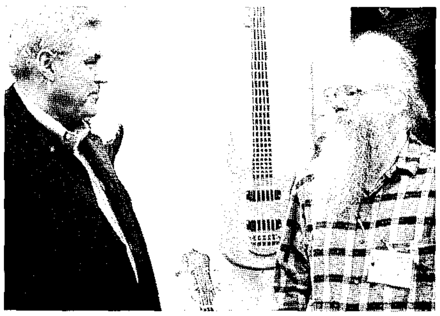
We slipped into NAMM 1993 as guests of Renkus-Heinz to see an advance preview of EASE 2.0 and hear about the progress of EARS, the Binaural Auralization program.

Frank Ostrander showed us his new equalizer for their Controllers (no longer called processors) used in the SR-4 loudspeakers. This is the loudspeaker that measured so well on and off axis in the Workshop last May at the Medora gym during the Precision Equalization demonstration. Frank witnessed the demonstration and made some very clever modifications to their existing "processors". Don't let his quiet, boyish look of naivety fool you; Frank is one fine engineer.

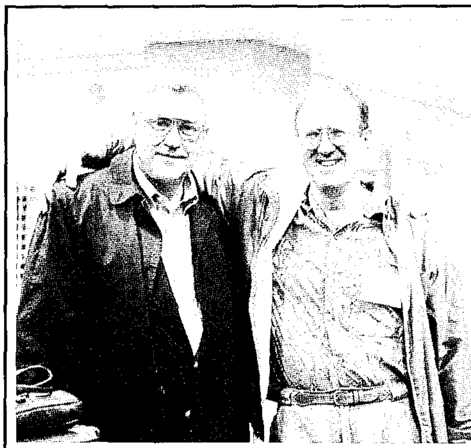
We were pleased to learn that Ron Sauro, a recent Syn-Aud-Con grad, has joined RH as Engineered Systems Manager. Ron is a very bright man with an intense interest and enthusiasm for EASE - long before he joined Renkus-Heinz.

Renkus-Heinz has a new supercharged sales manager who is dynamic, energetic, and best of all, believable. The kind of enthusiasm that Jimmy Kawalek generates can only stem from actual experienced facts.

Harro Heinz, President, can be very pleased with the strong staff he has put together. His son, Ralph, is bursting with energy and talent. Harro said that they just enjoyed their best year at RH, with very strong sales abroad.



We saw an old friend, Ron Wickersham, in his Alembic booth. Ron is the real article when it comes to creative design and we have long valued his opinion on audio technical matters. Ron played a key role in early Pressure Zone Microphones (though they were not called that then) and Time Align™ loudspeakers - working with Ed Long, and in addition, providing audio ideas used by The Grateful Dead to build the Wall of Sound touring system.



A little further down the aisle, we ran into Cliff Henricksen and discovered he now works for Carver (U S Sound having been purchased by Carver and Cliff will be moving to the great Northwest and his loudspeaker designs will be manufactured there.) Cliff Henricksen is one of the "count on the fingers of one hand" great transducer engineers in this country. He hasn't been very visible for several years, and we expect to see and hear much more from him.

We then stopped by to say hello to Hartley Peavey to both hear and tell the latest political jokes.

We saw Jim Kogen, President of Shure Brothers in their exhibit area. (You don't find many presidents of major major companies in their exhbit booths. I can probably count them on one hand.) We enjoyed an exchange on the European audio possibilities in the near future. Jim's close attention to his end-customers is a good example of how to know if your products are relevant to your market.

Live Sound IV 1993 Workshop

Chapman University in Orange, CA, was once again the scene of a successful, well-attended workshop devoted to Live Sound Reinforcement and its many new manifestations. The workshop was held January 12-14, 1993, with 96 paying people from around the world; with staff, crew, press, etc there were 125 people present. The Workshop was co-sponsored by ProSound News and Syn-Aud-Con.

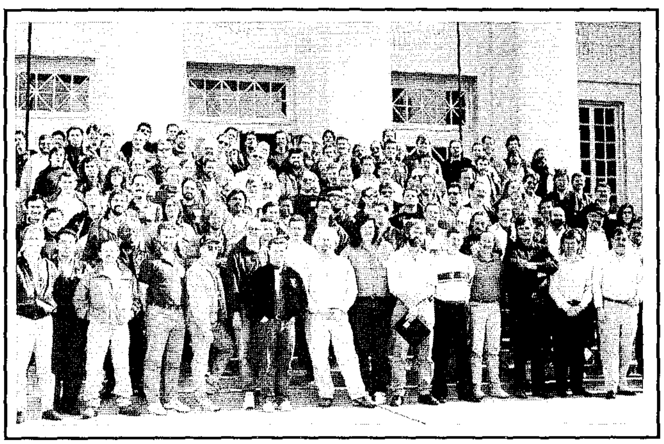
While quite different from our more engineering-oriented workshops, the Live Sound Workshop has achieved deserved recognition as the one where the founding fathers of the touring sound business share generously of their insights, experience, and intuitions about the future of touring concert sound and its new paths into theme parks and large church venues.

One look at the number of people in attendance (see picture 1) and the staff (see picture 2) reveals the "chicken and the egg" of this Workshop's success. The staff has much of real life value to share and the participants recognize that they do and will share it with them. On top of the shared experience, tons of the latest equipment is used and everyone gets a chance to play with it.

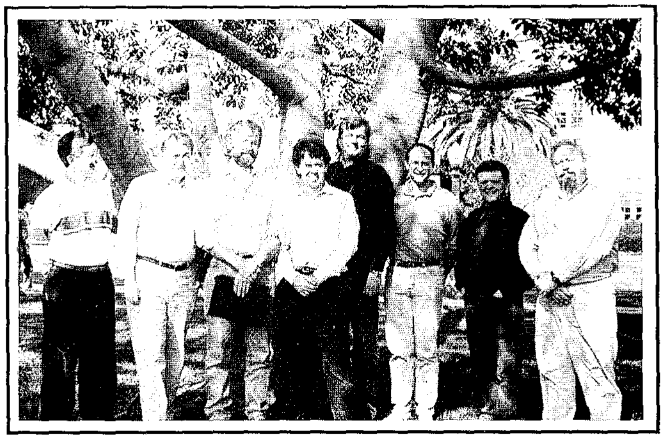
While we experienced some rain during our Workshop, we also had very pleasant weather as the pictures reveal, and the main monsoon didn't arrive until the NAMM show.

A "live" band again was the patient test bed used by the instructors to demonstrate microphone technique, monitor mixing, and other artist related matters.

The top people in Live Sound Reinforcement are moving into the the sound contractor market place. In our



Pic. 1—The sustained interest in Concert Sound expertise is evident in the size of this IV annual Concert Sound Workshop held at Chapman University in Orange, CA.

