SYNERGETIC AUDIO CONCEPTS

SYN AUD CON

newsletter

Volume 16, Number 2
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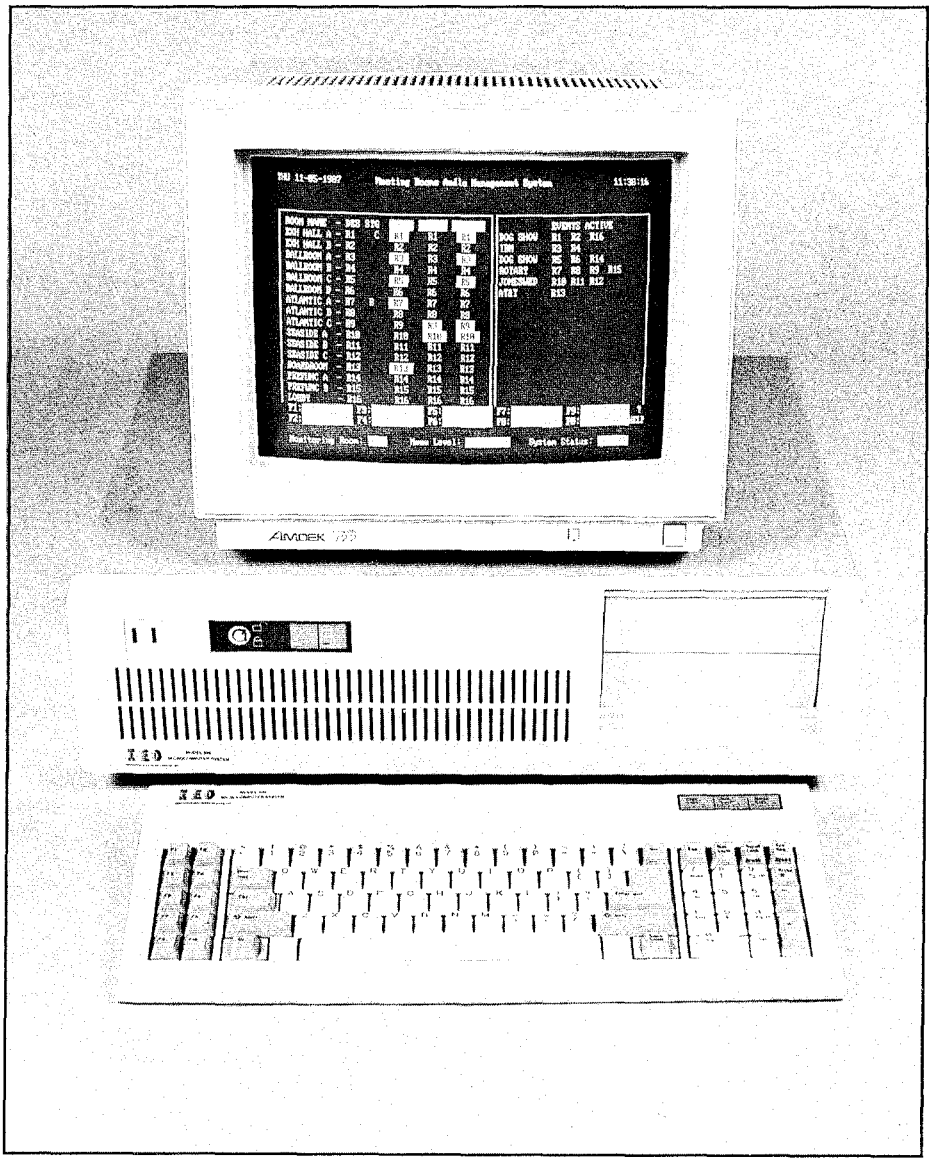
Innovative Electronic Designs

Innovative Electronic Designs Inc

A Company Who Lives Up To Its Name



SYNERGETIC SYN AUD CON AUDIO CONCEPTS

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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Design & Layout: Dashia Alfonso

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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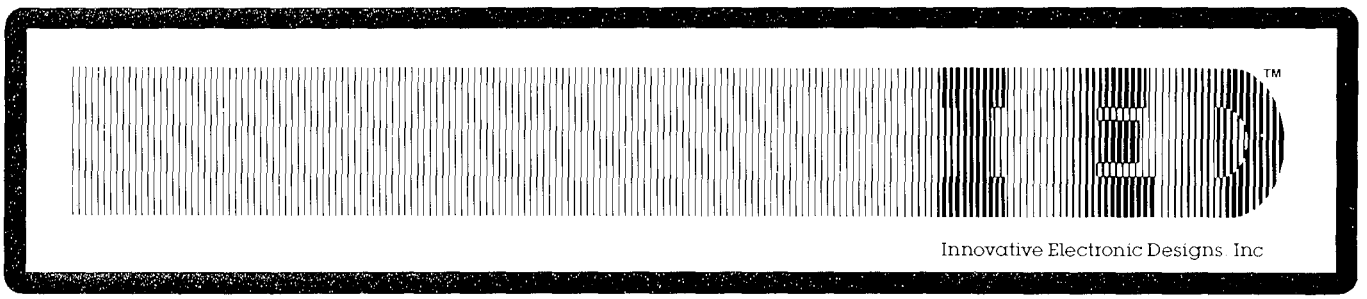


Innovative Electronic Designs (IED)

Innovative Electronic Designs, Inc (IED), is a Louisville, KY based firm specializing in the development, design, and manufacture of computer controlled audio equipment and systems. They have developed a unique modular computer controlled approach to building complex audio systems. Their encapsulated modules allow unusual versatility in both the design and the maintenance of a sound system.

Back in 1959 when I first joined Altec, they had introduced just the year before, all the basic ingredients needed by a sound system designer. Electronically there were mixers, line amplifiers, compressors, and a series of power amplifiers spaced 3dB apart in power. All of these components were level, impedance, and circuit compatible in any configuration conceivable and soon led to larger well designed sound systems.

Hardy Martin and his team of innovators has taken this concept out into the future. From their basic components, it is possible to design and build everything from a Resort Convention Hotel's audio needs to the paging requirements for the world's busiest airport. Tom Roseberry joined IED about three years ago to develop a marketing program. He is a man fully familiar with the best systems approaches of the past and well equipped to insure that IED fulfills their promise for the future.

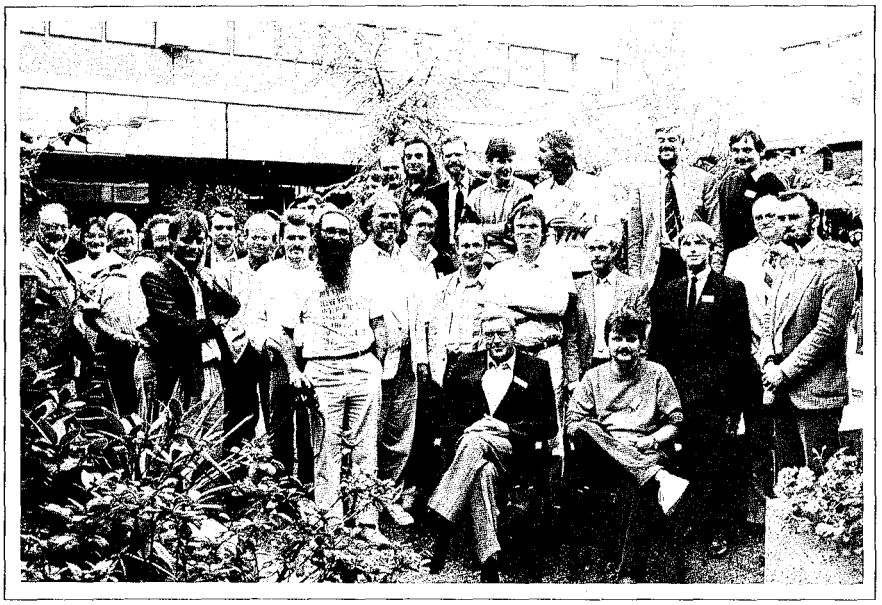
We fully respond to the computer control of the system and the fully automated testing of even the most complex system can pay off in many applications.

Utilizing balanced floating outputs and balanced differential inputs with trim pots for gain adjustments insures basic stability of performance. The use of "static ram" prepage storage allows interference-free paging with full priority, if needed or desired. IED's large coliseum system in Charlotte, NC, designed by Coffeen, Anderson, Fricke and Associates, and installed by Long Engineering of Winston-Salem, allows computer control of 2 main speaker clusters, 6 extended clusters, 16 satellite clusters, 16 under-balcony speaker arrays, 16 upper deck arrays and 8 concourse speaker arrays while maintaining proper signal delays and gain structures for various stage locations. In addition, the IED monitor system allows testing and monitoring of the line level signals and speaker lines of the sound system.

As computer literacy increases in our industry, and it is well advanced already, the philosophy of the IED approach will become increasingly attractive. IED has offered to share with the industry (AES paper in Nashville at the Sound Reinforcement Convention) the techniques employed for the control of audio switching and monitoring equipment from an IBM AT or XT compatible computer. They defined the RS-422 serial interface between computer and peripheral equipment plus the software protocol they use. They have made an important contribution to establishing a protocol worthy of industry acceptance for the interface of the sound systems and RS-422.

IED has come a long way in the ten years since Hardy Martin and Bob Ponto built their first product. The industry is just beginning to feel the real impact of their existence.

TEF Workshop in Braunschweig, Germany Sponsored by ANT



Don Eger, Dr. Patronis, Hellmuth Kolbe and Don & Carolyn Davis were the staff for this very special workshop. Werner Keller of ANT was the successful organizer and moving spirit behind bringing European TEF users the fullest and latest information from the U.S. When a new and better technology finally reaches a certain number of users, it begins to take on a life of its own. This is especially true when sharing of the quality witnessed in this Workshop is present among early practitioners of the art.

Wolfenbuttel

Our workshop was held in Braunschweig (very near the East German border crossing). ANT is located a very few miles away in Wolfenbuttel. It is an ancient German seat for a remarkable ruling family who loved great books. There are 500,000 books in the special library there from the first days of hand illuminated manuscripts to the literal history of printing. Books from the 16th century contain exciting original pristine copies of every Kircher and Schott book known. Housed in a beautiful set of buildings, this magnificent library is the pride of the city and quite rightfully so. During the war, Wolfenbuttel was in the path of the advancing armies but when the bombers came Wolfenbuttel was prepared. They built an enormous bon fire outside the town and the bombers bombed the fire instead of the town, thus saving not only the library but 650 of the finest examples of 17th century Germany architecture.

The TEF Workshop

What's beautiful to behold are two or more TEF users from anywhere in the world sharing the insights that come from using new and better tools. Each quickly realizes that because of these insights, ones not available to the TEFless, that they belong to a new special brotherhood of those who know versus those who don't. Look well at the eager, intelligent and excited faces from this workshop -- world class competitions in anyone's league from England, Sweden, The Netherlands, France, Switzerland, Greece, Germany and USA.

Photos by Edward Karsch

Helmut Krueger Genius Manifested

Genius is manifested whenever an engineer can look at a set of parameters and envision a totally different use for them.

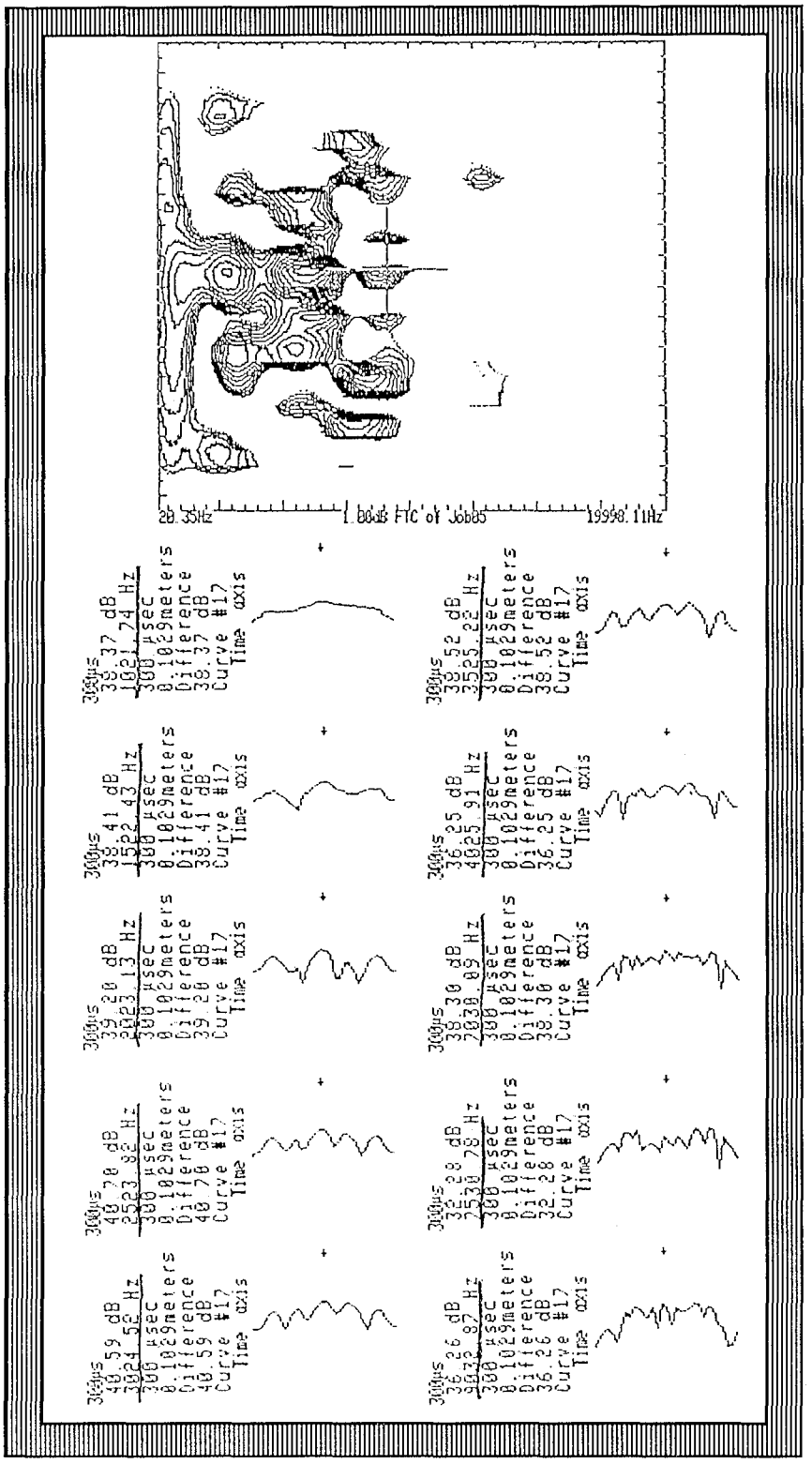
Helmut Krueger of ANT in Wolfenbuttel, West Germany is such a man. After the ANT/TEF workshop, the staff was invited to ANT for a plant tour and especially to hear incredible speakers developed by Helmut Krueger. We can't talk much about what we heard - yet, but if they prove that they can mass produce what Mr. Krueger has handbuilt - after 16 years of research, all the audio world will soon hear of Helmut Krueger. Mr. Krueger has developed a *completely* new shape for speaker fabrication.

