

SYNERGETIC
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 AUDIO CONCEPTS

newsletter

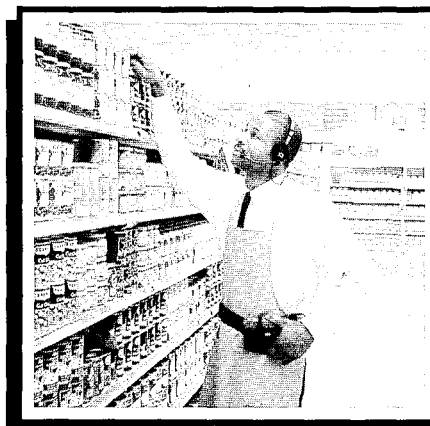
Volume 18, Number 3
 Spring, 1991
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INNOVATIVE—RESPONSIVE—PROFESSIONAL

HM Electronics



System 2300 Wireless Drive-up Teller



System 8112 wireless intercom with telephone interface. (Supermarket application)



System 8110 wireless intercom. (Construction site application)



System 8110 wireless intercom. (Warehouse application)

COMPETITIVE
 INNOVATIVE
 RESPONSIVE

RESPONSIVE
 INNOVATIVE
 COMPETITIVE

PROFESSIONAL—COMPETITIVE—INNOVATIVE

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EXCHANGE OF IDEAS

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

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

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

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

Editors: Don Davis
 Carolyn Davis

Design & Layout: Dashia Meadows

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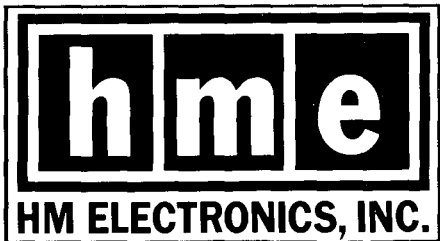
Synergetic Audio Concepts
 R.R. 1, Box 267
 Norman, IN 47264
 (812) 995-8212
 FAX: (812) 995-2110

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INNOVATIVE—RESPONSIVE—PROFESSIONAL—COMPETITIVE



System 2000A Wireless Drive-Thru



Series 700 Cabled Intercom
(BH720 Shown—Broadcast application)

When we first became acquainted with Harry Miyahira and HM Electronics' wireless microphones in the early 70's, there were three other manufacturers of wireless microphones. Today there are 33!

Have you wondered what HME is doing? HME doesn't think of itself as a "microphone company" but as a company providing innovative communications products. It is truly mind-boggling to sit around a conference table with President, Harry Miyahira; Vice President, Don Kutz; Vice President of Marketing, Mike Hughes; and Director of Engineering, Ken Fasen, and listen to what has been accomplished at HME in 20 years and to hear the future product plans! That is when the mouth drops open with awe and admiration.

It was necessary to implement organizational changes to cope with the tremendous growth. They knew that customer service was the key to past and future success. HME briefed us on their World Class Corporation (WCC) plan. This is a corporate wide effort participated in by employees, management, marketing, manufacturing and engineering to better understand each other's contributions to their own efforts and to agree mutually on a common set of goals they all feel they can wholeheartedly adopt.

It can be a genuine pleasure to work for a company that knows where it wants to go and by what route and yet be free of imprisoning outlining. For example, responsibility for total quality control goes right back to the guys and gals on the line. They can halt what they feel is not right and get it fixed.

HME is an exceptional company. They are making important progress in wireless infrared communication systems which transmit using lightwaves instead of radio waves. These systems are now installed all over Europe. They also are going into the battery business - industrial type communication batteries. Their System 8112 Wireless Intercom with Telephone Interface will create a market for HME that dwarfs their huge wireless intercom business with McDonalds.

Once again, we feel compelled to suggest that if you are not keeping up with what HME is doing, you are not keeping up with our communications industry.

COMPETITIVE—PROFESSIONAL—INNOVATIVE—RESPONSIVE

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It's a little like having a time machine. In the period from 1965 to 1973 I was intensively involved in the early versions of the Hewlett Packard computer/calculators. I was using them to develop and prove the validity of the acoustic algorithms used in the pioneer Acousta-Voice training programs.

I'm in such a period again. The advent of truly powerful measurement systems like Ariel and the Techron TEF 20, coupled to sufficiently fast personal computers, has plunged me head first into an ocean of the greatest software I have ever encountered.

In addition to the obvious, Ariel and TEF programs, let me list my favorite self-teachers:

Typing Tutor, Design CAD 3D, Word Perfect 5.1, Quattro Pro, Norton Commander, EASE, AcoustaCadd (for their speaker data, PHD, and Hyperception).