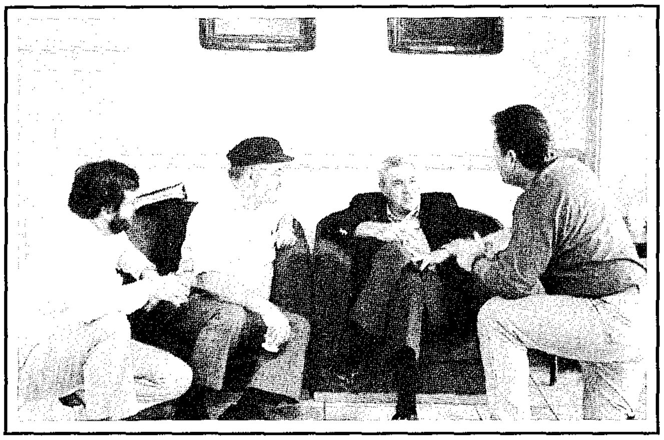


Pic. 2—The larger-than-usual staff brought together this year includes the original Five: Albert Leccese of Audio Analysts, Will Parry of SPL Ltd, M. L. Procise of Showco, David Scheirman of Concert Consultants, and Mick Whelan of Electrotec plus Paul Gallo of Pro Sound News, Co-Sponsor of the Workshop with Syn-Aud-Con for the past two years. Randy Siegmeister of Maryland Sound and Randy Weitzel, independent monitor engineer with the recent Michael Jackson tour, were valuable additions to the staff. We never lose the thrill of watching these highly competitive men working together in warm friendship for a week.

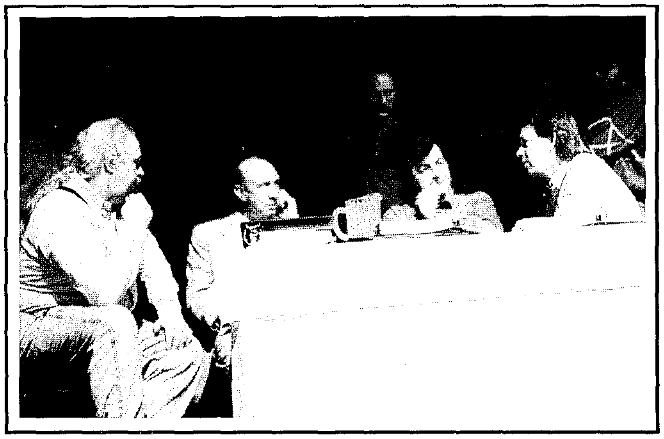
Pic. 3—Chapman University has, since our first workshop there five years ago, greatly expanded their facilities and our meals were held in the new restaurant they have built - where we used to park our motorhome during the workshop.

Pic. 4—A remarkable lady, Diane Rapaport from historic mining town of Jerome, AZ, is the publisher of two books that help musicians mine a different kind of mother lode. She has written one of the books: *How to Make and Sell Your Own Record.* Diane was the driving force behind *The Musician's Businss & Legal Guide.* They are both extremely worthwhile. They are published by Jerome Highlands Press in Jerome, Arizona, a publishing company that Diane owns.

lifetime, we have observed at least three distinct cycles of input to sound contacting. The first wave came out of those ready to graduate from selling high fidelity equipment. The second came out of music merchants as they learned more about the technical side of what they sold and the third is now the concert sound touring men and women. The original sound contracting business drew men from motion picture theater sound, broadcasting, and electrical contracting. It is likely that in this group picture there may well be the super sound contractor of the year 2,000.



Pic. 5— The discussion shown here is not for delicate ears unused to the dBm, analytic signal, and TEF techniques. The Live Sound Workshop draws a certain percentage of Syn-Aud-Con grads, and old friends that make the trip even more worthwhile for us.



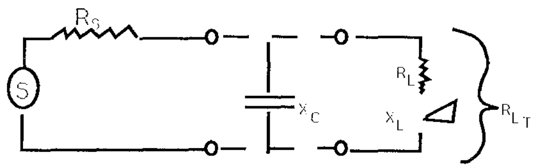
Pic. 6—The staff was wonderful about sharing with the members of the workshop during breaks and meals as well as during class time. This is an unusual picture. We had to threaten the staff to get them off the stage. Gary Wilson, chief electrical inspector for the city of Los Angeles had just addressed the workshop on ac power for tours, the 1993 NEC electrical code - a number of vital subjects for touring sound people. Come break time the staff wouldn't come off stage. They wanted to keep talking to Mr. Wilson. One of the few times that the staff wasn't out there mingling.

Pic.7—Here are three more people who enriched the Workshop program. Steve Conrad and Peter Baird from the sound department at the Crystal Cathedral. Mike Rives at MCA/Universal talked about theme park productions. He is shown here with Will Parry. I had a chance to talk to them during a break. They reinforced what I already know. People who work in audio do so because they love audio and people who love their work are fun to be around.

Impedance

In electronics work there are three primary passive components: Resistance, 'R', Inductance, 'L', and Capacitance, 'C'. Resistance is measured in Ohms; inductance in Henrys, and capacitance in Farads.

In as simple a theoretical case as could be imagined, we could encounter at the output of a sound system



Here we have the resistance of the source, capacitance of a lossless line, and resistance and inductance of the voice coil of a loudspeaker.

As sound system engineers, we rarely are called upon to measure these individual circuit parameters. What we are called upon to measure regularly is the total impedance of circuits.

Why Impedance?

A good question. Why so much dependence upon impedance, Z? It's because Z is what has to be 'matched' in 'matched circuits', what has to be made appropriate in unmatched circuits, and what must be available to correctly measure audio power.

What is Impedance?

In early communication circuits, the Atlantic cable and telephone long lines, the effects of impedance were felt, analyzed, and quantified. Oliver Heaviside was the first to show that lines of great length suffer from both resistance and reactance. Reactance was originally thought of as "wattless resistance" and the case of long lines manifested itself as a frequency dependent capacitance that acted as a low pass filter.

Michael Pupin, a Serbian immigrant, determined both the amount of inductance needed to compensate for the capacitance of the lines as well as the proper spacing of the inductors:

"Using these 'loading coils', as they were called, properly spaced in their lines, the transmission distance for the telephone reached from New York to Denver by 1911 without the benefit of amplification."

In 1893 A. E. Kennelly published a paper on impedance giving us that word to replace the term "apparent resistance" This same paper utilized the $\sqrt{-1}$ and Charles Proteus Steinmetz offered the term reactance to replace "wattless resistance" then in use. Steinmetz went on to show that:

$$A + JB = r\left(\cos\theta + j\sin\theta\right)$$
$$z\cos\theta = R$$
$$z\sin\theta = x$$

which was not known in engineering circles in the United States at that time and which in due time led to the

$$Ze^{i\theta}$$

Having now introduced all the terms, let's define them. See Figure 1.