Unique Measurement

He looked at the frequency vs time curves, FTC, and saw frequency vs cone breakup modes (frequency vs modal curves, FMC). In this case the horizontal scale remains frequency (linear). The vertical scale, however, is now the distance across the cone from one edge to another divided into 32 equal increments. This results in a truly remarkable "one glance" view of which frequencies the cone behaves as a piston and which frequencies it breaks up into multiple outputs. Even more clever is the use of the cursor to watch the behavior of the modes as what was formerly the time axis sub display now becomes the mode position on the cone at each frequency of interest. Running the cursor across the screen and watching the "modal axis" results in views that look like a "bird's wings" flapping as the frequency of the cursor is rapidly changed.

There are more costly ways to do this but I sincerely doubt that they provide any more accurate data.

We truly felt that this personified what Dick Heyser always described as a great idea -- one in which after you heard it, you stood in total wonder that you had been too dense to have see something that obvious.



Frequency vs Modal Curves

Signal Synchronization, Time Align™ Acoustic Center, Acoustic Origin, and Acoustic Wavefront

Equalizers and precision signal delay devices cannot change room acoustics.

We are seeing increasing understanding and use of signal synchronization (Sig-Synch for short). In a technique this new it is important that the practitioners use a vocabulary agreed upon as to definition.

Definitions

Signal Synchronization

Sig Synch is achieved when two identical sources covering the same frequency range and listening area add to +6dB on an energy time curve, ETC, measurement.

Time Align™

Time align is a trademark term owned by Ed Long and is applied to systems where transducers covering different frequency ranges are to be brought into signal alignment (synchronization) in the crossover region.

The Acoustic Center

Unfortunately this term has been adopted by a standards committee to mean what was called apparent apex. The acoustic center is re-defined as the point in space from which the angular coverage appears to originate, under this new definition. Many devices have different apparent acoustic centers for the vertical and horizontal coverage angles.

The Acoustic Origin

Since the standards committee in their infinite ignorance of actual practices confiscated "the acoustic center" a new term was needed to describe the point in space-time from which the acoustic energy appears to emanate. We now have chosen the term "the acoustic origin". Once the velocity of sound has been accurately ascertained, the time interval to the measurement microphone also defines the acoustic distance to the source. It should be noted that the points of angular coverage convergence usually occur in front of the diaphragms in horn systems whereas the acoustic origins are always behind the physical diaphragm.

The Acoustic Wavefront

In horns of differing lengths, for example, it is considered good engineering practice to insure that the mouths of the horns are physically aligned and that the acoustic origins are then synchronized by means of precision signal delay devices. The need for attention to the "acoustic wavefront" has to do with the emergence of a signal from one device being diffracted by the second device acting as a physical obstruction to the expansion of the energy from the first device. (i.e., diffraction). If you remember that synchronization is highly audible in the region from about 500Hz to 3,000Hz, this helps limit the problem to relevant cases (primarily midrange devices)

Examples

Two identical devices can simply be synchronized by physically placing them on the same axis. A long throw horn and a short throw horn should have their mouths physically aligned and their signals synchronized via precision signal delay devices.

Relative Phase

The matter of synchronization of crossover is a difficult problem both to measure and to solve. Remembering that in a great many cases it is frequency dependent, one of the more sensitive indicators is to use phase response measurements. The correct way to make a phase response measurement is to measure the phase change by frequency relative to the first arrival of loudspeaker energy at the measuring microphone. We call this measurement the *relative phase* because it is relative to some given arbitrary first energy arrival.

Absolute Phase

Absolute phase measurement is made by considering how many degrees of phase angle there is between the loudspeaker and the microphone at each frequency. For the phase of the loudspeaker to be seen this delay should be removed and that, of course, is what a TEF analyzer does when you TØ on the ETC. We have now read several AES Journal articles where the author (and unfortunately the reviewers as well) do not know the difference between actual phase and the signal's travel path expressed in angular terms.

Many express surprise at our insistence on the importance of the loud-

speaker's phase response. One of the key reasons is to ascertain if the phase response is minimum phase, i.e., the magnitude is the Hilbert transform of the phase. See Page 24 for a discussion on how to determine minimum and non-minimum phase points. Non-minimum phase areas in loudspeaker response *are not* equalizable by normal equalizers. Such areas usually indicate missynchronization or a severe resonance problem. The two advantages to phase measurements are 1) greater sensitivity, 2) narrower bandwidth measurements for meaningful results as compared to amplitude measurements.

A Few Basics to Always Keep in Mind

1. Equalizers and precision signal delay devices cannot change room acoustics. We appreciate that certain people say they can but that does not make it so.
2. EQ and precision signal delay devices (PSDD) can often help reduce the interaction of the direct sound with the space they are installed in but only if the correct directivities for the horns are chosen first and the EQ or PSDDs are simply restoring that directivity back to normal after they have been incorrectly adjusted.
3. Signal processing can process only the direct sound from a system and never the early reflected or late reverberant. If you have trouble understanding that, take the time to carefully think it through—it's absolutely fundamental! In audio, as in almost every other human endeavor, "the sting" is always preceded by the victims desire to obtain or believe in something for nothing. We like to believe that all of our grads do know the difference between falsity and fact. When cause and effect are kept in mind, then manipulating controlled diwrectivity devices, equalization, and signal synchronization will be applied with maximum efficiency and effectiveness.

Why Signal Synchronize?

Experience has shown those of us using TEF analysis and having access to precision signal delay devices that the major reason to Sig Synch is to control the polar responses of two or more devices. At St Boniface church in Anaheim, CA we found an approximate 4" (300 µsec) missynchronization causing a dramatic aberration in the polar response of an otherwise well designed system. Figure 1a and 1b show how the ETCs should look both synchronized and unsynchronized (note the 6 dB increase when synchronized). Figures 2a and 2b show the 3D waterfall in and out of synchronization; Figures 3a and 3b show the polar response of 2 speakers in and out of synchronization, and Figure 4a and 4b show what the frequency vs angle curves look like.

Actual signal synchronization has measurably improved intelligibility scores in overlap zones between near throw and far throw horns from over 10 %ALcons to less than 6% ALcons.

In another case, synchronization brought about 10 dB increased acoustic gain. Signal synchronization can often significantly reduce early decay time, EDT, (this is one of the primary reasons speech intelligibility improves in the Sig Synch area).

Signal processing can process only the direct sound from a system and never the early reflected or late reverberant. If you have trouble understanding that, take the time to carefully think it through—it's absolutely fundamental!

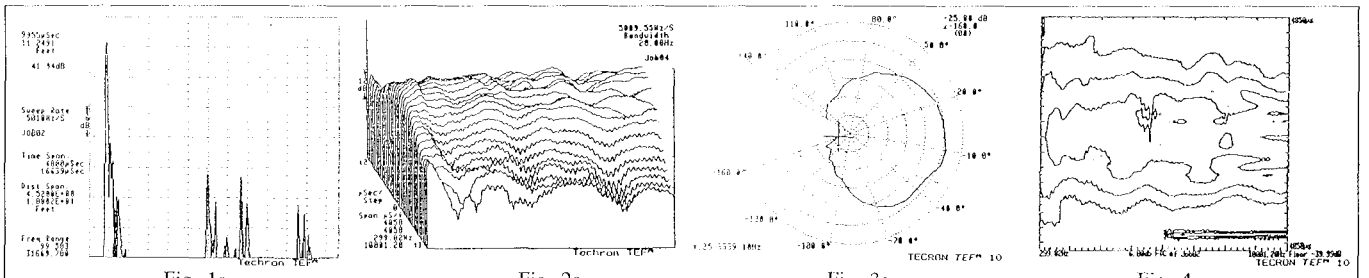


Fig. 1a Fig. 2a Fig. 3a Fig. 4a

Figures 1a through 4a—Two loudspeakers in synchronization

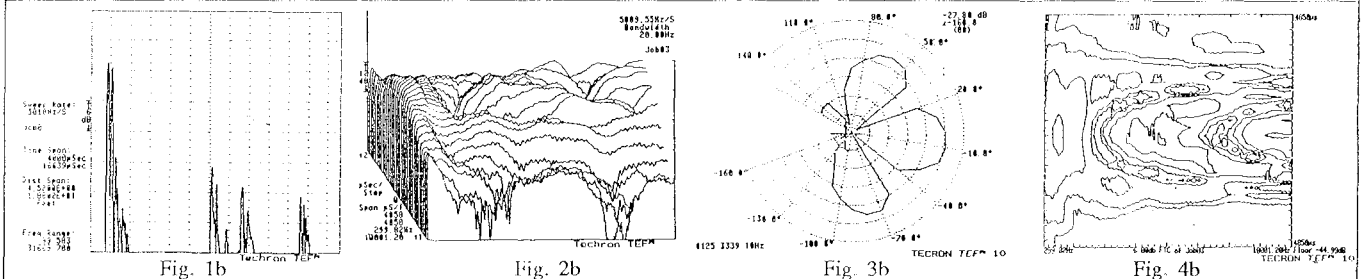


Fig. 1b Fig. 2b Fig. 3b Fig. 4b

Figures 1b through 4b—Two loudspeakers out of synchronization

What Can an Equalizer Equalize?

What Can an Equalizer Equalize?

The question, "What can an equalizer equalize?" needs to be asked. Some claim to equalize the room. Is this possible? We think not.

When an electronic or passive equalizer is installed in between a mixer and a power amplifier we need to know that all it can equalize is the electrical signal being sent to the loudspeaker.

What Comes out of a Loudspeaker?

What comes out of a loudspeaker is called direct sound level, LD. Early reflections from the floor, walls, and ceiling are called the early reflected level, LRE, and late-in-time, homogeneous mixing sound is called the reverberant sound level, LR.

When an electronic equalizer is employed it not only alters the LD at the listener but also the sound power level, LW, of the loudspeaker. This in turn affects LRE, and LR but has no effect on LAMB. The question over the years has been "how much can I alter LD without throwing the baby out with the wash?" Experience has shown that the answer is "not much". Certainly not enough to drop a specular LRE having a relatively full frequency response.

The Audience Effect

The so-called "audience effect" came about by people looking at sound fields with 1/3-octave real time analyzers. What an RTA sees is the total sound field level, LT, which is the combined LD, LRE, and LR plus any ambient noise present, LN. Adjusting a sound system to a uniform LT may or may not result in a sound you would want to listen to. In many cases the floor reflection can cause an operator to misadjust the direct sound level, LD. Then when the audience arrives and covers the floor the misadjusted LD is more clearly perceived and we say the audience affected the system. Really? Think with me for a minute.

What can the audience do to affect LD from a sound system? The answer, of course, is absolutely nothing.

What can the audience do to affect LD from a sound system? The answer, of course, is absolutely nothing. Therefore, it is clear that the audience can only alter LRE, LR and LN. Now, ask yourself the question "how can an equalizer adjust LRE, LR and LN?" The answer is that it cannot.

I would hesitate to mention such obvious facts except for the remarkable number of articles appearing to claim the contrary. The only way an equalizer can cause a change in LRE, LR and LN is to do damage to LD in the process.

What Can Affect LRE

Loudspeaker directivity factor, Q, is the classic way to handle unwanted LRES. Using a loudspeaker's directivity to stay off of surfaces producing unwanted reflective energy is also one of the most cost effective solutions. The second approach is to use either absorption or diffusion.

Electronic Directivity Control

The increasing use of precision digital delays (i.e., 10 usec per step in contrast to normal digital delays of 1 msec per step) to correct mis-synchronized loudspeaker arrays, where the mis-synchronization has resulted in directional lobing of the loudspeaker, demonstrates the importance and validity of directional control.

Good Engineering Practices

Today, thanks to advanced analysis in the hands of competent users, good engineering practice has become:

1. Adjust LD by measuring it alone with a TEF analyzer.
2. Optimize the reduction of LRE, LR, and LN levels by means of controlled directivity devices and measured synchronization of arrays.
3. Fundamentally control LRE, LR and LN through traditional use of absorption, diffusion, and noise abatement techniques.

What Point Am I Trying to Make?

The point I hope I have made is that electronic equalization in the frequency domain cannot correct phenomenon in the time domain outside of the minimum phase period (i.e., a few hundred microseconds). Therefore, claims to do so should be rightfully regarded as ignorant utterances or else fraudulent in intent.

A Vision of the Future

We are staying in Arizona between classes this year. Our motorhome has found it's "place in the sun" in a beautiful RV resort park. Mostly retired people live here, people doing exactly what they want with the reclining years of their lives. Early in the morning, at first daylight, a neighbor and I take our dogs out into the desert and take a long hike with them. Patch has become an addict for chasing jack rabbits. She runs at least a half a mile before conceding defeat, but what a race it is till she does.

The desert in the winter is a paradise and the only trouble is that the arrival of too many people like ourselves will eventually Californicate it. In the meantime, our personal view of the good life is eight months at the farm in Indiana and four months in the great American west.

It's little wonder that the great religions of the world sprang from desert cultures. The sensory deprivation provided by vast, wide open spaces forces human thought to a greater appreciation of the eternal things. The night desert sky, so vast it's incomprehensible, provides the cool balm that antidotes what in the harsh unrelenting sunlight can seem insurmountable, when all that's needed is a new perspective. When we become collectors of things rather than skills, it's time to disconnect from the material viewpoint and plug into something more substantial.