Hyperception

Let me discuss just the last one on the list. Hyperception is a small (6 key people) cadre that came largely from E systems in Dallas, TX. E Systems

develop much of the electronic magic all of us have witnessed doing its job over in the Sandbox. Even the Soviets remarked, "We will have to review our air defenses after this demonstration of American technology."

Suffice it to say that the Hyperception crew has attacked, with their Hypersignal DSP software, the signal processing of acoustic signals with equal skill and dedication. Real time 3D spectrum analysis, digital editing of arbitrary waveforms, streaming analog audio signals onto the hard disk and then playing back the signal after convolution with room design data, designing and using in real time Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, and converting the sampling rate of a waveform to another sampling rate using the difference equations function are but a few of the uses that can be made of Hypersignal software in conjunction with an Ariel SYSid board.

As can easily be imagined, our computer is beginning to bulge and we skate warily on the thin ice of being barely able to employ what we have in any kind of reasoning manner.

Mathcad

Mathcad's advertisement is correct "When you were in school you would have killed for a program like Mathcad so why don't you have it now."

When I was in school paying \$25-\$30 for a K&E or post slide rule was pushing the outer envelope of mathematical daring. Log Log Duplex Decitrig slide rules were carried in our holsters swinging from our belts like Obi Wan Kenobi's laser sword. To have been offered a program that automatically solved equations entered therein in the identical manner in which we'd write them on a pad of paper is still astounding today forty plus years later. Neither Mathcad nor the more expensive Mathematica were humanly conceivable back then. Having the equivalent of a Gauss or Euler available in a

box was sheer science fiction fantasy.

Let me give you just two examples. The first was Sam Berkow at the Joiner Rose Group putting "Hello" on his hard disk and then editing it for playback by creating an IIR filter that could also be mis-synchronized with the original signal to let us hear clearly the resultant comb filter effect upon playback from the hard disk into the amplifier and loudspeaker. Sam could also digitally edit the "Hello" waveform and make it more reverberant or with other editing make it sound like a different person. A brief demonstration convinced me that audio tape recordings are very shaky legal evidence.

In the case of Mathcad I was able to iteratively increment the Hopkins-Stryker equation for what would happen to level over distance for all Q's from 1.0 to 50 and see it both as a table and as a plot. (This later after the first lesson thanks to the natural form this software employs.)

If you imagine you can escape the inevitable, let me tell you about contractors like Randy Vaughan in Norfolk, VA who are now not only specifying and bidding the sound systems but the acoustic treatment as well. Randy is installing hundreds (yes hundreds) of RPG diffusors in high school facilities, with the result being remarkably better sound.

Jim Carey is rapidly gaining a national reputation as the measurement consultant of choice for synchronizing loudspeaker arrays. (The smart money has Jim in at the arrays planning stage as well as at its adjustment stage.)

We're aware that we are pushing this subject for all it's worth. Why? Because if we don't reach you, then we'll be missing you in our audio and acoustic industry between now and the year 2000. Don't be like the guy who when asked if he had read how dangerous smoking was and replied in the affirmative was then asked, "What are you going to do about it?" and he replied, "Quit reading." ■

Sam Berkow

—
Hyper Guide

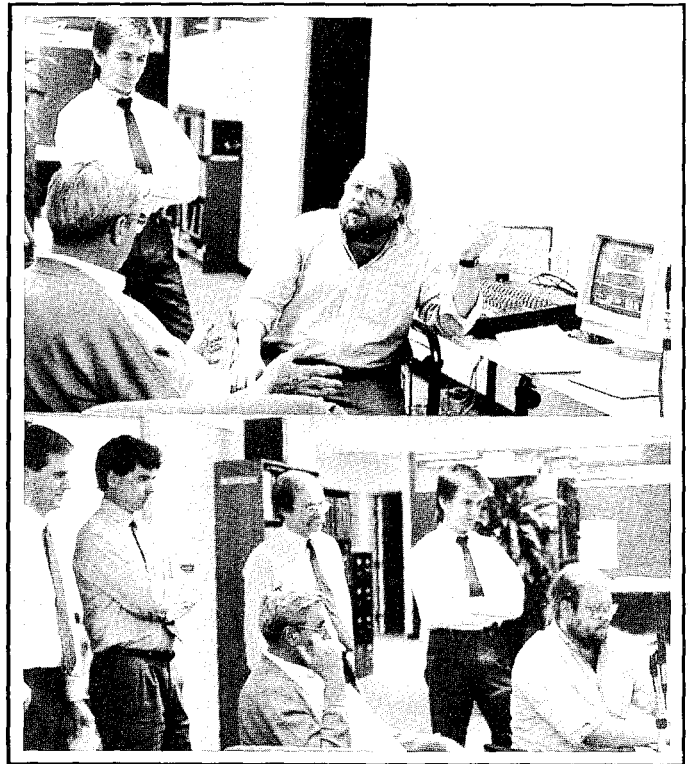
We are often asked how we identify the movers and shakers in our industry before the majority become aware of them.