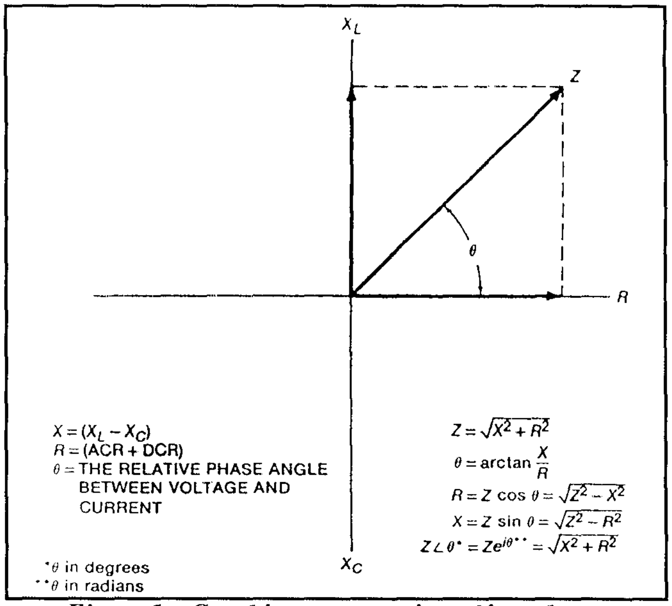


Figure 1—Graphic representation of impedance

We have defined impedance as the total opposition to the flow of current. Have you ever wondered why a matched circuit has just one-half the voltage of an open circuit?

In an open circuit, no current flows. Electronic circuits are electromagnetic circuits with the magnetic field polarized at 90° to the electric field. When no current flows there is no magnetic field and its energy is now present in the electric field with the resultant doubling of the voltage. See Figure 2.

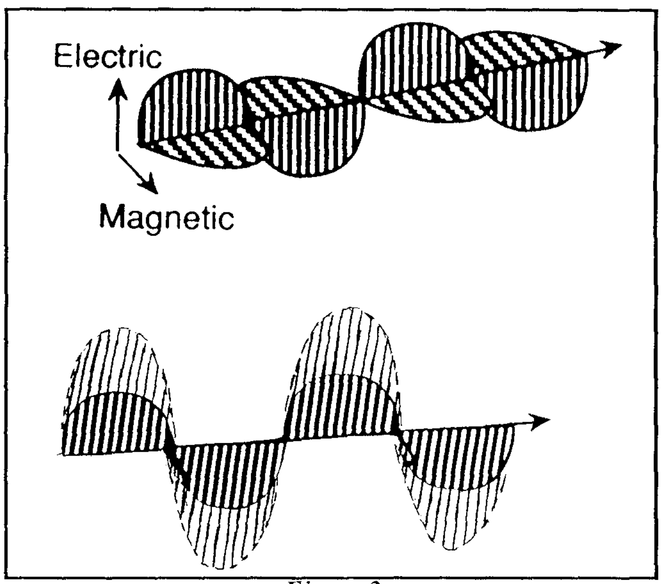


Figure 2

If we attach a load that is an exact match to the source, we draw the maximum available power but only one half the maximum available voltage. In the maximum power drawn condition, one half the power is absorbed in the load and one half in the source. If we were to attach a load that was a pure inductance or a pure capacitance all power would be *reflected* back to the source and none absorbed in the load.

The saying we use in class, "ELI the ICEman" describes the role of the phase relationship between voltage and current. The voltage "leads" current when inductance L is present and current leads voltage when capacitance C predominates. A load that was pure inductive or pure capacitive would absorb no power sent to it but reflect all the power back to the source.

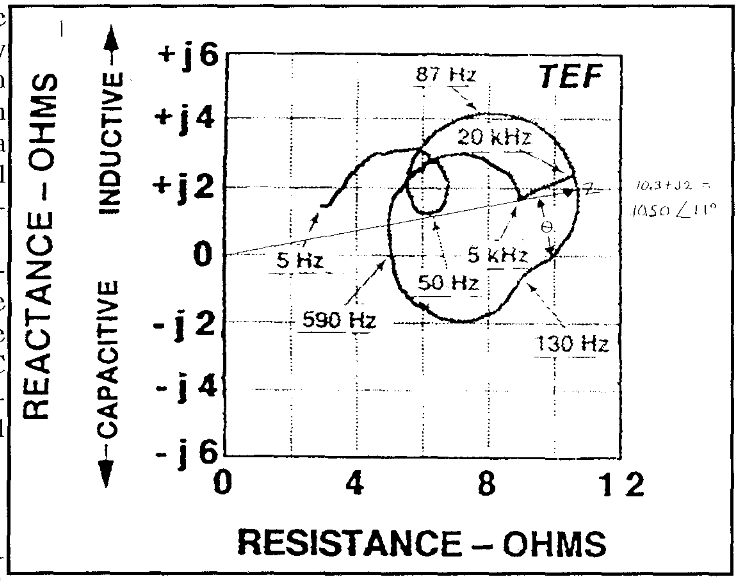


Figure 3

Distributed vs Lumped Parameters

The total impedance value measured on a transmission line may be due to a single component terminating the line (lumped parameter) or it may be due to a line loss, loading devices, and faulty terminators (distributed parameters.)

Distributed parameters can result in frequency dependent signal delays. Fortunately the short transmission lines used in auditoriums, gymnasiums, and the like do not normally have significant distributed parameters and can be modelled as lumped parameters.

Measuring Power

Recall that we said that Z was necessary in order to correctly ascertain the audio power

$$W_{AVG} = \frac{\left(E_{RMS}\right)^2}{Z}\cos\theta$$

The continuous sine wave power in a load is called the average power. RMS power is an error promulgated by the high futility industry. Opposing fads is a hopeless task.

The cos θ is sometimes called the power factor, P.F., by which is meant the fraction of the power sent to the load that is actually absorbed by the load.

Preferred Measurements

While Z is usually only measured as magnitude, a great deal of the time the design of a conjugate circuit (a circuit which not only matches the impedance but compensates for its phase with a mirror image phase of opposite sign) requires knowledge of the phase angle. As has been pointed out above, so does proper power measurements. This is why we prefer measuring what is called the complex impedance wherein every frequency can be instantly seen to be of a given magnitude, phase angle, and predominately capacitive or reactive at a glance. See Figure 3.

Finally, thanks to the miracle of TEF, we can see the complex impedance in all its calibrated glory using the Heyser spiral. See Figure 4A & 4B.

The next time somebody says Impedance, What's that? You have the answer.