I believe you can come closer to the family of man when they share the leavening of a modest but comfortable common community of interests minus the heat of competition. Again to me that's the attraction of Syn-Aud-Con to many. A place where the commonality of interests and goals supersedes any false sense of competition or rank of person.

MINNEAPOLIS CLASS

Interstate Electronics

Tom Stokes of Interstate Electronics in Willowbrook, IL booked a Syn-Aud-Con class in his facility in the Chicago area. I didn't make a key connection until he reminded me of an earlier meeting in 1959 when I was a young Altec field man and had brought John Hilliard in with me to discuss a military telecommunications problem that ITT was working on. Tom had been one of the engineers we had talked with that day 28 years ago.

Carolyn and I truly enjoy these special classes and the chance to see how professional our industry leaders have become in their approach to their employee's growth, their customer's satisfaction and their company's earned profits.

Tom Stokes, owner of Interstate Electronics, with all the signs of success

Employment Tests

Kevin Tucker, sales manager at Interstate Electronics, talked to us about employment tests. We hear so often from sound contractors that it is very costly to make a mistake and hire the wrong person for the job. Kevin has written an employment test. He asked if we would be a collection (and sharing) point for sample employment tests to be sent to us. We will then share all the employment tests with everyone that contributes to the bank. Remove your company name from the test, if you prefer. Kevin has made a very worthwhile suggestion. Again, if you send us your employee test and 5 others send one in, we will send each contributor the 5 other tests. This can't help but improve everyone's work.

The Audio System Designer Technical Reference

On rare occasions one encounters a reference that rapidly becomes a constant companion. The "Audio System Designer" technical reference is just such a case. It was researched and compiled by Peter Mapp Bsc, Msc, MINSTP, MIOA, FINSTSCE, AMIEE in association with Gaston Goossens—Marketing Director of Klark Teknik. It is a physically handy, sensitively assembled compilation of data one often needs to refer to but shouldn't have to memorize (see Table of Contents.)

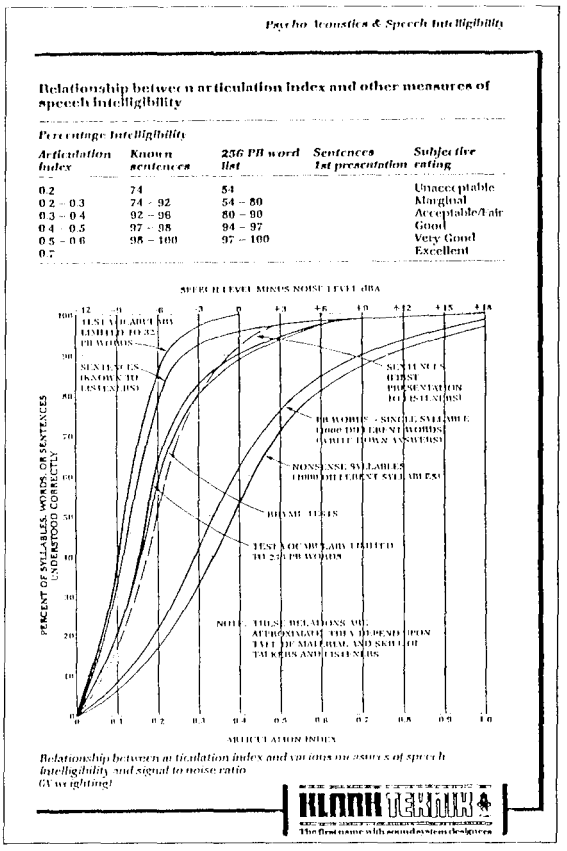
It is an attractive 7 1/2" by 9 1/8" 3 ring binder that fits easily into even the most economical of spaces, in brief cases or literature bags. Everything about it reeks of quality from the pen included to the heavy duty stock it is printed on. Largely free of error—theoretical Q and directivity index labels interchanged in one case—you have only to look at the contents to realize that authors are addressing current acoustic needs in a positive, useful way: comb filter peak and nulls, converting RASTi to %ALcons, directional characteristics of human voice, and similar topics bespeak up-to-date research.

Having met both Peter Mapp and Gaston Goossens enhanced my totally positive views of this reference even more for both are totally enthusiastic and skilled seekers of the truth and experienced enough to know the relevant from the inflated data available. Peter Mapp in spite of all the alphabet soup after his name is a man who would do "to ride the river with" on the most complicated or difficult of audio assignments. He has attended many Syn-Aud-Con classes.

We recommend this volume unreservedly to anyone working in the field of audio or acoustic systems. You'll not leave home without it thereafter.

Special Price of $25 to Syn-Aud-Con Grads

The Audio System Designer Technical Reference manual is normally sold for $60 and well worth it. Klark-Teknik is making a special offer to Syn-Aud-Con grads for $25 per manual, shipping and handling paid in the continental USA. Send your order to Syn-Aud-Con. Order form enclosed.



Relationship between articulation index and various measures of speech intelligibility and signal to noise ratio (A weighting)

General Acoustics

Typical sound pressure levels
Typical sound pressure level (SPL) versus sound pressure
Combining decibels
Inverse square law
Wavelength of sound versus frequency
Musical range versus frequency
Frequency range of musical instruments and vocals
ISO preferred octave and 1/3 octave centre frequencies with band limits
A Weighting
Background noise design criteria
NR curves (noise rating)
NC curves (noise criteria)
PNC curves (preferred noise criteria)

Sound Insulation & Absorption

Average insulation values (mass law)
Airborne sound reduction index of solid homogeneous wall (mass law)
Typical sound insulation performance of building materials compared with mass law
Resultant sound insulation of composite building structures
Summary of sound insulation performance for typical building materials -- Average 100-3150Hz
Sound reduction index
Noise reduction (NR) and transmission loss (TL)
Room to room transmission via ductwork
Typical sound reduction data in dB
Absorption/attenuation of reflected sound components
Dependence of sound absorption on the angle of incidence
Panel absorbers
Helmholtz absorbers
Porous absorbers
Bass traps
Average absorption coefficients

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Room modes (Eigentones)
Optimum room ratios
Sound pressure and power level
Relation between reverberation time, volume and absorption
Room constant versus surface area and absorption
Critical distance as a function of room constant and directivity
Reverberation time formulae
Reverberation time criteria
Reverberation time data for concert halls
Typical reverberation time design targets

Psycho Acoustics & Speech Intelligibility

Dynamic range of hearing
Equal loudness contours
Typical hearing loss with age (Presbyacusis)
Haas effect
Directional characteristics of human voice
Male speech spectra
Female speech spectra
Articulation index
Relationship between articulation index, communication and speech privacy
Dependence of the percentage syllable articulation on speech level
Speech interference levels
Speech privacy (approximate guidelines)
Percentage loss of consonants (% Alcons)
Probable articulation loss of consonants
Probable intelligibility
Converting RASTI measurements to % Alcons
PB wordlist

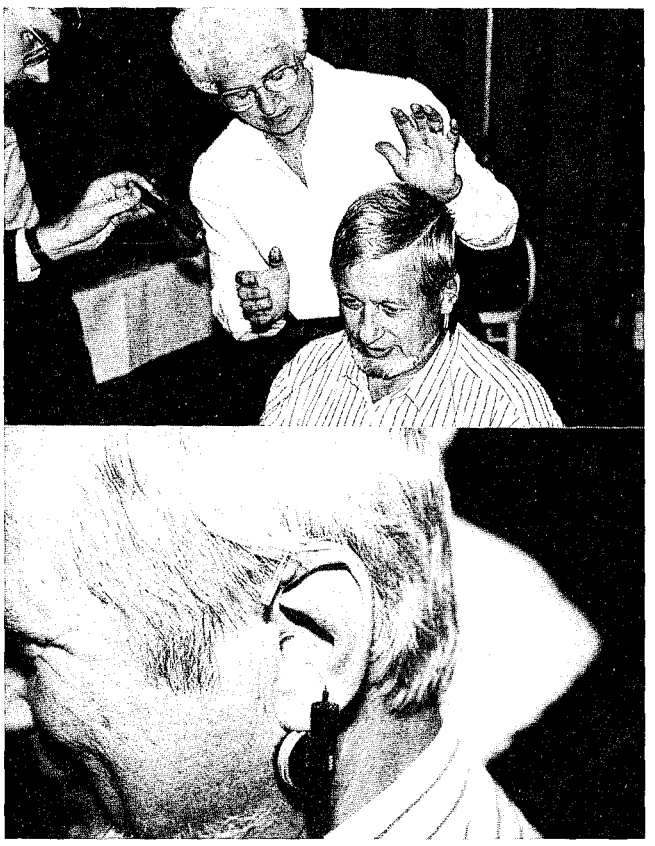
Sound System Engineering

Ohms law
Basic electronic pad circuits
Fixed carbon resistor colour code
Electronic noise measurement curves
Distortion (THD) conversions
Voltage versus dBv and dBu/dBm (600Ω)
dB ratios
Voltage and power conversions
Acoustic power from a loudspeaker
Power versus SPL
100 volt line loudspeaker systems
Loudspeaker line losses
Distance, velocity and time
Wind and temperature gradients
Atmospheric air attenuation
Sound propagation through trees
Speed of sound in various media (at 21°C)
Effects of time delay
Percentage disturbance
Combfilter peak and nulls
Speech integration and intelligibility
Ceiling loudspeaker coverage
Sound system equalisation curves

Physical Data

Metric conversion tables
Conversion factors
Audio connectors

The Importance of Outer-Ear Acoustics in Recording



No! Carolyn has not taken up hair styling for men nor has Hellmuth Kolbe taken to wearing large earrings. The second illustration shows how the "In the Ear" ITE™ microphone system looks when correctly fitted. These pictures were taken by Werner Keller during the special ANT sponsored TEF workshop in Braunsweig, Germany.

Pinna Acoustic Response, PAR™, recordings have proven, to date, to be superior to all other methods insofar as directional perception is concerned especially when the playback is over loudspeakers.

In a paper entitled *Acoustic Origins of Individual Differences in Sound Localization"* given at the Acoustical Society of America meeting in Hawaii in November 1988, we found the following statements:

(1) a listener's accuracy in judging source elevation can be predicted from an analysis of the acoustic characteristics of the listener's outer ears;

(2) The pattern of elevation errors made by one listener

A. can be transferred to another listener
B. by presenting to listener B the simulated free field sources derived from the outer ear acoustics of listener A. *Thus it is believed that many of the individual differences in localization behavior are traceable to individual differences in outer-ear acoustics.*

In the Ear, ITE™, microphony coupled to Pinna Acoustic Response, PAR recording and playback technique, are based uniquely on the differences in individual ears and particularly on the difference between the outer ear acoustics, OEA, of any given listener's two ears. We believe that it will be found that superior outer ear acoustics do indeed exist and that recordings done with inferior outer ears acoustics will be found to be inferior recordings.

This work on OEA was done by Elizabeth Wenzel, Doris Kistler, and Scott Foster (NASA—Ames Research Center, Moffett Field, CA. 94035, Department of Psychology and Waisman Center, University of Wisconsin, Madison, WI 53705 and Crystal River Engineering, 12350 Wards Ferry Road, Groveland, CA 95321.

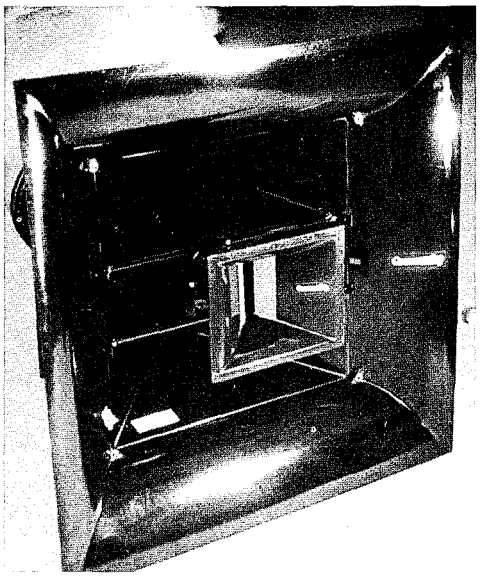
CoAxially Mounted Horns are Now Commercially Available

Gene Patronis' work with James Young on a coaxially mounted set of horns using precision digital signal delay to synchronize their acoustic output has brought on a rash of similar devices. As you may recall we first described Gene's version in Newsletter Volume 15 Number 3. As usual the ancients have been stealing our inventions and we find Frazier having done at least the coaxial mounting of the horns back in 1975. Without precision delay it was a doomed product. The UREI and Klark-Teknik precision signal delays can be used to accomplish the desired synchronization. When the correct amount of signal delay is applied to the high-frequency driver, you can get essentially a coincident coaxial radiation with appropriate time performance. (See our writeup below about the work of Hans Deitze under the direction of Harry Olson at RCA.)

Community M4 CoAx

Now Community Light and Sound Inc. offers the M4 CoAx. Built to meet the needs of the sound contractor, the M4 CoAx from Community allows any of the PC 400 series high frequency horns to be coaxially mounted directly in the center of the matching M4 PC 1500 series horn with a PCMX mouth extension.

Bruce Howze, president of Community (we call Bruce the James B. Lansing of this decade) says that they got the idea for the concept from the Patronis/Young speaker written up in the Newsletter. He recognized the value of the product. "Cluster design can now be simplified and reduced in size because you can locate the high frequency horn in the middle of the mid-range horn, and you can obtain improved directivity performance at the mid-to-high crossover point. In fact, if the crossover and delays are designed properly, it's almost as if you have one speaker that is capable of going from 200 to 20,000Hz."



The M4 CoAx from Community

All I can say, is BRAVO!

RCA LC—1C (First Coherent Coaxial Monitor Loudspeakers) For Sale

John Wiggins of Community led me to a most interesting resource for a legendary loudspeaker system.

Hans Deitze was one of the RCA team under Harry Olson and it was Mr. Deitze that had major responsibility for the development of the RCA LC-1C monitor loudspeaker along with the LS-11 floor cabinets to house them. This monitor was the first coherent coaxial unit according to Mr. Deitze.

The interesting news is that Mr. Deitze has approximately six of these systems (brand new—he acquired the inventory when RCA closed their acoustic lab). Prices are $3,200 a pair for stained finish version and $3,500 a pair in walnut cabinets. For someone wanting a signal synchronized two way monitor system in classic enclosures this is your opportunity to do so. I can recall hearing this model unit at WBAA over forty years ago and remember them as exceptional coaxial systems particularly good on voice.