They are men and women who have:

1. Unusual levels of physical and mental activity;
2. Dutifully pay their dues by working for the best minds available;
3. The wit to champion, with unusual discrimination, the best tools available;
4. Confidence that they know what they are doing so well that they feel no insecurity in sharing it fully with others.

Sam Berkow is a man we believe is capable of dragging all of us into new and better methods of acoustic analysis.

Sam attended our Intelligibility II Workshop and showed those present Hyperception at work. Sam's enthusiasm has won us over completely, and we are now demon-



strating his special versions of Hyperception in each of our classes. That Sam can make it clear to me means he has infinite patience and a true love of sharing.

Mark carefully what we say. Sam is a man you will be hearing lots more about both now and in the future.

The pictures shown here were taken by Carolyn during a visit in February to Joiner-Rose, the well-known Dallas consulting firm.■

Peers

Joel Lewitz and Wolfgang Ahnert sized each other up in a moment's time and then spent the evening making a full demonstration of AutoCad to EASE and EASE to AutoCad. Those of you who have attended recent Syn-Aud-Con classes know that we demonstrate Joel's excellent AI Privacy computer program (some people still call it Noise Masking).

What will continue to fascinate me to the end of my days are the men and women with the energy, intelli-

gence, perseverance and desire to find a solution to the most difficult problems, problems that most of us would prefer to walk around. They exude a power we always hope is contagious.

Critics have occasionally referred to the vast number of talented friends that Syn-Aud-Con has as a "cult". Syn-Aud-Con is a family, not a cult. Those



who enjoy being a part of that family share one trait in common—a delight in excellence.■

The Amazing Hyperception

In the present classes we are demonstrating the culmination of the 19th and 20th centuries' acoustic technology.

Fourier, LaPlace, Heyser et al manifested as practical working tools, that any serious audio professional can afford, namely Ariel, TEF, EASE, and Hyperception. All four of these tools total less than the first TEF analyzer at just under \$10,000!!!!

Imagine the following:

1. You take an architects drawing on AutoCad and transfer them to EASE
2. EASE then allows you to apply acoustic treatment to each surface in the drawing followed by a complete mirror imaging trace of the energy vs time and distance
3. You then take anechoically recorded music or speech that you have "streamed" onto the hard disc on your computer and using the digital signal processor DSP in your TEF or Ariel, controlled by Hyperception software, you mathematically convolve the music or speech signal with the energy time curve from the design and listen to the before and after sounds over a good quality monitor loudspeaker. ("Streaming" is a very simple process.)

Two Examples

The first is the sentence, "Hello fellows" repeated four times in 4.5 seconds (note time scale at bottom of wave form scale in Figure 1a). "Hello Fellows" is spoken directly into the 1/2" measuring microphone. We then delayed this signal by approximately 300 μ sec and combined the two signals for the second waveform. See Figure 1b. Note particularly the cancellation of the peak energy caused by the comb filter affect.

The second example is of some music by Handel. Fig-

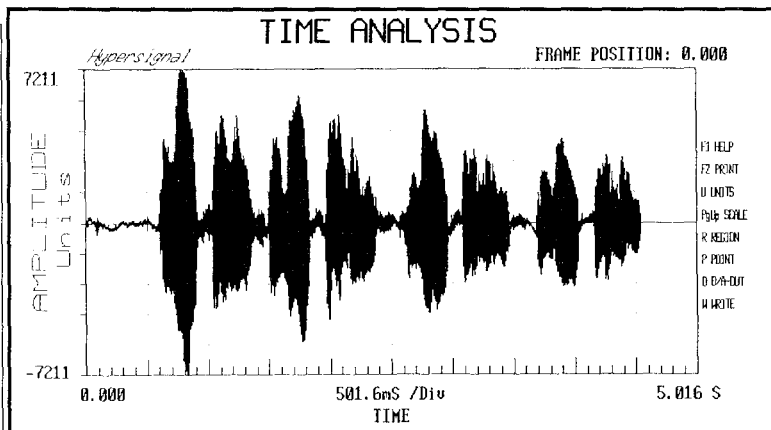


Figure 1A is the waveform for "Hello Fellows" repeated four times. I have spoken directly into a 1/2" measuring microphone in a very "dead" room. This waveform is preserved digitally on the hard disc of my computer.