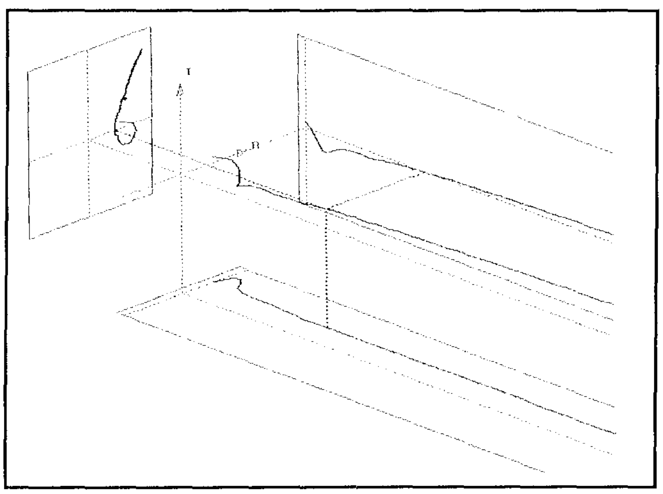


Figure 4A

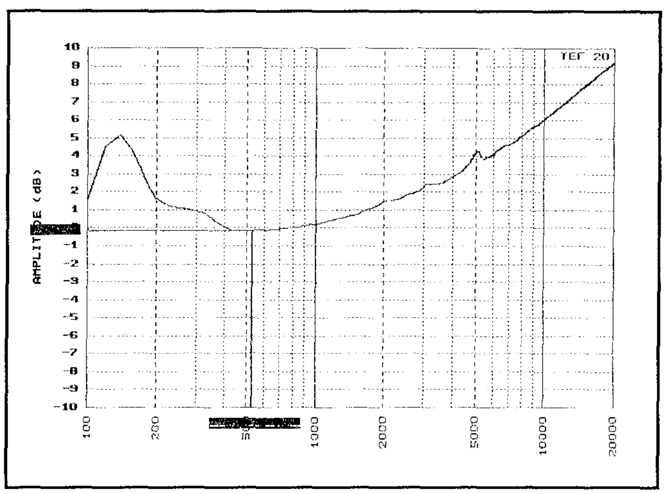


Figure 4B

Hearing Assistance System vs Assistive Listening System

Peter Tappan of Kirkegaard & Associates in Downers Grove, IL has done it again. It was he who started the campaign to change the use of Time Delay to Signal Delay.

Now he wants our help in changing Assistive Listening Systems to Hearing Assistance Systems.

Peter does a great job of explaining his reasoning. See his letter reproduced here.

KIRKEGAARD & ASSOCIATES

12 February 1993

Dear Don and Carolyn:

Some years ago, with your help, I conducted a largely successful campaign to get people to use the term "signal delay" or "audio delay" instead of the then common but incorrect "time delay."

Today, we are encountering a similarly inappropriate term, and I would like to recommend its replacement to our industry. The term is "assistive listening system," and it is a gross misnomer.

In the first place, the equipment is not a listening system. It does not listen; people do. In the second place, it does not even assist people to listen. Listening is something people do on their own, without requiring any assistance. What the system does is to assist people to **hear**.

Let us, therefore, call it a **hearing assistance system.** After all, we do not talk about looking eye dogs!

Looking forward to seeing you at the NSCA Convention.

Sincerely,

Peter W. Tappan

Euler's Equation

One of Euler's greatest discoveries was the connection between exponential and trignometric functions. It has been said that this equation contains the history of mathematics in its symbols:

- π the unending transcendental value
- e the exponent of the naperian based logarithm
- 1 the fundamental number
- 0 the place holder
- \+ the basic addition operator
- = the equality symbol

In audio work, a knowledge of this equation greatly simplifies impedance problems, acoustic phase problems, and a greater ease in following transfer function equations.

Euler's Equation

$$e^{i\pi} + 1 = 0$$

Where: $e^{i\pi}$ is $(\cos \pi + i \sin \pi)$

As Used in Audio

$A e^{i\theta}$

Where: $A \cos \theta$ is the real part
$A \sin \theta$ is the imaginary part
$e^{i\theta}$ is the phase angle in radians

$Z e^{i\theta}$

Where: Z is the magnitude of the impedance
$Z \cos \theta$ is the ACR
$Z \sin \theta$ is thereactance
$e^{i\theta}$ is the phase angle in radians

Is RT_{60} Still Relevant?

The term RT_{60} stands for the time in seconds for an interrupted steady state signal to drop in level by 60 dB (i.e., to 1,000,000th of its original Lp.)

The famous Sabine Equation for this parameter is:

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

Where: V is the internal volume of the enclosed space in either feet or meters
Sa is the total absorption present in ft^2 or M_2
c is the velocity of sound in either feet or meters

To properly measure RT_{60} the measurement must take place beyond critical distance, D_c, from the sound source in the part of the sound field that is predominately L_R (i.e., L_D at least 6 dB below L_T). A further requirement is at least 30 dB of S/N between L_R and L_{AMB}. It is also understood that the reverberant sound field is mixing and homogeneous (i.e., Ergodic).

These constraints often conspire to make the measured decay meaningless. What is always relevant is the energy time curve, ETC, for a given point of observation.

Statistical vs Specific

One of the great appeals of the Sabine Equation is its justification of the statistical application of absorbent materials. Specific application of the same material requires extensive ray tracing or imaging at the design stage and careful measurement at the application. The economy and efficiency gained by the specific approach quickly offsets the increased computer cost at the design stage and the increased cost of instrumentation at the measurement stage.

What Kind of Microphone

Experience has taught us that omni-directional microphones are probably not the best choice for these measurements. We have seen significant information appear when In-the-Ear measurement measurements are made vs the same measurement made with an omni. RT_{60} measurements are intended to be made using an omni source and an omni receiver. In real life we use highly directional sources and the listener also discriminates directionally. This is probably why RT_{60} measurements and what we hear do not correlate any better than they do.

What does correlate directly and meaningfully is the specific application of acoustic materials to specific reflection paths relative to the source and the listener. This is not to say that areas won't be identified as needing treatment in total. In treating specific reflection paths the three most common and useful materials are:

1. Diffusors
2. Absorbers
3. Reflectors

The further from Ergodic a space is, that is, when the Sabine Equation has the least possible chance for validity, the more pertinent becomes specific approaches.

Sabine carefully delineated the constraints to be met before applying his equation. It's the material suppliers and their cohorts who have ignored these constraints.

The Real Need in Difficult Spaces

Often the most essential need for the sound system designer or the trouble-shooting contractor dealing with difficult indoor acoustic environments is to reduce the reverberant sound field level L_R, not its decay time RT_{60}. We do this by:

1. Increasing Q and lowering L_W
2. Shortening D_2 (with due consideration for the effects of N factor) thereby raising Lp
3. Careful orientation of sources seeking a high architectural modifier M_a absorption sparingly used in a manner that increases M_a.