Industry News

BIAMP and IMC Join Forces

BIAMP Systems of Portland, Oregon, and International Music Company of Fort Worth, Texas, have announced that effective last August 19th BIAMP has become a wholly owned subsidiary of IMC.

The sales and management team at BIAMP will remain unchanged.

BIAMP seems delighted with the stability that IMC will bring to BIAMP. We have followed BIAMP closely for the past 3-4 years. BIAMP management that goes back 3-4 changes ago asked us to give them some advice about where we thought the market was going.

We got especially interested in BIAMP when the Leupold Scope people bought BIAMP and brought in good management to run BIAMP. When Leupold invested all that they felt they reasonably could under the market conditions, they sold the firm to Ralph Lockhart and a couple of partners in 1986. Ralph was the director of sales at BIAMP at the time.

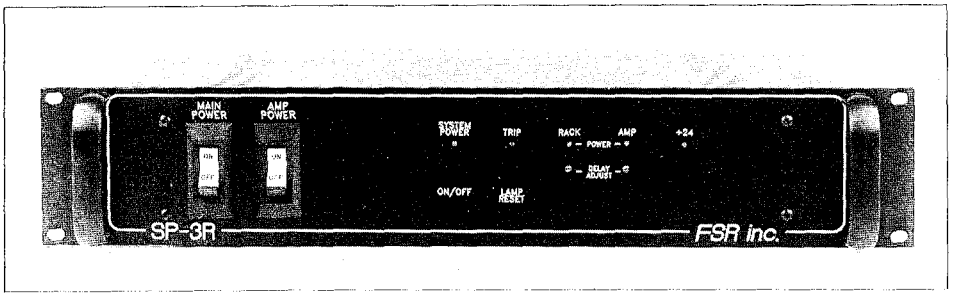
It has been a struggle for Ralph. He raised the capital to buy the company and to keep it going for a couple of years, hoping that he would be able to keep the well engineered products selling well enough to interest a company in investing in BIAMP and letting him run it as he knows it should be run: with integrity and honesty, and a desire to provide a good product **made,** not assembled, in the US.

FSR, An Innovative Company

A new 21-page specification catalog is available from FSR. Over 150 products are listed in quick-reference form with both specifications and applications. Write FSR for a free catalog: 220 Little Falls Rd., Cedar Grove, New Jersey, 07009, 201-239-0988

FSR is the very innovative company that is renowned for having their ears open to their customer's needs. They are constantly improving their product line. They have added an emergency shutdown to the SP-3R Sequential AC Switcher. Should the SP-3R receive a signal from an emergency source, such as a fire alarm, the system power will shut down in proper order (amps sequence down first, then rack); and an LED will light, indicating an emergency trip has occurred.

The fully solid state AC Switcher features self-contained, 24-volt, 2.5-amp power supply; full sequencing on power up and down; elimination of any system "pop" while reducing possible damage to speaker systems; all functions are fully remoted.

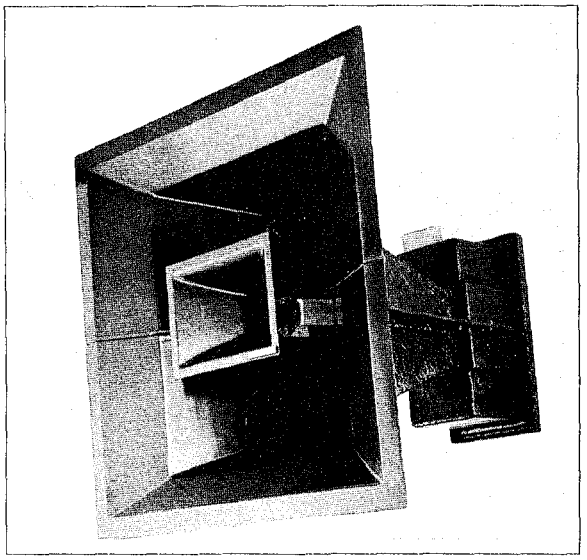


SP-3R Sequential AC Switcher from FSR

Speech Reinforcement Horn The Frazier Cat 77

We received a press release quoted here on a "soon to be shipped" product from Frazier. When Jay Mitchell talks, we listen. He is a bright young man.

A single package provides a bandwidth of 120 Hz to 12 kHz in a two way configuration that is horn loaded through its entire bandwidth and provides its nominal 90 x 40 directivity as low as 350 Hz. The FRAZIER CAT 77 consists of a FRAZIER 90 x 40 low frequency horn with an integral coupling enclosure containing two 8" heavy duty cone type transducers. A FRAZIER 90 x 40 high frequency horn is centrally located at the mouth of the bass horn and coupled to its 1" driver by an "acoustic delay device", which obviates the need for electronic alignment delay.

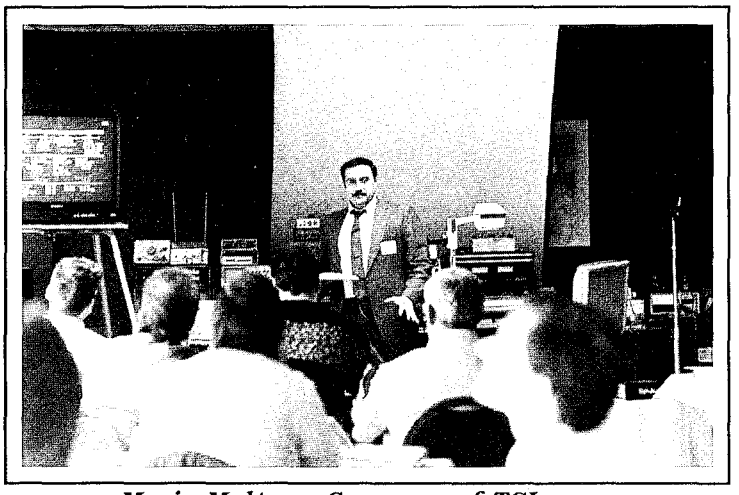


When I read the above press release from Frazier, I called Jay Mitchell to ask, "What do you mean 'acoustic delay device which obviates the need for electronic alignment delay?"

When he told me what he is doing, it resulted in my hand striking my forehead, accompanied by "of course". I don't want to spoil his fun, but let me say that when you see the simplicity of his solution you to will say, "Of course" and dimple your forehead.

After Jay had made his "discoveries," he found, like many of us, "that the ancients are stealing our inventions." In this case, Dr. Patronis.

A Company With a Mission



Mario Maltese, Co-owner of TSI, demonstrating his sound system design spreadsheet to the last New York class

OUR MISSION

To Provide the very finest audiovisual and sound systems, products and services, consistently exceeding the expectations of our Clients.

To Conduct our affairs with integrity and enthusiasm, displaying extraordinary commitment, empathy and response to our Clients, while earning profits deserving of our efforts.

To Uphold our position of technical leadership.

To Thrive on challenge, growth, fun and fellowship.

We have watched the growth of TSI in Mineola, NY with a great deal of genuine interest. When we say growth, we mean being able to witness a leader manifest innate leadership as success in business. TSI has a mission, and men with a mission are hard to either stop or top. We are reproducing a copy of their mission sheet here, not as something you can copy and benefit from, but as a reminder that if you too decided to write down exactly why you are in business and what you expect from it you might be surprised. TSI loves their mission. For it to work you have to live it. Pick a mission you can live—you can't fake it.

CHICAGO CLASS

Optimizing Home Listening Rooms

by

Peter D'Antonio, Charles Bilello & Don Davis

The last paper that Peter D'Antonio writes is his best. If you have been put off by his math in other papers, this is the one for you. There is no math here.

Peter has an ability to fuse together his work and that of those around him. In fact, I have found myself rubbing my eyes when I read one of his new papers, and saying, hey, that's partially my work -- or Charlie's work. At the same time, I have to say that he has said it better than I have in the past. He is not stealing anyone's work. His mind has grasped the individual parts contributed by many (in this case the work of Peter plus Charles Bilello and Don Davis) and melted them down into one cohesive whole. When he is finished, you wished you had said it so well.

Polar Responses of the Human Head

The unique polar responses for the human head that are shown below were originally made at the 3L workshop held last summer at the Syn-Aud-Con farm. After those workshops, Charles Bilello undertook extensive reprocessing of the polars in order to remove any response aberrations of the test loudspeaker so that the data reflects the true polar response of the human head as measured at the eardrum. For those wanting to read a definitive paper, order "Optimizing Home Listening Rooms, Part I", AES preprint 2735 (G-2), from the 85th convention, Los Angeles, November 1988. The authors are Peter D'Antonio, Charles Bilello, and Don Davis.

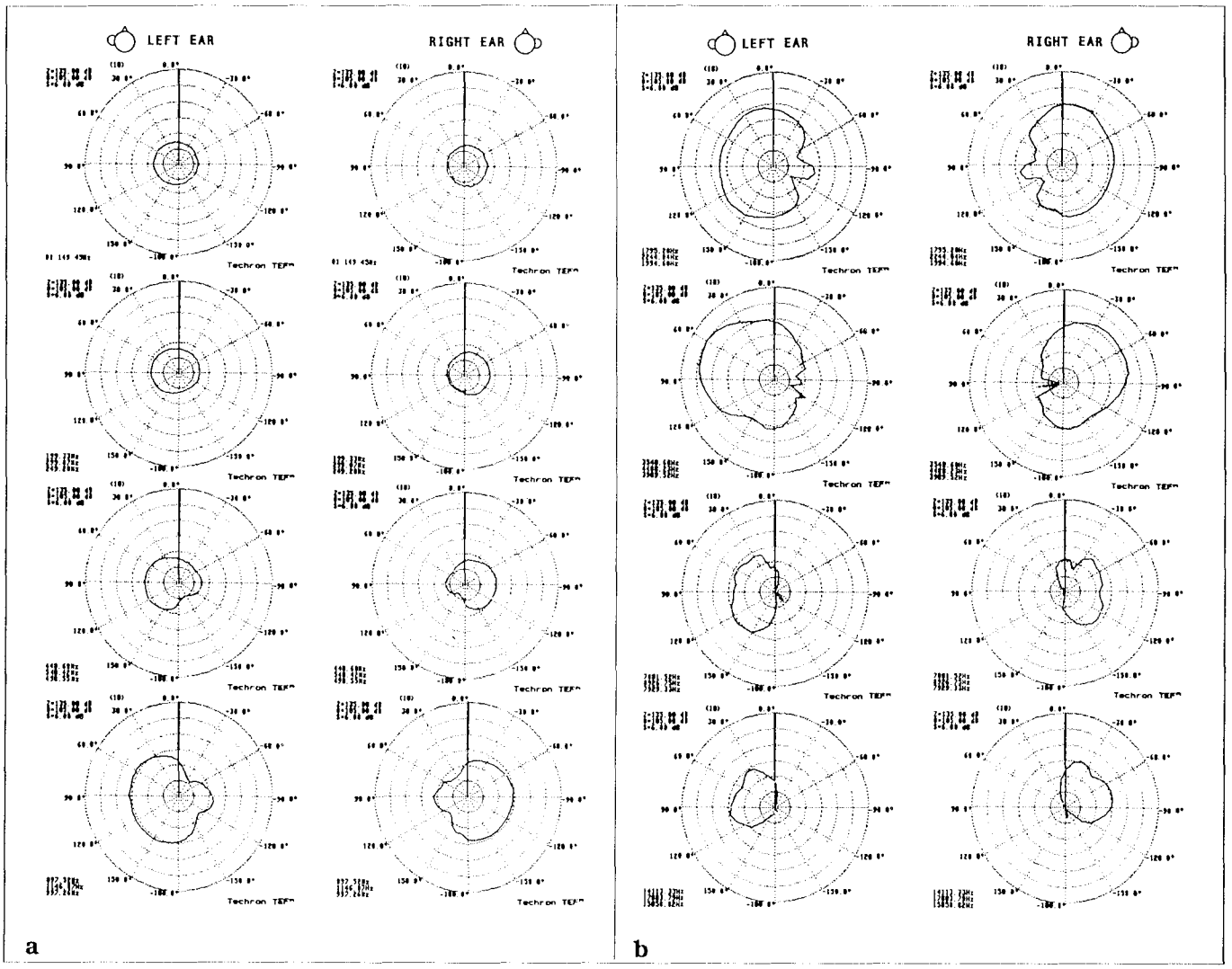
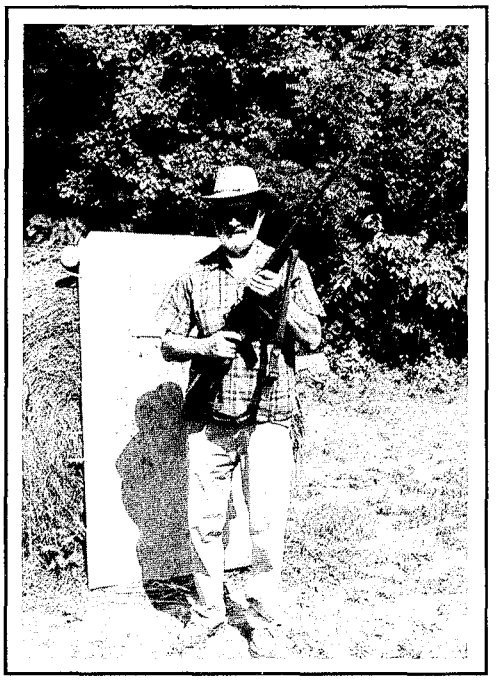


Fig. 1 Horizontal polar response of the ear with probe microphones placed in the ear canal just in front of the eardrum. Responses are displayed at selected 1/3 octave averaged center frequencies (lowest of three numbers) indicated at the bottom left of each display. The subject was placed on a rotating platform 10' from a loudspeaker, which was at head height. (a) Responses of both ears from 100 Hz to 1000 Hz (b) Responses from 2000 Hz to 16,000 Hz. The response at 100 Hz is for just that frequency and not a 1/3 octave average. The data were collected in 10 degree increments and the grid spacing is 6 dB.