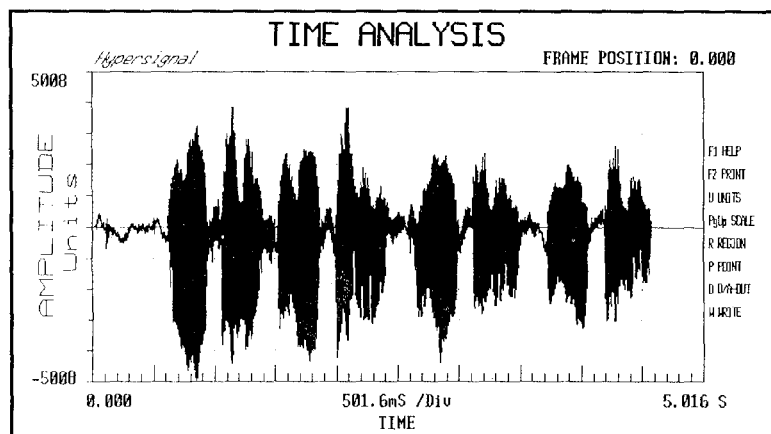


Figure 1b is the same waveform but with a clone of itself added by approximately 300 μ sec later. Note particularly the degradation of the first word "Hello" in each case.

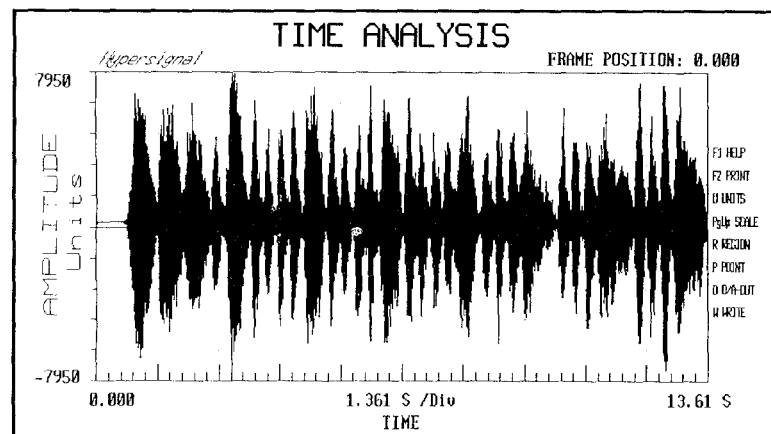


Figure 2a is an anechoic "Handel" from the Denon disc.

Figure 2a shows the anechoic waveform (The Denon test disc) for 13.6 seconds of the music. Figure 2b is the same music after being convolved mathematically with a concert hall design ETC.

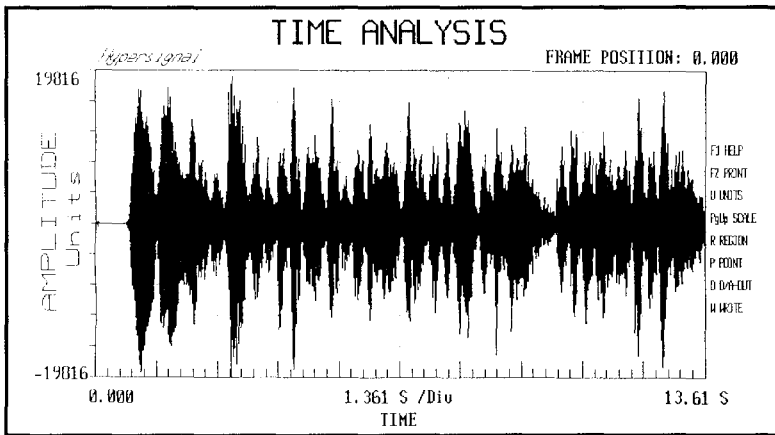


Figure 2b is the same waveform mathematically convolved with an ETC from a building in a computer that does not yet exist as a physical structure. These are the waveforms we are playing back in current classes.

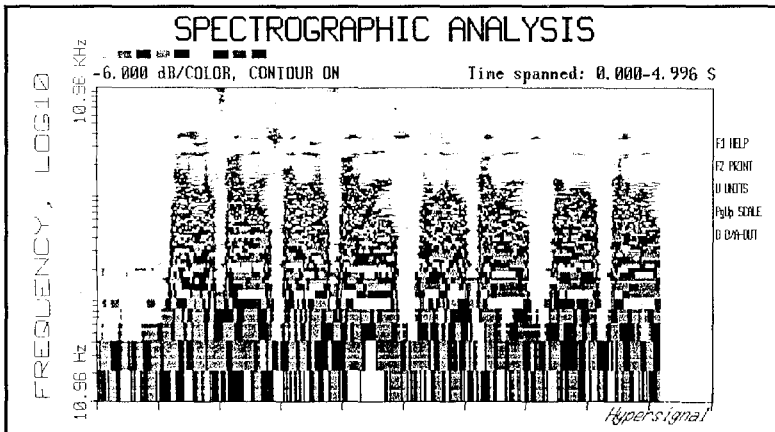


Figure 3a is a spectrographic analysis of "Hello Fellows" without delay.