Finally, when we involve RT_{60} as an engineering parameter, let's be sure that is what we have, that we did measure the decay of L_R free from the influence of L_{AMB} and that we are at least twice D_C. Be sure you are not looking at a highly reflective sound field instead of a reverberant sound field. As a concluding rule of thumb, remember that in a space large enough to be a public room, a measurement of RT_{60} less than 1.5 secs is probably not meaningful as an engineering parameter.

See *Sound System Engineering* for definition of terms.

W.I.R.E.

Ohms law is expressed as: E = IR and W = EI

The potential force (E) is the product of the current (I) and the resistance (R) and: The power (W) is the product of the voltage (E) and the current (I).

From these two simple equations the WIRE wheel is generated. See Figure 1.

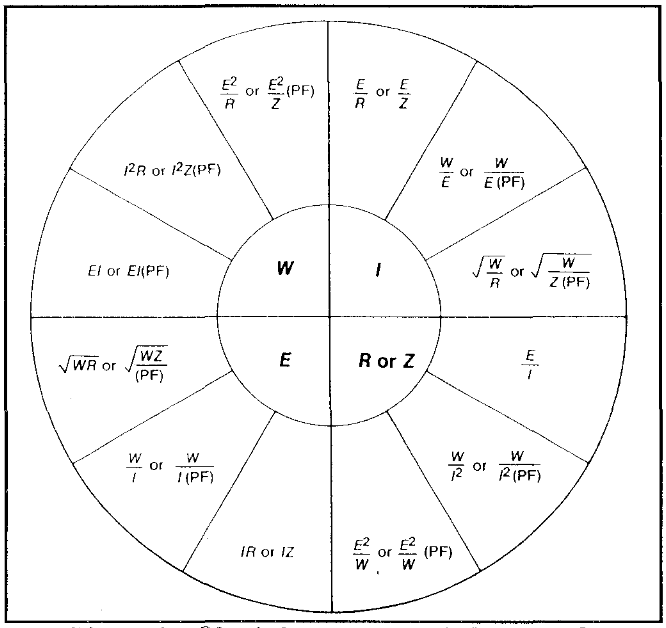
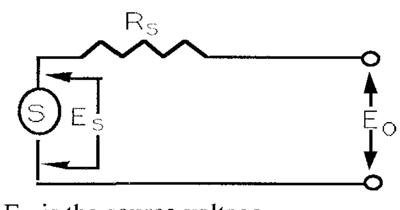


Figure 1—Ohm's law nomograph for ac or dc

Audio Systems

In audio systems, the primary use we make of Ohms law is to find power and voltage values. Current is rarely measured. Typically we deal with either a source or a load.

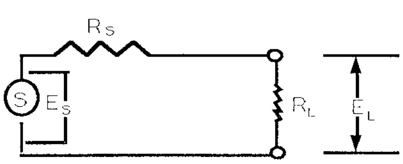
A source is diagrammed as:



Where: E_S is the source voltage
R_S is the source resistance
E_O is the open circuit voltage
($E_O = E_S$)

Available Power

A source is said to develop its maximum available power when the load presented to it equals its source resistance.



This is a voltage divider circuit and:

$$E_L = \left(\frac{E_S R_L}{R_S + R_L}\right)$$

See Figure 2.

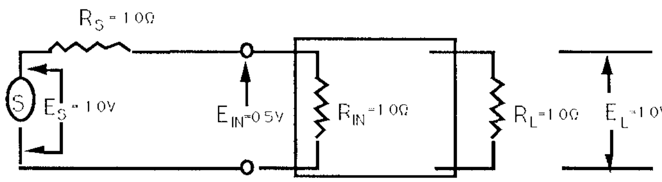
If we assign an E_S = 1.0V and R_S = 1.0Ω and R_L = 1.0Ω, then

$$E_L = 1.0\left(\frac{1}{1+1}\right) = 0.5V$$

The power dissipated in R_L then becomes:

$$W = \frac{(E_L)^2}{R_L} = \frac{(0.5)^2}{1} = 0.25W$$

If we connect our source to the input of a "black box" with an R_{IN} =1.0Ω, a R_L = 1.0Ω, and E_L = 1.0 V then:



We would find at R_L that:

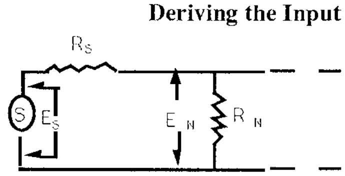
$$W = \frac{(E_L)^2}{R_L} = \frac{(1.0)^2}{1} = 1.0\ W$$

This would mean that the black box was an amplifier because the power went up from 0.25 W to 1.0 W (a 4 to 1 ratio). Our voltage, however, merely doubled.

Some Rules This Has Taught Us

1. The difference between a matched circuit and an open circuit is a two-to-one voltage change
2. When, in a matched circuit condition, doubling the voltage quadruples the power
3. Amplification is an increase in either voltage or power
4. Power is related to the square of the voltage across a given resistance
5. We now know the meaning of R_S, R_{IN}, R_L, E_S, E_{IN}, , E_L, W, I, R, E

Deriving the Input Voltage EIN



Let: E_S = 1.0V, RS = 1.0Ω, R_{IN} - 1.0Ω. Find E_{IN}

Ohms Law states: I = E/R

$$R = R_S + R_{IN} \qquad E = E_S$$

$$I = \frac{E_S}{R_S + R_{IN}} = \frac{1.0}{1.0 + 1.0} = 0.5\ AMP$$

$$E = I \cdot R$$

E = E_{IN} when R = R_{IN} $\qquad$ E_{IN} = 0.5 (1.0) = 0.5V

Combining Equations

$$E_{IN} = \frac{E_S}{R_S + R_{IN}} \cdot R_{IN} = \frac{E_S R_{IN}}{R_S + R_{IN}}$$

$$\text{And: } E_S = \frac{E_{IN}(R_S + R_{IN})}{R_{IN}}$$

It's Amazing What 4-bits Will Buy You

At the same time that Barry McKinnon sent us the info on architects, consultants and sound contractors, (page 26) he included a press release from Sony on High Definition 20-bit Sound.

Sony got a bit carried away on the jacket of a CD and said, "...it is now possible to make not only excellent reproductions without loss of quality, but to reveal hidden details and vividness of colour not evident in the original recording." It was the "not evident in the original recording" that bothered Barry. As he said in his fax, "Those 4 extra bits seem to be pretty creative. Amazing what 4 bits will buy you these days."