Rambo Move Over

Slipping quietly but rapidly through the deep Hoosier forests, a bearded warrior fresh from slaying "causality" shock troops of the evil empire, displayed his prowess with a national match MIA (the civilian version of the military M-14). How many Syn-Aud-Con veterans can recognize this fearless fighter? Answer is on page 27.



Rambo, yo'all

Ready, get set. . .

A check at the 100 yard shooting bench

Errata for Newsletter Vol. 16, No. 1

Mark Poletti (not Paoletti or Paoloetti)

We don't like making mistakes in the Newsletters and Tech Topics. And we are especially disappointed when the mistakes are in writing of other people's work. We did it twice, that we know of, in the last Newsletter (Vol 16, No 1, page 9 and page 20.)

On Page 9 we misspelled Mark Poletti's name (we spelled it two different ways, never right.) Mark Poletti is the young man from New Zealand whose important study of the Heyser Transform was recently published in both the Journal of the AES and the Journal of the Acoustical Society of America.

Grant Elliott

On Page 20 in Newsletter Vol 16 No 1, we wrote about Grant Elliott's Translation Program for the CADP to AutoCAD. The last line in column one was swallowed by the computer. It should have read: *Larry's (Elliott) son is very computer literate. He gave us a program and an instruction manual (printout) for CADP to AutoCAD Translation Program.*

1989 SYN-AUD-CON SEMINAR AND WORKSHOP SCHEDULE

2-Day SEMINARS

S. San Francisco,CA
February 8-9

Vancouver, B.C.
February 15—16
February 17—Optional 3rd Day for "On Location" measurements

Dallas, TX
March 21—22

New York Area
October 17-18

Washington, D.C.
October 26-27

3-Day SEMINARS

The Farm in Indiana
April 13-15
May 19-21
June 22-24
July 21-23
August 24-26
September 22—24
October 5-7

3-Day WORKSHOPS

TEF Tutorial Conference
Nashville, TN
May 23-24

This conference is intended to bring together owners of TEF analyzers in order for everyone to share how they are using the TEF analyzer. It will not be a "hands on" workshop but an exchange of information. Cost of attendance will be determined by number attending.

Computer In Audio
The Farm
June 15-17

The computer class is planned for those who want to use spreadsheets and CAD programs in their audio work. Syn-Aud-Con would like to know how many of you would plan to attend a three day computer workshop at the farm . This workshop will be instructed by skilled programmers and users of MS-DOS and McIntosh personal computers. If you are interested, tell us so . The workshop will be held to 12 persons maximum.

Workshop Registration Fee
At the Farm - $500 for 3 days

Seminar Registration Fee
At the Farm - $500 for 3 days

Active Cancellation Using Adaptive Filters

We needed to know about active cancellation of noise so we called Jim Yerges in Chicago. He told us about Nelson Industries in Wisconsin so we called them for their literature. We received an article published in *Sound & Vibration* "A Practical System for Active Attenuation in Ducts." by L.J. Eriksson and M.C. Allie of Nelson Industries, Inc. Stoughton, Wisconsin. The article appeared in the February 1988 issue. Using the trade name Digisonix, these people have utilized adaptive filters in an extremely competent manner to achieve highly useful low frequency cancellation of unwanted noise.

In addition to the article, they sent two pages of questions and answers which reveal a great deal about their clear concise approach to this problem. We are reproducing a few of the 23 questions and answers here. If you have a need to know about active noise cancellation, be sure to be in touch with Nelson Industries, Inc., Highway 51 West, P O Box 200, Stoughton, WI 53589-0200. Ph 608-873-1500.

1. What problems does DIGISONIX™ silence?

Low frequency noise (below about 400 Hz) propagated in a fluid-filled (air, gas, liquid) pipe or duct. This can include industrial fan ducts, HVAC supply or return ducts, ventilation ducts on enclosures, and process noise from liquid pumps, for example.

2. Can broadband noise be cancelled?

Yes, the system is effective on both broadband, random noise, as well as narrowband, tonal components.

3. What if I also need silencing above 400 Hz?

The system may be used in combination with a traditional passive silencer to provide effective silencing at all frequencies. Active noise control is significantly more effective on low frequencies while passive silencers are very effective on high frequencies.

4. What does the complete system contain?

A controller (wall or shelf mounted), an amplifier, one or more microphones, and one or more loudspeaker modules. Power to controller and amplifier is 110V AC; interconnections are with standard microphone and speaker wiring.

5. What is the procedure to operate the controller?

Simply turn on the power. The microcomputer is fully automatic and does all necessary calculations to compensate for source characteristics, duct or pipe dimensions, microphone response, and loudspeaker response.

6. What happens if the noise source frequency or amplitude changes?

The controller automatically follows changes in noise source frequency and amplitude without any adjustment.

7. Is the performance affected by changes in temperature or flow rate in the duct or pipe?

Changes, such as these, in the acoustical system are also followed automatically by the microcomputer-based controller.

Sound & Communications Blue Book

Every year we write about the *Sound & Communications Blue Book*. If every one in the sound industry had the *Blue Book* the girls in our office would get a lot fewer phone calls asking if they knew how to reach so and so. We don't mind the phone calls. It's just that so often the information needed is in the *Blue Book* and a phone call could have been saved.

The *Blue Book* comes free with your subscription to *Sound & Communications* magazine. And a free subscription is available to most everyone working in the audio industry. The *Blue Book* is well over 100 pages. There is an index of manufacturers and a product index. Each manufacturer is listed under the products they manufacture. Their name, address, phone, company contacts, reps and product description are all there.

Sound & Communications Publishing Inc, 25 Willowdale Ave, Port Washington, NY 11050. 516-767-2500.

EV Conferences in Wiesbaden, London, Stockholm and Milan, 1988

We were once again invited by EV-Europe to participate in their yearly meetings for their customers and distribution. This was not a vacation trip but a working trip as can be easily seen from the schedule: two days in Wiesbaden, Germany; two days in London; two days in Stockholm, and two days in Milan—all in two weeks.

We met a lot of competent, successful and highly motivated people. The weather cooperated beautifully and I even had an upgrade to a Mercedes-Benz at Amsterdam for our drive into Germany. After five hours at 125 mph, I turned the car in with the greatest reluctance I've felt in many years. A Mercedes at 55 mph would have to be one of life's greatest perversions. When I was a boy in Indiana, we had no speed limits and the cause of car accidents then as now had very very little to do with speed. The belief that cars cause accidents smacks of idols. The parallel in audio is the belief that more expensive equipment makes better audio engineers. Competence is a quality of human beings not devices. That would seem to be a given, but we still hear youngsters discuss systems by manufacturers' catalog number rather than by performance criteria. In Europe the participants in the EV meetings were asking relevant, penetrating questions with regard to performance.

Wiesbaden Germany

Truly a jewel of a city. We drove into town as if it were one of our old home towns. The shops in Wiesbaden are for the wealthy—not the rich, but the wealthy. Mike Todd is quoted as saying "I've never been poor. Poor is a state of mind. I've often been broke, but never poor." Carolyn and I have a very rich life; we're just not wealthy, so we window shop.

Manfred Koch was our host from EV International (Sales Manager for EV/Europe.) The meeting was huge - over 200 consultants, university professors, sound distributors and sound contractors mostly from Germany and Switzerland. At Wiesbaden we again got to see Hellmuth Kolbe, Dr. Wolfgang Ahnert, Werner Keller of ANT, Heinz Weihe of the States Opera, and many many others going back to our years at Altec, circa 1972.

Dr. Wolfgang Ahnert

The EV Delta Max continues to impress us as a superior design. I know that some of our good friends have heavy investments in other older equipment, but my honest opinion is that we're in a new era so far as prepackaged high level concert sound is concerned.

Given another year and a dozen more TEF analyzers there will be little need of our instruction in terms of what's new in intelligibility and similar measurements for the EV family in Europe.

Peter Christiansen talking with Hellmuth Kolbe

London, England

Tony Oates of ShuttleSound is a very successful business man. He and his partner are breaking records for EV. He organized a splendid meeting in his newly expanded facility.

We stayed at Wimbledon in a very comfortable hotel with one of the highest priced low quality restaurants it's been our misfortune to encounter. Fortunately our host in England, Tony Oates, countered this experience with a series of delightful meals catered for his conference as well as special evening get-togethers at pleasant restaurants with which he was acquainted.

The London meeting included some excellent consultants who are Syn-Aud-Con grads: Peter Mapp, Andy Munro and Neil Grant. There were many people there that we were excited to meet and to share in their work.

We had the joy of seeing Julius Caesar performed at the new Barbizon Theater. The next night we were at Royal Festival Hall for an all Shostakovich concert. Don also found a new T.E. Lawrence book, Images of Lawrence by Tabachnick and Mateson to celebrate the year of his centenary. Many hitherto unpublished photographs appear in this book. It was T.E. Lawrence who wrote "are all great reputations built on fraud?" Lawrence meant by this that when great deeds are done they are often totally unrecognized while some minor aberration is blown up into a myth of some sort that the ignorant can "feel" they understand. The AES's recognition of Heyser is similar, but what Heyser truly stood for is a blank page to the same group. (A past president of AES said to me, when I objected to the reviewers of Heyser's last paper, that "you would think they would get someone who had a better understanding of *architectural acoustics.*")

Stockholm

Stockholm, Sweden

Olle Wigeluis, of Audiatur was our host for the EV conference held just outside of Stockholm at the Star Hotel in Sollentuna. It was the best equipped conference space that we have ever held a meeting in. It had everything - except a properly installed speaker system. (The equipment was good but impossible placement of the loudspeakers.) One impressive fact about all these meetings is that the TEF analyzer used by us at each meeting was on loan from someone native to the area.

Our host in Stockholm, Olle Wigeluis

Here we met with grads from Finland, Norway and Sweden: Imgemar Ohlsson, Stig Thodenius, Mattie Sarapaltio, Ake Eldsater, Clenn Junefelt, Lennart Nilsson and over a hundred audio professionals from Norway, Sweden, Denmark and Finland.

Clenn Junefelt took us on a personal tour of The Globe, a huge new project requiring mammoth equipment of all sorts. Clenn is the acoustic and electroacoustic consultant. We had never been to Sweden before and greatly enjoyed even our brief glimpse of a fascinating country. Stockholm did not get bombed during the war and consequently one can see the avenues and buildings that instantly remind them of pre-war continental Europe.

Milan, Italy

The EV conference was held in a little town north of Milan. It was a joy to get out into the countryside and walk the streets of a small town, visit all the churches in town.

Mr. Pierfranco Galeone was our host. The meeting was exciting. The interest in audio is intense. Italians are vitally interested in good sound engineering. This helps to account for the high sales volume that Mr. Galeone enjoys. The other reason is his drive and the loyalty and efficiency of his staff. Mr. Galeone had the meeting superbly organized and his staff worked tirelessly and efficiently throughout the meeting.

The last time we were in Italy, Carolyn and I had driven there in a factory car from Porsche. The year was 1959 and we had been loaned Baron Huschke von Hanstein's car. This was a powerful coupe with special lights for high speed night time driving. We had driven down from Stuttgart over St. Gotthards pass to Milan for the Gran Prix of Italy at Monza. I still have a picture of Juan Manual Fangio and ourselves out in the Paddock area. After seeing the race, we drove from Milan to Brussels overnight (ah youth!) all two lane back roads, which in those days before the tunnels through St. Gotthards Pass was no small feat. I can still remember the

Milan

sheer delight of rushing down the dark tunnel of trees on the French roads with the powerful lights literally drilling a light shaft through the darkness leaving us with the feeling of flowing through a conduit at 125 mph. Most exhilarating of all, was the fact that I had never seen the road before so each turn or hilltop had a potential high speed adventure on the other side.

Later we drove to Nurburgring and lap after lap on the track there to the delight of the officials who loved having a Porshe "factory" car on their track.

Pierfranco Galeone took us to dinner one evening at the restaurant in a former monastery where Gran Prix drivers dine together the night before the race. Another evening Mr. Galeone took us to a restaurant owned by a former olympic bicycle racer who had won the gold metal. Italy is a pleasurable experience in the hands of a generous and gifted host. It is no place to go alone as an American minus the Italian language.

We heard a joke in Italy, which we laughed heartily at while we were there. By the time we were home (49 hours from bed to bed it wasn't very funny): Heaven is where the Germans are the engineers, the English are the policemen, the French are the chefs, the Swiss are the organizers and the Italians are the lovers. Hell is where the English are the chefs, the Germans are the policemen, the French are the engineers, the Swiss are the lovers and the Italians are the organizers.

In trying to leave Italy we got fogged in and as a result had a series of experiences that were memorable if not pleasant. Let me hasten to add that our host knew nothing of this having left us, he felt, in safe hands fully checked in at the airport.

One advantage of the many missed and changed flights was to arrive in Atlanta. We feel that Atlanta is the best point of arrival and departure for overseas flights to Europe that the US has to offer. The Atlanta airport easily outperforms any other airport in terms of easy movement from one part of it to another. When one adds that Delta can fly you there from almost anywhere in the US, a traveler's cup overfloweth.

Ken Bourne from Vega

I don't want to fail to mention our wonderful traveling companion throughout the trip. Ken Bourne, Director of Marketing for Vega, participated in each of the 4 EV conferences. We enjoyed and appreciated being able to learn from each of his presentations. Ken's wit and integrity is part of his every action.

A Word about EV/Altec

A final word about what EV/Altec nee Mark IV are accomplishing in the international marketplace. They are showing the best of American technology to the best people worldwide. EV has chosen a path of high integrity and is planting the true seeds of long term growth by avoiding hype and circuses, and supplying education and real product leadership. We witnessed much of this last year and this year confirmed it even more. Their colleagues in the international market are being supported by the best equipment, training and long range planning possible.

Ken Bourne, Director of Marketing

Energy Can be Defined Geometrically From First Principles?

While the AES dithers regarding publication of Heyser's last paper in their Journal, Dick's good and loyal friend, John Prohs, has seen to it that it was included in the special "Time Delay Spectrometry" anthology of which John was the editor. John included it over protests from some of the AES people. Price is $27. Worth? Priceless!

What Dick was trying to do in this paper, according to his good friend and co-worker, Manny Tward, and unfortunately did not complete to his own satisfaction, was the demonstration that energy could be defined geometrically from first principles. A satisfactory energy theorem from first principles would be the most important event in physics in this century. Dick's paper needs the widest possible circulation. It's also important to remember that only a small minority saw what Einstein was doing at the beginning of his work.