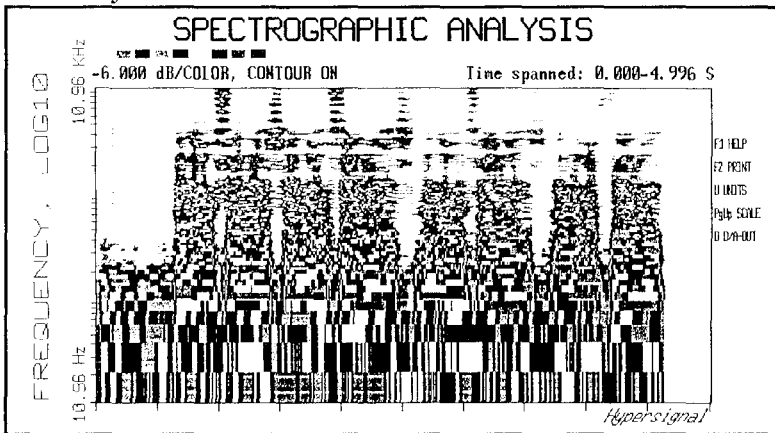


Figure 3b has 300 μ sec of delay added. Note the time smear and the high frequency combing.

Spectrographic Analysis

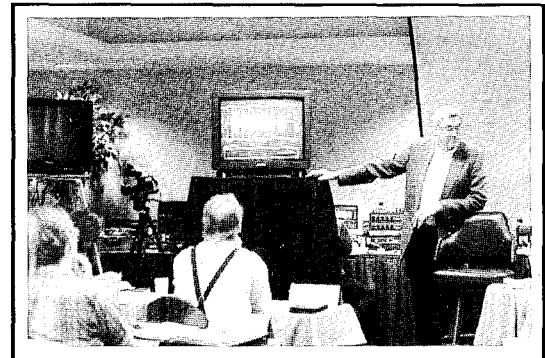
Spectrographic analysis has long been used to study voice signals. The Techron FTC (frequency vs time curve) is such a method of analysis. Hyperception allows this form of presentation also.

Figure 3a and 3b is another way of looking at waveform

of "Hello Fellows." The effect caused by combing is evident especially in the time smearing it causes the speech spectrum in addition to the nulls and peaks produced. In Figure 3 the vertical scale rises from 11Hz to 11,000 Hz. The horizontal scale is from 0 sec on the left to 5 sec on the right.

Listening to this played back allows us to hear what a design that exists only on paper will sound like, at the chosen location in the hall, before it is built.

In each case once we have viewed the waveform, simply pressing the letter "D" on the computer plays it back on the sound system connected to the computer. This means that when a room design containing bad geometry is being presented at the drawing board stage you can hear the echo at the time where an eraser is the cure. ■



Don demonstrating Hyperception in the Seattle Class.

From Bill Wagner of Montana. It seems that two men came across an extremely aggressive Grizzly bear. One of the men sat down and put on a pair of track shoes. The other man said, "You can't outrun that bear." The first one replied, "I don't have to; I only have to outrun you."

Current Status of TEF—20 Measurements

Those fortunate enough to have attended recent Syn-Aud-Con classes have seen us demonstrate the "Heyser Spiral" on the TEF-20 Beta version. Techron, as of this writing, (late April) has in successful operation:

- *EFC, both magnitude and phase (This is a sound lab.)
- *ETC including RT₆₀, %ALCONS, and regression
- *The Heyser Spiral we are currently using in our classes is a Beta version programmed for Syn-Aud-Con by Ron Bennett of Techron. We fully expect that it will become a part of the standard "sound lab" software later in 1991.
- *Full Speech Transmission Index, STI, both plots and charts
- *Rapid Speech Transmission Index, RASTI, both plots and charts
- *Noise Level Analysis, NLA, a super site survey measurement which includes L_{MIN}, L_{MAX}, L_{EQ}, L_{DN}, L_{MEAN}, and any three user chosen L_%'s, auto calibration of your microphone to the TEF when the microphone is in the presence of a known level, and the choice of standard SLM weighting.
- *NC curves automatically run as either plots or tables