The same day we got Barry McKinnon's fax, we received a press release from Dorian Recordings talking about their use of 20-bit Analog to Digital Converter developed by Vince Capizzo. I will quote a portion of the press release because it explains why those 4-bits are so important:

"True 20-bit conversion provides far higher levels of audio resolution - the ability for the digital signal to resolve fine musical details and nuances in dynamics, tone color and spatial information. ...the difference between a traditional 16-bit system and 20 bits is very clear: 16-bit systems offer a maximum resolution 2^{16} gradations of musical information, while a 20-bit system resolves 2^{20} gradations. This might not seem like much difference at first glance, but in fact it is -- there are only 65,536 gradations available to a 16-bit system compared with 1,048,576 in a 20-bit system! The difference is manifested in a far more open, detailed, life-like sound with a significantly better representation of very minute sonic 'cues' that contribute psychoacoustically to our perception of the spatial elements in sound - where the sound is coming from, the acoustic environment in which the sound occurs, and the palpable 'aural image' of the sound."

Dorian Takes Historic Leap Forward in Realm of Digital Technology

Still we have 16-bit playback medium, not 20-bit. However, Craig Dory says "we can optimally choose the best 16-bit window out of the 20 bits we've recorded.....yielding better sound quality than was ever possible in a recording that was originally mastered with just 16 bits."

Cinema Sound

Gene Patronis's Patent 5,004,067 for Cinema Sound System for Unperforated Screens filed in June 1988 was recently reviewed by George Augspurger in the J. Acoust. Soc. Am. The review has a friendly tone but, due to the limitation of space, does not discuss the features that make the system unique.

The Patronis system covers the 150Hz-up frequency range with a controlled directivity that is uninterfered with in the vital dialogue range by either network anomolies or synchronization anomolies. It is, to the best of our knowledge, the only theater system currently in use by a major chain that can make that claim.

In the modern format of multiple theaters in a cluster, the AMC theaters using the EV manifestation of the Patronis system are noticeably superior to the other systems presently in use.

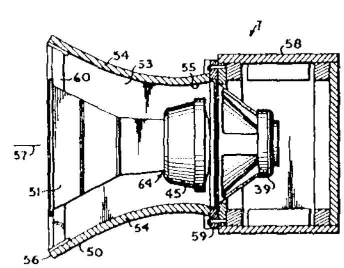
The J. W. Davis Pataxial systems are the forerunners of these designs. They represent an excellent choice for small auditorium as single units, and in the larger 15" version, can very satisfactorily cover auditoriums such as the Fox Theater in Atlanta.

5,004,067

43.88.Tj CINEMA SOUND SYSTEM FOR UNPERFORATED SCREENS

Eugene T. Patronis, Dunwoody, GA
2 April 1991 (Class 181/188); filed 30 June 1988

The problem addressed here is not new. Rear screen projection systems, for example, present the problem of where to locate the loudspeakers. If the image is relatively narrow, then loudspeakers can flank the screen. If the screen is wide, then dialog loudspeakers must go above or below. Some commercial front projection systems also require unperforated screens. For



these installations, the patent proposes special, coaxial mid- and high-frequency horns mounted above the screen. Frequencies below 150 Hz or so are reproduced by conventional loudspeakers set below the screen. Although performance measurements are not included, the patent provides a clear description of this new theatre sound system.—GLA

National Electrical Code Handbook (NEC) & Other Important Publications

The *National Electrical Code Handbook* is the authority on safety and power grounding. It is available for $65. The NEC code without examples and explanation is $32.50, plus shipping and handling on all orders. Members get a 10% discount. Order from National Fire Protection Association, One Batterymarch Park, Quincy, MA 02269; 1-800-344-3555.

Anthony N. St. John's article on EMI interference, "Grounding for Signal Referencing", in the June 1992 IEEE Spectrum ended with a heading of "TO PROBE FURTHER." There is so much important source material there that we are reproducing his text with permission.

"Two important sources of information on maintaining power quality in a facility are *Guideline on Electrical Power for ADP Installation*, Federal Information Processing Standards Publication 94 (FIPS PUB 94, U.S. Department of Commerce, 1983) and the soon-to-be-published IEEE Emerald Book, *IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.* FIPS PUB 94 costs $26 and may be ordered from the National Technical Information Service, NTIS; 1-800-533-NTIS. Presently, it is available in draft form from IEEE Publication Sales for $31; the order number is DS 01586; 1-800-678-IEEE. The Department of Defense's useful and comprehensive Military Handbook *Grounding, Bonding, and Shielding for Electronic Equipments and Facilities,* MIL-HDBK-419A, 1987, consists of two volumes, 'Basic Theory' and 'Applications.' The handbook is available from the Defense Printing Service, Standardizations Documents Order Desk. The service may be reached at 215-697-3321, or fax to 215-697-2978. IEEE Standard 518-1982 *IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources* may also be ordered from IEEE Publication Sales; its price is $31 and its order number is SH 08813. Henry Ott's *Noise Reduction Techniques in Electronic Systems*, second edition (John Wiley & Sons, New York, 1988), is a comprehensive and highly readable text."

Another Source of Reference Books

A publication came to the office recently that we had not seen before and perhaps you haven't either, yet it is a publication that I believe any sound contractor would like to know about:

Construction Bookstore
Box 2959
Gainsville, FL 32602-2959

The publication is billed as "The World's Biggest Construction Reference Catalog - thousands of hard-to-find books and codes for architectural, design, construction, electrical, engineering, maintenance and trade professionals."

Sources of Interference in Signal Circuits

According to the Electric Power Research Institute in Palo Alto, CA. about 80% of EMI (electromagnetic interference) problems are due to conducted EMI generated within the facility; the remainder is generally attributed to the utility system.

A rule given is that problems arise when radiated field levels are above 1.0 microtesla (at 60 Hz) for magnetic-field coupling and 1.0 V/M for electric-field coupling. Radiated magnetic-fields above the 1.0 μT level can often be found around electrical panels, while electric-fields above 1.0 V/M are frequently measured near desk top fluorescent lamps, especially those that employ high frequency electronic ballasts.

For conducted interference, nonlinear electronic loads, rectifiers and inverters via metallic conduit are the culprits.

Computers and other equipment with nonlinear converters can also generate harmonics, electrical noise, and impulses. Filters or transient voltage surge suppressors can corrupt the ground by dumping noisy current onto an otherwise clean signal-reference ground.

High inrush currents from electric motors can create propagating magnetic fields. Such fields can upset nearby high resolution monitors, high density, disc drives, and other magneto-sensitive devices when, for example, an electrical panel is on the other side of a wall from a desk with a personal computer on it.

Arcing in electrical circuits can be an interference problem correctible by an electrician with a screw driver by tightening connections in electrical panels.

These concepts are from an article by Anthony N. St. John of San Diego Gas & Electric Co. published in the June 1992 IEEE Spectrum. Those of you with EMI problems and with access to this publication will benefit by reading the entire article, "Grounds for Signal Referencing" pp 42-45.