ANAHEIM CLASS

Causality

We live, so far as we are presently able to demonstrate, in a causal universe. That means that before we can have an effect we must first have a cause. Interestingly, causality is the deep divide between religionist and physical scientists on many occasions. For religionists, the first Cause is called God. For the physical scientist, the first Cause is the great unknowable. I appreciate that a majority of people fall somewhere in between these two extremes but the above statement perhaps may outline the limits.

What I want to do here is provide a series of quotations from the science of signal processing. First I want to make a personal statement.

In "The Church of the First Chirp", Dick Heyser was the first cause. In over twenty years of friendship I never knew Dick to be wrong on a technical matter. Therefore, I fully believe he will be found totally correct in his views regarding causality. P.M. Gammell was a close associate of Richard C. Heyser at JPL and co-authored many articles with Heyser.

P.M. Gammell in *Coherent Processing of the Full Analytic Signal Information of Ultrasonic Waveforms*, writes:

Not only is there a propagation delay with any components, but a definite delay, prescribed by the conditions of causality, is necessary to any operation that approximates the Hilbert transform of a function.

The need for such a delay to satisfy causality is most apparent if one considers the approach of convolving the time domain record with 1/T. An output cannot occur until a sufficient record, both forwards and backwards in time, is processed around the epoch under consideration. The length of interval that must be processed is related to the accuracy of estimate desired compared to the rate that 1/T falls off. This is a direct consequence of the desire to preserve the low frequency components.

The relationship between the analytic signal and energy is that the *magnitude* of the analytic signal is proportional to *the rate of arrival of energy*, while *phase* is related to *the instantaneous partition of energy*.

In particular, phase information is usually neglected and the absolute value of one quadrature component of the signal is taken as an estimate of its envelope.

In over twenty years of friendship I never knew Dick to be wrong on a technical matter. Therefore, I fully believe he will be found totally correct in his views regarding causality.

Because the square of the analytic signal magnitude is equal to the true rate of arrival of energy this quantity represents the shape of the energy packets arriving from the reflecting interfaces.

The "imaginary" part is the Hilbert transform of the real part. In the frequency domain this is accomplished by shifting the phase of all frequencies components of the real part by 90 degrees (Blake and Waterhouse 1977). In the time domain this is accomplished by convolution with 1/t.

Because processing is *not carried out in real time*, it is *not subject to the conditions of causality*. This is a direct parallel to the complex wave function of quantum mechanics where complex wave function was the direct result of the desire to avoid negative frequency components.

Oppenheim and Schafer show that if a sequence is causal, then the real and imaginary parts of its Fourier transform are a Hilbert transform pair. They show that *the minimum phase sequence is that of least delay*.

A wave of any type (i.e. electromagnetic, bulk acoustic, or surface) propagates by exchange of energy between two forms. Although these forms are generally denoted as potential and kinetic energy, respectively, they are more properly referred to as *the energy of coordinate configuration and the energy of rate of charge of configuration*. This later designation corresponds to the {qi, qi} of the LaGrange or Hamiltonian formations.

Key Source Equation

The relationship between the real and the imaginary parts of a signal or of a transfer function of part of a system has been treated by several authors. The same fundamental relationships are variously expressed as:

The Hilbert transform
The Dispersion (Kramers-Kronig) relations
Bodes Theorem

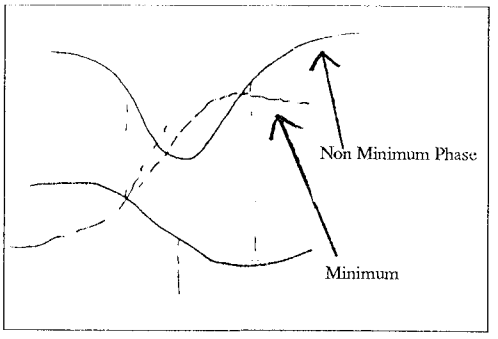
They are all related to the Cauchy integral formula and the Cauchy-Riemann equations.

Hermitean

Real part symmetric in frequency, imaginary part antisymmetric in frequency.

Reading a TEF Phase Plot

Reading minimum vs nonminimum phase response from the two plots of magnitude vs phase:



A downward curvature in (A) corresponds to an upward inflection in (B), while an upward curvature in (A) corresponds to a downward inflection in (B), also, a downward curvature in (B) corresponds to a downward inflection in (A), while an upward curvature in (B) corresponds to an upward curvature in (A).

(The following article, "*Fundamental Ideas of the Frequency Interpretation of Probability*" was taken from "Principles of the Theory of Probability" by Ernest Nagel. Published by International Encyclopedia of Unified Sciences, Vol. 6.

One of the main difficulties in most debates on causality is that the term is not explained with sufficient precision to make discussion fruitful.(As a matter of fact, specific contributions to the sciences of nature rarely if ever contain the term.) Without entering into detailed analyses of the issues sometimes raised, the following observations may help clarify some of them.

(i) Questions of causality can be significantly discussed only if they are directed to the theories or formulations of a science and not to its subject matter. No clear sense can be given to most pronouncements that the world or any segment of it is a causal process. On the other hand, in discussing the causal or noncausal character of a given theory, two factors must be examined: the state (or system of properties) in terms of which the physical system under discussion is described and the laws (or system of equations) which connect the states at different times and places. The state of a system is sometimes specified with the help of properties belonging to what are taken as "individual elements," sometimes with the help of the properties of a field, and sometimes in statistical terms involving the properties of aggregates of individuals. The laws also can differ markedly in form: they may establish a unique correspondence between states at different times or they may have the form of probability statements; they may be explicit functions of the time variable or they may not, etc. No universally accepted criterion has been formulated for judging whether a theory is "causal." Classical mechanics is frequently considered as the example par excellence of such a theory; the states considered by it are the positions and momenta of material particles, and its laws are certain differential equations of the second order not containing the time variable explicitly. It is often assumed that, in order to be a causal theory, the states employed by the theory must be those of classical mechanics. In that case, however, neither classical electromagnetics nor modern quantum mechanics are causal theories, although the former is usually so regarded. In some cases, on the other hand, the distinction between noncausal and causal theories is made on the basis of whether the states are specified in statistical terms or not, so that classical statistical mechanics and modern quantum mechanics would both be classified as noncausal theories. The main point to be borne in mind is that both factors, specification of state and form of law, are relevant to the discussion. Even theories which employ statistically specified states have been said to be causal because their laws establish a unique correspondence between its states at different times—although with respect to certain properties of individuals in the system the theories have been classified as noncausal, because the equations supply only probability statements concerning the occurrence of properties of individuals.

"Because processing is not carried out in real time, it is not subject to the conditions of causality."

Principles of the Theory of Probability

(ii) Because probability statements supply no information about any individual member of the reference class, it has been imagined that a physical theory involving probability considerations precludes a "causal" explanation of the phenomena under consideration. Now such a theory will usually specify the state in statistical terms; and, as a consequence, the predictions of the theory may have the form of probability statements concerning the properties of individuals. In some cases, however, it is also possible to describe the situation in terms of nonstatistical states, so that laws of a "causal" type may connect these new states. Whether it is possible or convenient to do so is obviously a matter to be decided for each case by experiment and scientific policy. It so happens that for the phenomena studied by classical statistical mechanics it is possible to do this; and, as a consequence, the "indeterminism" of classical statistical mechanics has been usually regarded as eliminable or inessential. Such an elimination is not possible for modern quantum mechanics within the framework of its procedures, and marks an important difference between classical and recent physics. In any case, nothing more than a very technical scientific difference is involved; and at least some physicists are of the opinion that future research may remove this difference. It should also be noted, moreover, that if the ¥-function in modern quantum mechanics is taken to specify the state of the system, without seeking to interpret this function statistically, quantum theory may also be regarded as a "causal" theory, for its laws have the form of equations usually regarded as of the causal type: they establish a unique correspondence between states at different spatio-temporal regions.

Isobars Needed

Mark Doubet is using the new PHD program and he says that it is great. But, he has a problem. The PHD program does not presently include:

All EV HP horns	EV DH1A driver	EV DH2 driver
Altec 299 driver	Altec 906 driver	Altec MR II 594 horn

Anyone that has isobars on these horns and drivers, we hope you will share them with Mark Doubet. We would appreciate if you would send us a copy also — and of course John Prohs would be grateful to have the data.

Mark Doubet's address is dB Acoustics, Inc., 5007 8th Ave, Marion, IA 52302. Phone 319-373-1425.

"Psycho Optics"
A Correction on the TEF Analysis of Bass Cabinets
by Mick Whelan

When we said "the horizontal narrowing is very apparent" on Page 7 of the last Newsletter (Vol 16, No 1 - *TEF Analysis of Bass Cabinets* by Mick Whelan) and any of you saw it, you were the victim of psycho optics because we inadvertently put the same plot in both Figures 2 and 3. The correct sequence of these plots is shown again.

Figure 1 is the bass cabinet by itself; Figure 2 is both bass cabinets operating, Figure 3 is the bass cabinet under test with a second bass cabinet beside it but shorted out at its input terminals, and Figure 4 is both bass cabinets operating but separated by 6"

This time we hope the horizontal narrowing is apparent. Whether or not this frequency dependent narrowing is good or bad depends on the crossover network and the higher frequency device you intend to use with those woofers. Mick Whelan did this exercise not to find out if the narrowing would occur but rather to see what the 6" spread did. Mick knows his basics and ran the test to confirm what he already had guessed would be the result, in spite of the manufacturer assuring him that it would not have an adverse effect.

Our apologies to Mick for mucking up a perfectly good set of data.

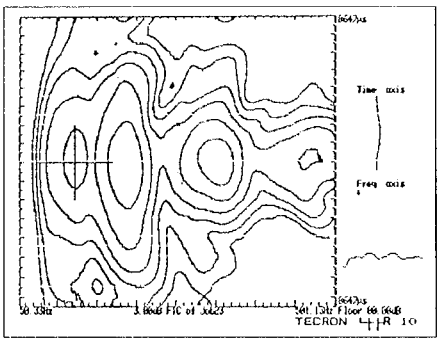
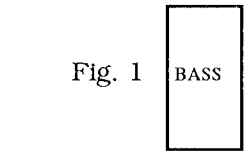


Fig. 1



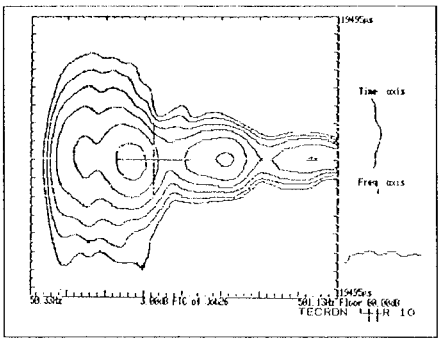
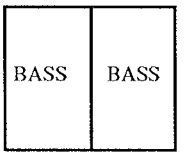


Fig. 2



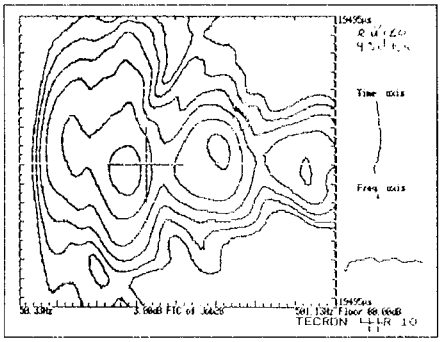
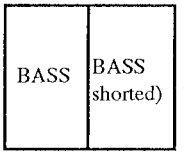


Fig. 3



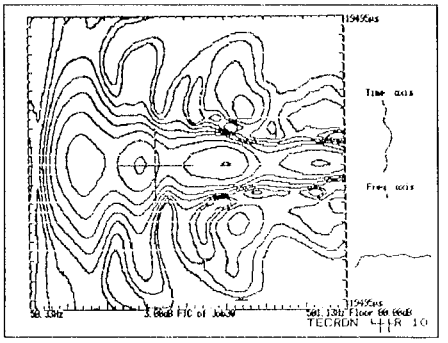
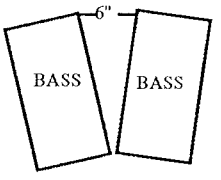


Fig. 4



New TEF Owners

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Via R. Grazioli Lante, 70
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Italy

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Las Vegas, NV 89102

Comfa AG
IM Rocel IOA
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CH 6301-2UG

IMHOF Aukustik
Demustrasse 12
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Switzerland

Kaj Gambak
SeaLab
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Chuck Hamlin
NASA
Marshall Space Flight Center
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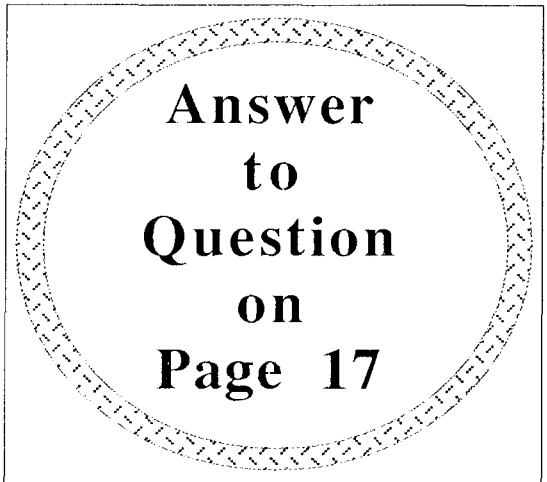
Chuck Warthall, Jr.
601 Michigan Ave
Pensacola, FL 32505



The man in the beard on Page 17 is none other than Herr Professor-Doctor- extraordinary Eugene Patronis.

Several Newsletters ago we published a picture of David Andrews in his MP uniform in Vietnam - without beard and pony tail. Mike Morley, who has worked with David for over 10 years, did not recognize David in the picture. Beards do that.

"Let Me Count the Ways" to Use Quadratic Residue Diffusors

by Jim Yerges

As we have noted before, Jim Yerges is a great novelist in the disguise of a great acoustical consultant. At the Atlanta Loudspeaker Design workshop last spring, he came up with an epic on diffusors. The highest compliment I can give his works is "I wish I had written it."

For those of you not personally familiar with the victims Jim has chosen from members of the class, I feel it is only fair to state that the activities associated with each is a result of a first cursory impression of outward appearance and home base, and not a critique of their habits. As is well known, only critics of Syn-Aud-Con have bad habits.