Of particular note is the careful thought that has gone into making the cursors super useful. Watching the cursor track and display data on four simultaneous displays of the analytic signal is mind boggling. Dick Heyser's valiant at-

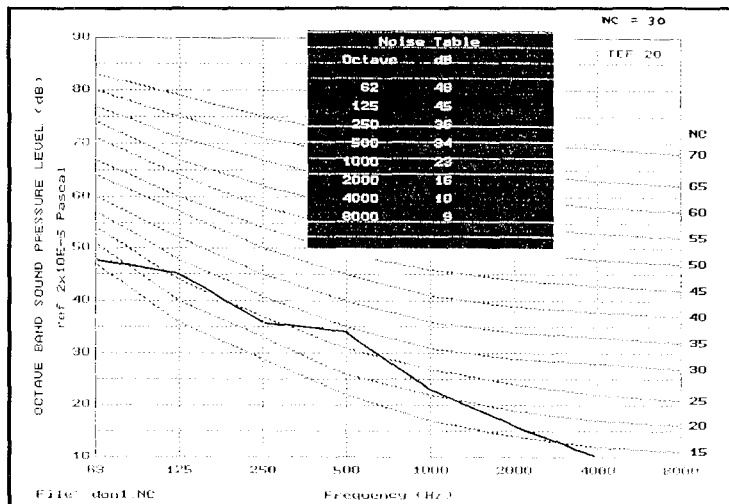


Figure 2. The NC measurement showing the alternative "pull down" table

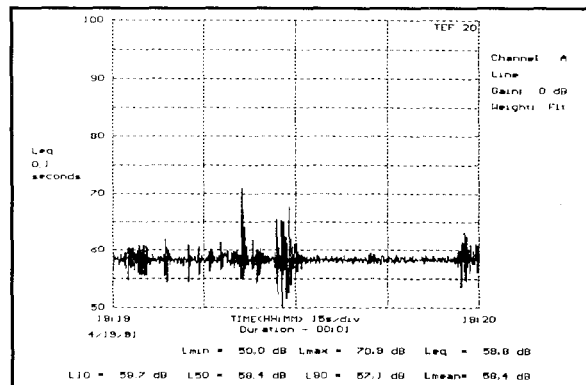


Figure 3. The NLA measurement. In this case the three L_%'s are set for L₁₀, L₅₀ and L₉₀ (levels exceeded for 10, 50 and 90% of the time)

tempt to bring audio and acoustics into the Quantum Mechanics era continues. We are pleased to see genuine progress in this most complex task.

The basic instrument exhibits qualities that will easily carry it on through this decade if spirited and inspired programming takes advantage of the basic engines. We have learned that Techron and Hyperception will be interactive and that news means accelerated software for use in the professional acoustic realm.

TEF technology is still exploding with Bruel & Kjaer having a new version using the concepts suggested by Mark Poletti of New Zealand.

We are still looking for two more display forms:

1. The Wigner distribution, both 3D and contour.
2. A 3D display made one sweep at a time with user labeled axes with both the 3D and the contour displays available at the touch of a key.

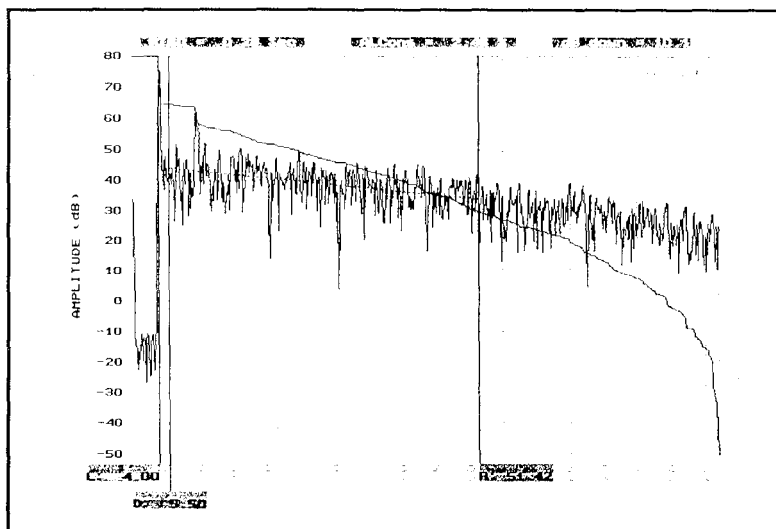


Figure 1. TEF-20 ETC with three cursors set. L&R define the time and level change over which the RT₆₀ is computed. D defines the division between the L and R