Truly Great Music

Carolyn and I listen early in the morning (we get up at 5:00 a.m.) and in the evening to the local University FM station. They feature classical music primarily and distorted news. This allows us to hear a great deal of music that we're not already familiar with. Every once in a while our attention is drawn away from our reading or working by a particularly beautiful piece of music. So often the composer is Dvorak.

Now Dorian Recordings has brought out Dvorak's "Complete Music for Violin and Piano." As they point out in their, as usual, excellent accompanying notes, Dvorak's "Nocturne, The Romanze, and, of course, the perennial Humoresque" were originally conceived as works for violin and orchestra, and therefore, are not included here.

What is included that makes an exceptional recording even more exceptional is the Sonatina in G Major, op 100.

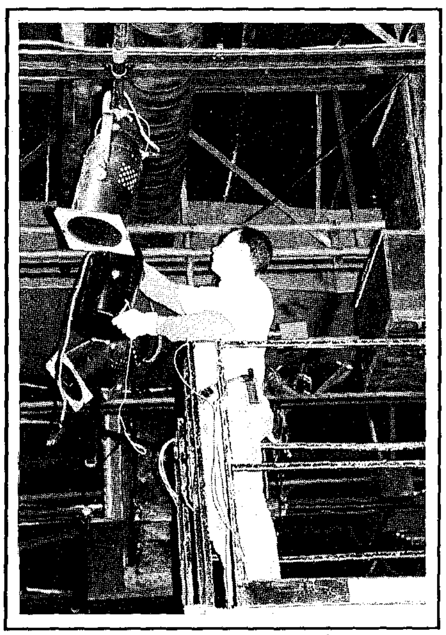
Ivan Zenaty is the violinist and Antonin Kubalek at the piano. Both men are Czech. Mr. Zenaty's violin is a rare instrument made by Guiseppe Guadagnini and the Dorian recording captures the lyricism of the artist and the remarkable tone of the instrument.

This is truly one of those records you can tell your CD to repeat all day long without getting tired of it.

Soundcheck Church Production Conference

"We will build, and they will come!"

One hundred forty-nine people from twenty-two states came to Grace Church - St. Louis this past January to share knowledge and encourage each other's work in their local church production ministries.



Grace staff member, Steve Moncey, adjusting lights during Chris Gille's discussion of stage lighting and staging.

Soundcheck founders, Curt & Jeanna Taipale, hosted the event. It was a labor of love. The registration fee was nominal and they had 16 workshop instructors, including Craig Janssen and Blair McNair (now with Techron) who taught classes in loudspeaker coverage and alignment, acoustical measurement, and sound system design. Curt Taipale covered system operation topics, including microphone techniques, console signal flow, and others. Chris Gille taught on lighting and staging. Those were the names we recognized. There were many more.

Curt and Jeanna say that the conference was extremely effective and that they "plan to pick up the pace, and continue communicating technical excellence to the churches. We encourage sound contractors and consultants to let their church contacts know about our Soundcheck events and encourage them to attend *(or even send them as part of the sound system installation contract)."* Italics are mine. Curt may be starting something very worthwhile to our industry.

Curt Taipale teaching a class on system operation. I don't know why we were surprised, but this class is still the most popular topic.

Curt said, "We try to back up our points with demonstrations wherever possible, and we're good at not stepping on other contractor's toes. We can effectively teach them how to better operate their systems, how to stay out of trouble, and reinforce things like 'don't try adjusting the system EQ once your contractor has set it."

Taipale Media Systems Inc
1471 Colgate Drive
St. Charles, MO 63303
314-946-3891

It might be worthwhile for you to ask Curt to give you a few names from people attending. Select one or two to call to ask how they feel about the Workshop. Even attend yourself. Like I said earlier, maybe Curt and Jeanna have started something that deserves to continue and prosper.

"The Great American–Japanese Boat Race"

Gene Patronis sent us "The Great American-Japanese Boat Race." This would be funny if it weren't so close to the truth. One of the frustrations of being older, especially if your life has been rich with experiences from all over the world, is the realization that a majority of the young want to make their own mistakes, follow their own ignorant choice of leaders, and trash all tradition be it good or bad. (I should know; I was there once.) Since it always happens in every generation I suspect it is genetic.

What I like to call "classless management" seems to work best in the companies we are privileged to observe closely. These are the companies where, if you attend a company function, it is impossible to tell who are the managers and who are the workers. There is such a thing as nine rowers in young entrepreneurial companies. More power to them, be they on this side of the water or the other.

THE GREAT AMERICAN-JAPANESE BOAT RACE

Once upon a time, an American motor car company and the Japanese decided to have a competitive boat race on the Tennessee River. Both teams practiced hard and long to reach their peak performance. On the big day they both felt as ready as they could be. The Japanese won by a mile!

Afterward, the American team became very discouraged by the loss, and morale sagged. Corporate management decided that the reason for the crushing defeat had to be found. A continuous "Measurable Improvement Team" was set up to investigate the problem and to recommend appropriate corrective action. Their conclusion:

The problem was that the Japanese had eight people rowing and one person steering, whereas the American team had one person rowing and eight people steering. The American Corporate Steering Committee was formed which immediately hired a consulting firm to do a study on the management structure. After some time and several million dollars, the consulting firm concluded that: "Too many people were steering and not enough were rowing".

To prevent losing to the Japanese again in the following year, the team management structure was totally reorganized to four General Steering Managers, three Area Steering Managers, and one Staff Steering Manager. A new performance rating system was developed for the person rowing the boat to give him more incentive to work harder. The spirited theme of the management team was: "We must give the rower impowerment and enrichment; that ought to do it."

The next year, the Japanese team won by two miles!

Humiliated, the American corporation laid off the rower for poor performance, sold all the paddles, cancelled all capital investment for new equipment, halted development work on a new canoe, gave a "High Performance" award to the consulting firm, and distributed the money saved as bonuses to the senior executives.

They further lobbied the government to limit the number of Japanese rowers allowed in the country.

I'll Save it for My Kids

A favorite rifle, a treasured book, a painting or sculpture that speaks to you, a well made motion picture—all things you collect with the subliminal thought lingering in the back of your mind that you would like to share it with a child someday.

Such transferrals of mental baggage can rarely happen. The youngster as he grows up collects his own mental baggage which is almost as untransferable to the older generation as is the older generation's to him.

Oh yes, the physical artifacts can be transferred, but the magic went with the original experience.

So too it is with collections of papers and early books on audio and acoustics. We have encountered only a few individuals who have walked into our office and felt the impact of the collected works on the shelves.

Worship of inanimate objects is "idol" worship. Respect for and appreciation of the thoughts of originators of them leads to the most wonderful way of life. To handle an original edition of Wallace Clement Sabine's "Collected Papers on Acoustics" is a thrill - to measure in the Symphony Hall he designed is to be a companion to him.