Peter has covered some of the more obscure applications of the RPG devices. Don Davis asked me to explore some of the more obvious applications, so I have polled the workshop membership to learn how designers are using reflection phase gratings. Several of the people to whom I spoke note that the RPG's afford convenient storage for collections of objects whose depths may be described by quadratic residue numerical sequences. For example, Bill Etter from Newport News, VA has an extensive collection of vinyl LP's and 45's as well as the newer CD's and tapes, cassettes, and cartridges. All of these dissimilar formats reportedly store neatly in the various wells of a single RPG diffusor.

David Andrews lives in New York City, where RPG's have become popular as window box planters. They are particularly handy for assorted species of garden vegetables requiring differing root depths in adjacent rows. Consider, for example, the shallow root structures of legumes or leaf lettuces, as contrasted with carrots, potatoes, and other tubers. Reportedly, the deepest wells in the RPG accommodate even David's enormous hybrid marijuana plants.

David and Richard Menasco, of Tallahasee, FL recently attended the Kissimmee Fishin' Frenzy, and report that many of the high-speed bass boats in the tournament were fitted with RPG's. Rods and rigs of various sizes and lengths are kept well organized and ready for immediate action. The deepest wells make serviceable live tanks if they are lined with visqueen and fishermen theorize that the narrow wells restrict the mobility of the captive fish, improving the chances for a trophy weigh-in.

Ron Baker, Mike Lamm, and Jack Wrightson all hail from Texas, where they report that RPGs are widely used as anti-slosh baffles in cross-bed gasoline tanks on the larger pickup trucks. As well as the obvious comfort and safety benefits, the OEM has made some as-yet unsubstantiated claims for improved mileage.

Scott Crist, from Minnetonka, MN notes that RPG units treated with marine sealer or common pine tar make reasonably useful flotation devices. In northwestern Wisconsin and several counties in central Minnesota, they have been added to snowmobiles used for travel over treacherous frozen lakes to ice fishing shanties. In this instance, the supplier states unequivocally;

"Listen - wave motion is wave motion. It doesn't matter whether it's acoustic or aquatic."

Don Heavener, from sunny Miami, FL concurs about the water resistance capabilities of the RPG's, and further argues that their sturdy construction makes them ideal shipping containers for certain substances. Don claims that they can even be dropped from a light plane at low altitude in the dark without damage to the goods.

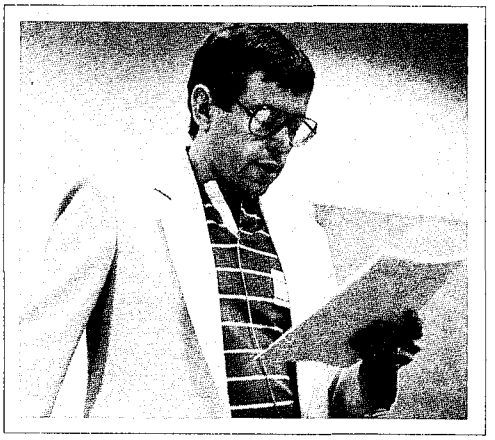
Our hostess, Carolyn Davis, from Norman, IN makes the following observation:

"In the preparation of canapes and hors d'oeuvres for cocktail party serving trays, an interesting effect can be achieved by hurling fresh fruits, raw vegetables, or hard boiled eggs against the sharpened metal dividers of certain units."

Mary Gruszka of Edgewater, NJ notes that Montessori pre-schools often employ the wood divider RPG units as playground sandboxes. Toddlers probe the wells with tiny beach shovels, achieving a hands-on working familiarity with abstract mathematical number series concepts in the non-threatening environment of the playground. Mary claims that this is especially beneficial to young girls, giving them a sense of esteem and self-worth in the traditionally male-dominated areas of math and physics.

Professor Eugene Patronis claims to have some evidence that the quadratic residue sequence discourages house cats - domestic and feral - from burying feces in playgound sand boxes.

Charles Bilello, of West Hempstead, NY notes that if the wells of an RPG are filled with concrete, it makes a fairly creditable specular reflector for audio applications.



Jim Yerges, son of the famous acoustician, Lyle Yerges, is an acoustical consultant located in the Chicago area.

New Turntable for Loudspeaker Measurements

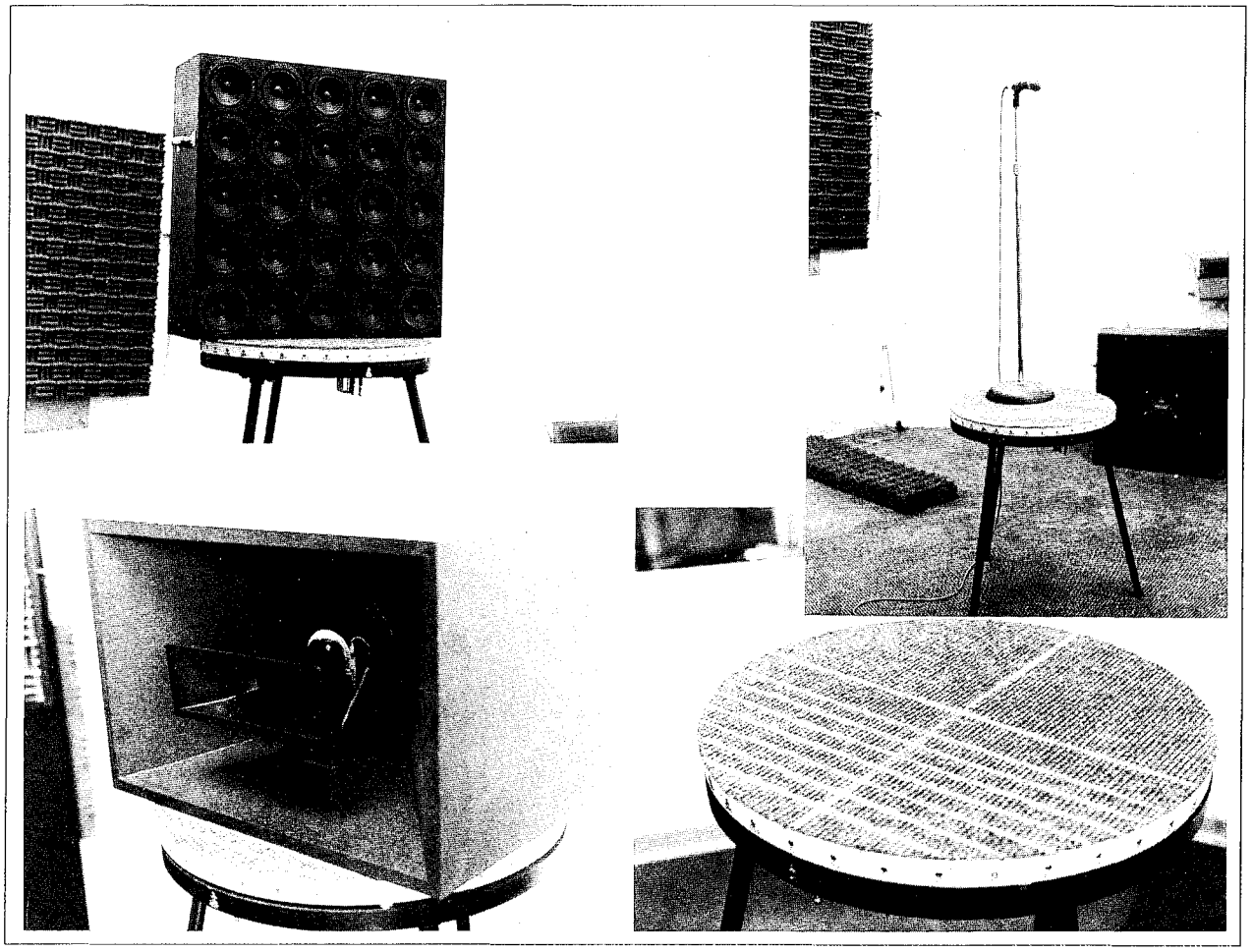
Mike Lamm of J. W. Davis Co in Dallas has made us a new turntable for our classes that's really classy.

A few new features it has in addition to the virtues inherent in our old turntable are:

1. A sight line on top to make sure the measuring microphone is on-axis.
2. Parallel lines on top to align the speaker front.
3. Brass studs every 10 degrees as a permanent indicator.
4. A locating ring and pin for making measurements at 5, 15, 25 etc.
5. A manual lockout on the rear locating pin for ease of measuring at 10 degree increments.
6. Short (24") lower leg segments to be used alone when doing polar plots of microphones. This will allow the mic under test to be mounted on a standard mic stand while still placing the turntable at a convenient height.

Mike is building these in his garage and it is his product, not a J W Davis product. Mike says he is willing to build these for others for $225. Delivery is 4-6 weeks.

We have been very pleased with this unit and it does everything we ask it to do. We have now used it in four classes with total satisfaction. One aspect of the turntable that is important to us but might not be to others is that it is lighter and much easier to carry than our original turntable.



Mike Lamm, 600 Hardwood Trail, Mesquite, TX 75150. Phone (214) 686-1425

A Visit with Dr. Blauert

We had the privilege on our September trip to Europe to meet with Dr. Jens Blauert at Ruhr University in Bochum. Dr. Blauert is a most gracious host under the most trying circumstances—his assistant of many years, Dr. Christopher Proesselt, had been put in the hospital that morning with a broken blood vessel in the brain. Dr. Blauert came to his lab personally to show us what they were accomplishing in the areas of psychoacoustic research that we were most interested in. Dieter Michel showed us a computer simulation of the Basilar membrane's wave action under differing stimuli. We had a fascinating discussion with Dr. Blauert on the deep ear—shallow ear approaches to recording and while we ended with differing viewpoints, we both found areas worthy of further research before engaging in future discussions.

Dr. Ahnert commented last year that he felt that Dr. Blauert was one of the outstanding research leaders in Germany. It is his feeling that graduate students working under Dr. Blauert's guidance are accomplishing important work. After meeting Dr. Blauert, it is easy to agree with Dr. Ahnert's assessment.

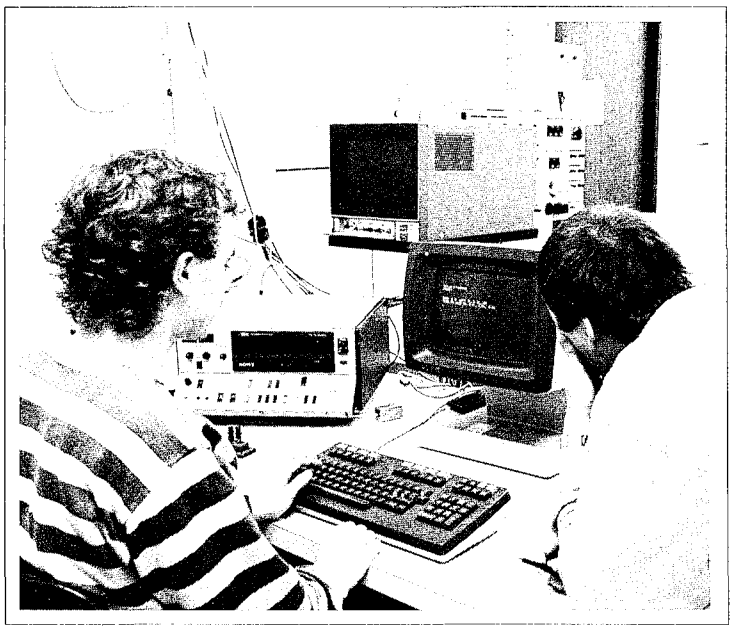


Photo by Dieter Michel

Students working in Dr. Blauert's research lab

Dr. Blauert is a man of great charm and a most pleasant and well informed host to the region in Germany where he lives. Dr. Blauert took us to several truly lovely old castles and I'll simply state again—"I'll agree to a class system if I can be King."

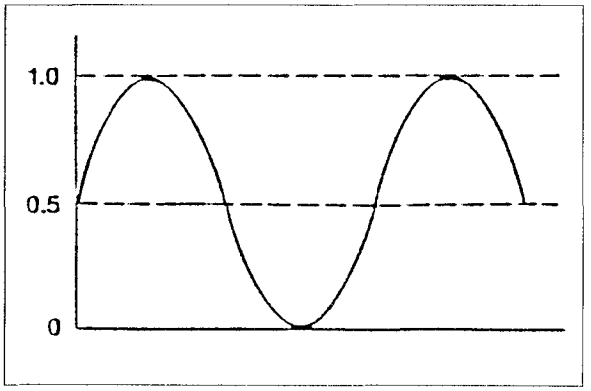
When told how fast we travelled from Hamburg to Munich three years ago, Dr. Blauert expressed sincere disbelief unless we were talking about aircraft. Upon travelling some of the same roads again this trip we could see why he had trouble believing us because traffic has grown over the years to limit the continuous top speeds we were able to achieve even three years ago.

Our group, Dave Andrews and Lucille Talayco, Don and Sylvia Eger, and Don and Carolyn along with Gene and Charlotte Patronis was travelling in three cars—two Ford Sierras and a Peugot. When Gene Patronis got home, a colleague asked him what Europe looked like and Gene replied, "a blur." Dr. Patronis enjoys fast cars and took a genuine interest in high speed cornering. Travelling fast in a straight line is no fun but entering sharp bends at 120 mph is; in the wet even more so. Davis' rule states you're not cornering hard until the car moves laterally.

A Basic Question on Voltage

Here's a truly basic problem for those of you interested in voltage calculations.

Assuming that the plot shown is a continuous sine wave voltage amplitude signal, can you correctly compute its RMS value?



We'll print the names of the successful calculations in the next Newsletter along with the correct answer. Be sure to ask yourself what kind of voltage values have to be present to cause this display before undertaking the computation. Hint: One is DC and one is AC.

Original problem sent into a technical journal by Munzer Haque of Houston, TX.

Starting in April 1989 we will begin a series of classes at our farm in Southern Indiana. These classes will be a maximum attendance of 12 people. The classes will be held in the Syn-Aud-Con laboratory housed in a renovated 105 year old farmhouse. There will be one class each month from April through October 1989.