TEF SPEECH INTELLIGIBILITY TEST			
TEF 20			
FREQUENCY	STI	EARLY RT60	S/N RATIO
125 Hz	0.50	1.54	0.1 dB
250 Hz	0.35	3.36	-4.4 dB
500 Hz	0.30	4.53	-6.1 dB
1000 Hz	0.39	2.82	-3.3 dB
2000 Hz	0.44	2.19	-1.9 dB
4000 Hz	0.39	2.78	-3.3 dB
8000 Hz	0.31	4.22	-5.7 dB
-- OVERALL --			
STI = 0.39			
Equivalent S/N Ratio = -3.5 dB			
Equivalent Early RT60 = 3.06 s			
-- SUBJECTIVE EVALUATION --			
POOR			

Figure 4. The full STI as a table

TEF RAPID SPEECH INTELLIGIBILITY (RASTI) TEST			
FREQUENCY	STI	EARLY RT60	S/N RATIO
500 Hz	0.33	3.91	-5.2 dB
2000 Hz	0.43	2.28	-2.1 dB
-- OVERALL --			
STI = 0.30			
Equivalent S/N Ratio = -3.7 dB			
Equivalent Early RT60 = 3.10 s			
-- SUBJECTIVE EVALUATION --			
POOR			

Figure 6. The RASTI measurement

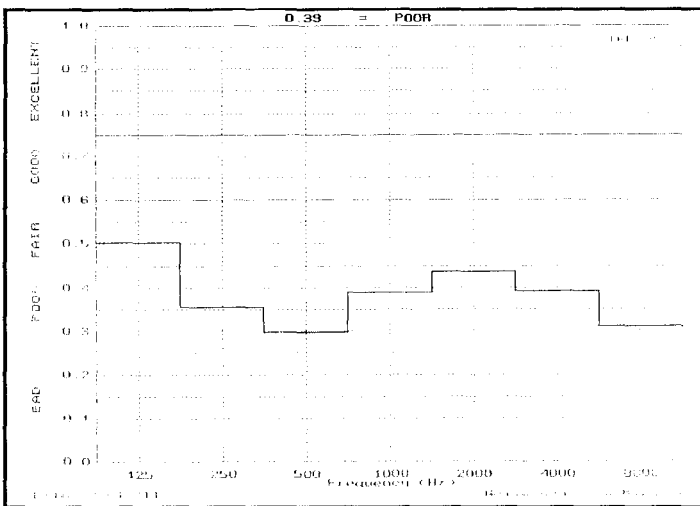


Figure 5. The full STI as a graph

Much remains to be done but at the present time the TEF-20 has now accomplished all of the measurements that allow the purchaser to generate meaningful income from its use. The graphics, especially when used with Pizazz Plus, allow outstanding presentations of the measured data.

First time instrumentation buyers can learn the basics on the TEF-20 and by so doing be prepared to intelligently participate in the advanced versions as they appear. Many envy those in at the beginning of any great era. This is the beginning of real computer-based acoustic measurements.

An Example Measurement

This is an ETC measurement where the 'L' cursor (left) and the 'R' are set at 4 msec and 51.42 msec respectively. The Schroeder integration comes up with the cursor call up (shift F2) and the dashed regression line (embedded in the ETC plot) can be obtained by pressing 'S'. The 'D' Cursor at 5.50 msec divides the L_D from the L_R .

The RT_{60} , %ALCONS, and the dB difference between the 'L' cursor and the 'R' cursor levels are all shown at the top of the plot. ■

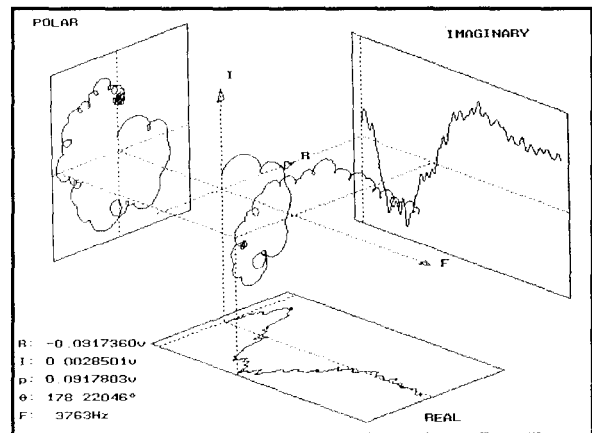


Figure 7. The Heyser spiral in the frequency domain with the cursor "on screen" and its four readings tabulated at the lower left. 'R' is the real part, 'I' is the imaginary part, 'a' is the amplitude, θ is the phase angle and 'F' is the frequency the cursor is set to.