Taking a walk with the giants is not a casual reading experience, but a use of their ideas as a starting point for apprenticeship to their skills.

The one thing that might transfer to another generation is the example you set. The Syn-Aud-Con grads who have been attracted to our classes over the years have become our children. We revel in their triumphs and condole their setbacks. Most important of all, they are a part of our shared experience of life.

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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Decades and Octaves

Decade

A decade is a ten to one interval

$$\frac{\ln HF. - \ln LF}{\ln 10} = \text{decades}$$

Octave

An octave is a two to one interval

$$\frac{\ln HF. - \ln LF}{\ln 2} = \text{octaves}$$

Variations

$$e^{\left(\text{decades} + \ln L.F. \times \ln 10\right)} = H.F.$$

$$e^{\left(\frac{\ln H.F. - \text{decades}}{\ln 10}\right)} = L.F.$$

$$\frac{\ln H.F. - \ln L.F.}{\text{interval \#}} = \ln \text{interval}$$

$$e^{\left(\frac{\ln H.F. - \ln L.F.}{\text{number of intervals}}\right)} = \text{interval type}$$

War Zone:

The Architect, the Consultant & the Sound Contractor

We hear a lot of comments about the incompetence of the architect, the consultant and the sound contractor -- depending to whom we are listening.

Barry McKinnon has recently moved from sound contracting to a consulting firm, Barron Kennedy Lyzun & Associates in Vancouver, B.C.

Barry sent us a humorous piece, which he said came from Cavannaugh Tocci, and who knows the originator:

- ❖An Architect is said to be one who knows a little about a lot of things and keeps learning less and less about more and more until knowing practically nothing about everything.
- ❖An Engineer is one who knows a great deal about a very few things and who eventually knows more and more about less and less until finally knowing practically everything about nothing.
- ❖Whereas, a Consultant starts out knowing practically every thing about everything, but ends up knowing nothing about anything, due to extended close associations with Architects and Engineers.
- ❖Only Contractors start out with and always retain full and complete knowledge about anything and everything and that's because they never understand or pay any attention to Architects, Engineers, or Consultants!

From Joseph A. "Ski" Bienkowski

The material from Barry prepared us for five pages from Consultant, Ski Bienkowski, venting his frustration on the Sound Contractor: Here are a few excerpts:

- ❖Gain Structure: Shelf for the amplifier to sit on.
- ❖Head Room: What you don't have if you design the equipment to mount in a rack that is less than 60 inches tall.
- ❖You Need Zero Level: Got it! The volume ain't up.
- ❖Stereo Imaging.: What you get if you use two mono channels out of phase with each other.
- ❖Octave Band: Isn't that some new music group?
- ❖The Sound System's Isolated Ground: This is the big green wire that runs from the building's main service panel to the sound system equipment rack and attaches to the building conduit system which also attaches itself to the sound system equipment racks. As in "single point grounding."
- ❖Sound System Power Sequencer: Twenty circuit break ers in the sound system power distribution panel.

Equal Time for the Sound Contractor

Let's hear from the Sound Contractor. I am willing to wager that the first one we will hear from is Bob Reim. He has filing cabinets full of material he can pull out to handle any frame of mind. He keeps our spirits up. Our very favorite is the one we reproduced in this Newsletter, Our Life Motto. We are going to have it framed!

One time I was with Dr. Boner when he was in rare form. He had the crowd roaring with laughter at his Architect Bloopers. Someone added one to the list: An architect who had built a public building without rest rooms. Dr. Boner replied, "Why, that's uncanny."

Words of Wisdom from John Murray

John Murray of TOA liked John Wiggins quote in the last Newsletter saying that a loudspeaker engineer's knowledge of acoustics ended 3 feet in front of the loudspeaker. He said that he would like to add his two cents. He wrote:

"Speaker manufacturers are improving the situation. Their involvement has now been extended to 39 inches thanks to the metric system."

John also commented on most architect's lack of knowledge of acoustics.

Question: When does an architectural student at a university catch up on his sleep?

Answer: During acoustics lectures.

And, we liked what John referred to as his own quote: "Time is a perception that accelerates with age."

Classified Ads

WANTED: Sony MORS 505 Headphones with dual & separate volume and tone conrols. If you have, or you know someone who has, the no-longer-made headphones, Sony MORS 505 or a model which is similar to the Sony, please let us know. A man in a Correctional Institution in Florida has need of the headphones because of a hearing problem that he has. You may contact us here at Syn-Aud-Con, Ph 812-995-8212 or FAX 812-995-2110.

WANTED: Joiner Consulting Group is looking for a consultant with skills in one or more of the following areas: audio systems, video systems, RF and AV. Contact: Dave Burnor, 817-640-7300.

PUPPIES

Last Spring Gene Patronis took pictures of our new puppies, Roc and Wade. We found them on the highway one Sunday morning, one with a broken leg.

They were about the same size as our cats. At the present time they are larger than either Patch or Pedro and still growing. We are told that these "little fur balls" can end up weighing 170 lbs apiece.

Don is growing more muscular daily by lifting each dog into the pickup truck when he goes around the farm. Seems I read a Greek myth about such a case once.

Starting Them Young

Jim Bumgardner of Techron believes in starting his son and daughter young. Shown here is the new "banana" position. That's a .22 caliber Smith and Wesson they are shooting, and it has been used to train fifty years of young shooters. Becky turned out to be a dead shot.

Lest We Forget

Forty-nine years ago, a 37 year old Lieutenant Commander named Steve H. Simpson, Jr. used his unique handheld FM 260 MHz Joan-Eleanor radio to talk directly to an agent named Bobbie. Bobbie was standing next to a Nazi installation and providing vital information on panzer movements and key bridges to be blown.

Steve was at 30,000 feet in a British DeHavilland Mosquito fighter-bomber #707 making sure his project was indeed valid.

The 4 lb 1.5" x 6.25" x 1.25" radio used by the agent on the ground had a narrow cone shaped beam that made RDF by the Germans difficult.

Later when Paul Land, 34 years old, and Toni Rush, 37 years old, of Operation Hammer were dropped into Berlin by a A-26 these former Berliners were able to talk directly to Steve's flights overhead.

Steve is 85 years old and goes to work daily (Southwest Sound in San Antonio, the company he and his son own). It is undetectible to our ears that Steve has lost any of his extraordinary drive or quick-wittedness. We feel privileged to know such a man. Steve worked directly with the great men of American Intelligency, William "Wild Bill" Donovan and William Casey. Few know about these men and even fewer are themselves capable of even understanding, much less intelligently appreciating, the sacrifices they made. But then, men of this caliber don't do what they do for applause - they do it for duty, honor and country.

SYN-AUD-CON SPONSORS

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.

Their presence on this list as a Syn-Aud-Con sponsor indicates their desire to work cooperatively with you in professional sound.

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