These classes will focus on the decibel, gain and loss measurements, impedance matching and measurements, acoustic gain and designing for speech intelligibility as well as the measurement of speech intelligibility. Emphasis will be on "hands on" experiences using the laboratory and its wealth of equipment.

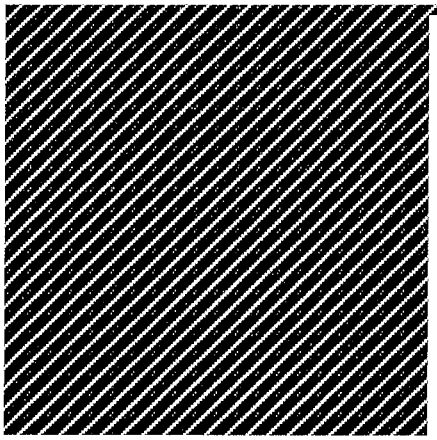
Classes held at our farm have the advantage of getting to see and use all of our test equipment much of which is either too bulky or too delicate to take on the road. They have the chance to see our library of acoustic and audio reference. Perhaps best of all, due to the restricted size of these classes they have more face to face time with the instructors. Another benefit is that these are three day classes. This is our most frequent request on our evaluation sheets turned in after our classes. When we have no "load in, set up, and load out" we can easily support three full days of intensive class activity.

A final distinguishing feature of these classes will be the testing of participants at the end of each day's session so that they are able to realistically rate their performance in the class relative to their peers.

We are planning to have a distinguished grad at each class to assist Don and to take part in a new program of training Syn-Aud-Con grads how to teach others what they know.

Southern Indiana is hilly, wooded recreational land and lunch breaks (brown-bag sandwich type) will allow time for short exploratory hikes into the surrounding woods or a quick dip in the small swimming pool.

There will a limited number of parking places for totally self contained RV vehicles. Motels are in Bedford, 13 miles to the farm. Those flying in to Louisville or Indianapolis will need to rent a car.



Boosting Filters Causes Distortion

We recently read a statement in a manufacturer's tech letter that said "By boosting or equalizing the high frequencies, a flat response can be obtained and at all angles of the stated coverage of the constant directivity horn. Then you'll have the open, transparent, super clear sound you maybe thought you couldn't get from a horn."

Carolyn then asked Dr. Patronis for his comments on the above statement as mine were unprintable. Dr. Patronis replied:

"Most high frequency compression drivers (including the one quoted in the article you sent me) exhibit diaphragm break up modes and/or resonances in the 10 to 15 kHz range. Boosting the driver output by equalization in this range usually leads to higher distortion and premature driver failure. The constant directivity horn just assures that this distortion will be observed at all angles."

Art Davis at Altec originally pointed out to me back about 1960 that when you boost highs and leave mids as they are, the main thing happening is that you are raising harmonics relative to the fundamental.—i.e., increased distortion.

Perhaps we can infer from this that if we increased distortion at the high frequencies, many users would perceive it as "open, transparent, superclear sound." Certainly those who prefer "cone sound" over "horn sound" at the higher frequencies on high level systems can be clearly identified as preferring distortion; guitarist do like their "Fuzz boxes." If the customer likes distortion, don't fight it.

Eliminating Loudspeaker Crosstalk in Recording Playback

Comments by Wayne Lippy

Wayne Lippy attended one of the Summer 3L Workshops here at the farm. After the workshop he wrote us the following:

One of the many remarkable experiences at the recent workshop was Don Keele's demonstration of the Bock-Keele Nearfield Barrier set up. The technique (detailed in AES Preprint 2420 A&B, November 1986) is an innovative solution to the limitations typical of the standard stereophonic listening configuration: poor center channel, limited horizontal imaging, and the negative comb filtering effects of interaural crosstalk on frequency response especially in the area of 2kHz. Keele defines Interaural crosstalk as the effect of the delayed signal (up to 250 microseconds) which reaches the opposite ear from an off-center (panned) signal source.

Don has created a situation which yields a true center image and amazing lateral localization by using a barrier to eliminate both the crosstalk between the spaced speakers and interaural cross correlation. The 1988 model incorporated an additional pair of speaker enclosures for frequencies below 100Hz.

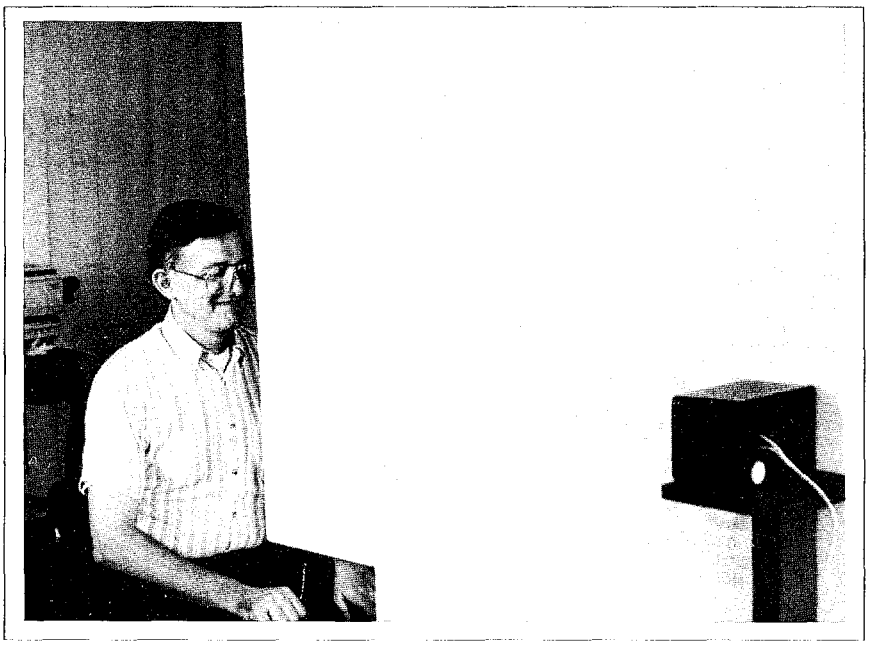
Excerpts played from binaural CD recordings which contained impulsive sounds rich in spectral content (i.e., plucking strings, fireworks, etc.) produced remarkable wide horizontal localization often times so real that the eyes were drawn to the side to "see" the source of the audible images. This effect was best explained by Dr. Larry Humes of I.U., "Rapid on-set events have a higher degree of physiological coding causing perceptual alterations dependent on how salient are the differences in interaural parameters."

Don Davis commented that the occurrence of wide horizontal localization indicates the presence of the directional cues in the original recording which are lost due to the effects of crosstalk and cannot be experienced in the typical stereophonic listening situation.

This idea was reinforced by the "In-the-Ear" (ITE™) recordings made during the workshop expressly to encode the directional cues to produce a similar effect in our experimental listening room situation which produced more accurate localization.

Readers are encouraged to experiment with the nearfield barrier set up which is easy to construct. Care should be taken to eliminate paths for early reflections which could spoil the effect. An appendix of especially suitable prerecorded material can be found in Part B of the AES preprint.

See the picture we took of Don Keele at the Summer 3L Workshop demonstrating the elimination of loudspeaker crosstalk.



AModel Array Modeling Program Available for $10 from Joe Mitchell

Joe Mitchell, Schaumburg, IL now has his AModel array modeling program ready to be shared with others. (See Newsletter Volume 15, Number 4, Pages 6-7.)

This unique program models the full complex frequency and polar response of the chosen array by means of vector algebra. The need for the complex response becomes immediately apparent upon viewing plots of mis-synchronized sources (See Figures 1a and 1b.) Figure 1c lets you see helpful phase relationships such as the Bessel array and Figure 1d shows a sound column.

Joe notes that the operator of the program can choose his desired array configuration and taking measurements from engineering drawings of the array can then model the acoustic result.

Any combination of Lsensi, Q and polarity can be chosen. The program assumes the same settings of these parameters at all frequencies.

Joe writes:

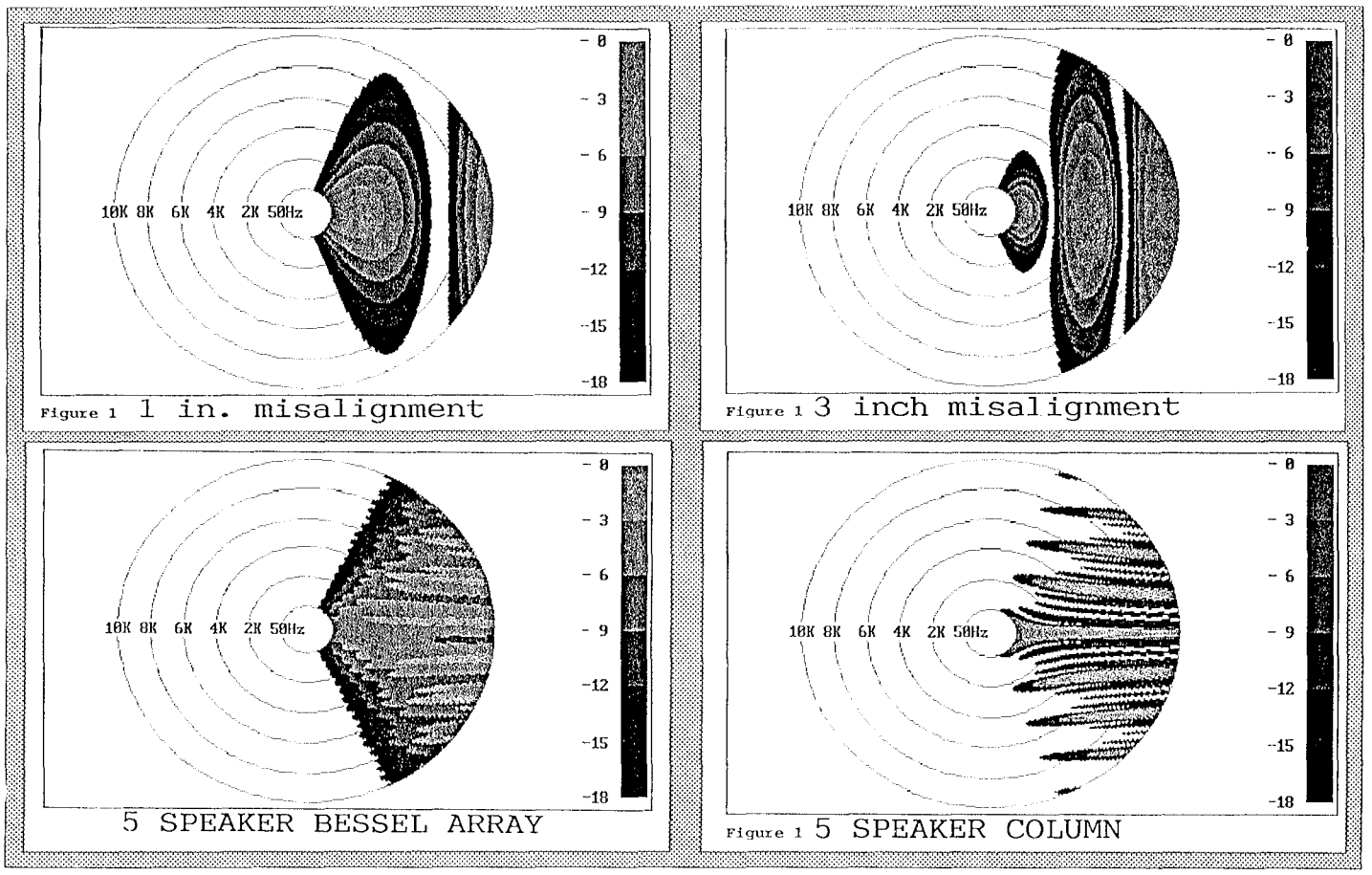
You will need a 1.2 Meg. 5 1/4" disk drive for an AT level machine with EGA card and display. A math coprocessor is an essential. Measurements need to be taken from engineering drawings or from the actual speaker to be modeled. A decision must be made as to where you want to place the array with respect to the origin. Since the front four speakers in the Bose-802 model are coplanar, I chose to place them in the xy plane intersected by the z axis at the origin.

The array elements should be placed symmetrically about the z axis. The AModel program uses a left-handed coordinate system in which the -z axis is "on axis". (Consider the viewer standing in front of and facing the array; taking a step forward toward the array is positive direction and stepping backward is a negative direction.)

After an array element is placed at its measured position relative to the origin, the measured elevation and windage angles (relative to the -z axis) can be applied.

We have been demonstrating this program in our recent classes on our new IED computer. It is in color and Joe has arranged within the program a "slide show" of typical jobs for the class to see.

The price of the program is $10 - enough to cover the disk, (1.2 Meg. only), a mailing carton, and shipping. Send your $10 to Joe Mitchell, 1090 Kingsdale Rd., Hoffman Estates, IL 60194. Ph 312-882-7400.



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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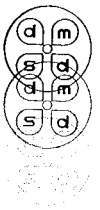

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Reprints Available from TV Technology on TEF Basics

by Mary Gruszka

Mary Gruszka is a valued member of the Syn-Aud-Con family and one of the early TEF pioneers. She recently shared with us a reprint she is offering of her series of articles on TEF for TV Technology magazine. These eleven articles in a single reprint can be had for $10 by writing:

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The $10 is to cover the printing and mailing costs. If you have a TEF analyzer, these articles provide you with some well thought out "get acquainted" exercises you can perform with your unit. And, even if you don't, they will give you a good idea of what the TEF analyzer can do and what the displays mean.

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GenRad microphone, capsule #1962-9610 and preamp #1972-960, 1/2" random-incidence response. $400. CONTACT: Mike Lamm, J. W. Davis & Company (214) 651-7341

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Yamaha PM3000 32x8. Includes road case. $20,000.00 CONTACT: Peter Russell, Staging Techniques, Inc., 342 West 40th St., New York, New York 10018. 212-736-5727. FAX 212-594-0547

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Dbx 157 noise reduction unit ($100.00), Sony PCM processor 701ES ($500.00), A+D Propak II ($100.00), Nakamichi audio analyzer T-100 ($500.00), Leader 0-scope LBO-310A 4MHz ($75.00). CONTACT: Mike Lamm (214) 686-1425

For Sale:

Hewlett Packard 335A Synthesizer/Function Generator with Opt. #1. Excellent condition. Make offer. Howard Schwartz Recording. Ask for technical department. (212)687-4180.

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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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