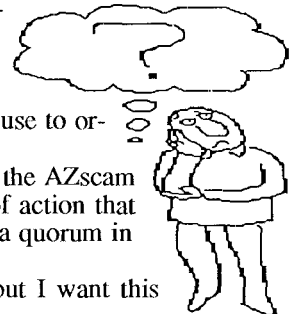
Fun at the Politician's Expense

Driving up to Seattle on Interstate 5 we saw the following sign of the times, "Every politician should have two terms—one in office and one in jail."

We then read a frustrated chief executive describing his House of Representatives, "You can lead the house to order, but you can't make them think."

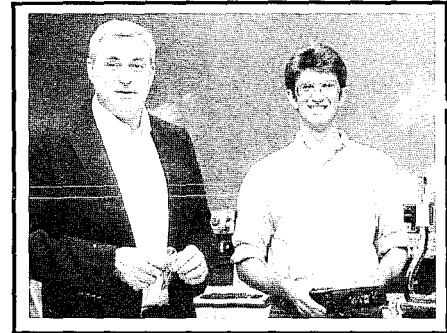
During our Western tour this winter, we heard that the AZscam in Arizona had taken so many of the legislatures out of action that they "should stop arresting them or they wouldn't have a quorum in the legislature."

A tidal wave of other comments come to mind, but I want this printed.



Calgary Stampede

Sound System



Don with Barry McKinnon

When you decide to "run bare-foot" through an older, existing sound system that has a good reputation, you can't come up with marginal improvements in the new one and expect to survive with your good reputation in tact.

Barry McKinnon of DSE Production Equipment in Calgary was faced with this challenge in the re-do of the Calgary Stampede sound system. (Yes, this is the same Barry McKinnon that you see authoring excellent articles in several of the audio maga-

zines - one of the few authors in the popular press that you can take on faith. He knows what he is talking about, and he THINKS.)

Barry was responsible for the loudspeaker design. He had several helpful allies, in addition to the excellent staff headed by Rocky Anderson at the Stampede, that all of us expect to see used on first-class jobs these days:

1. Binaural use of DAT recorders. The Crown SASS is surprisingly useful for this kind of work, or the ITE

system for those fortunate to have it.

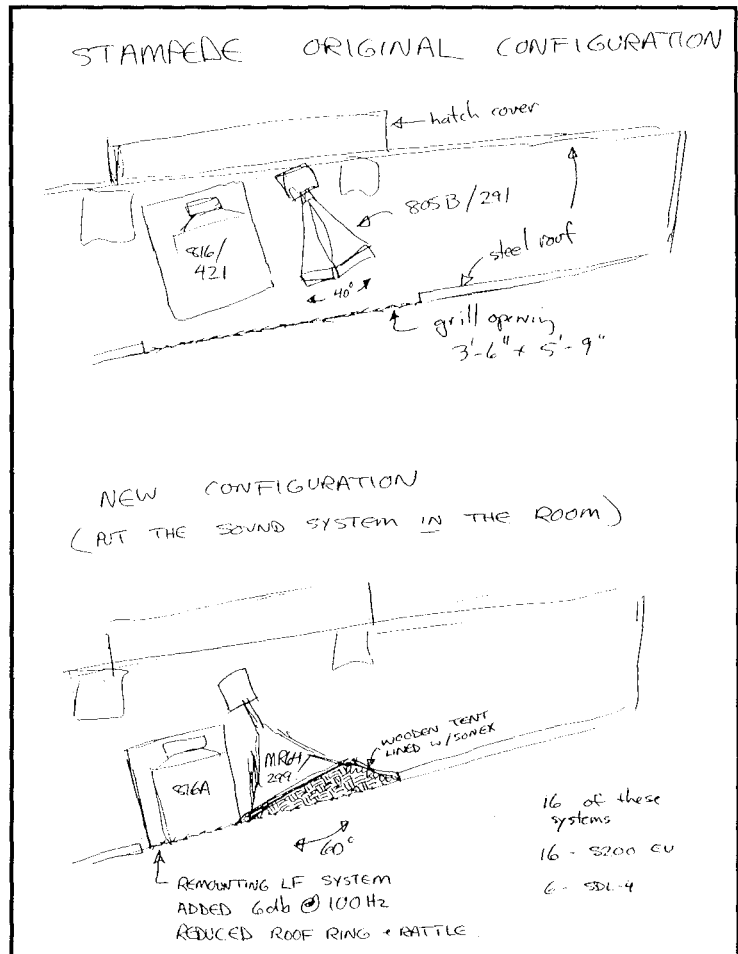
2. TEF analysis, particularly in handling the time domain synchronization. A member of the staff at Calgary said, "I couldn't imagine how you could do a system like this without the TEF."

3. Knowledge of the modern technique of housing arrays and protecting them from too-early reflections. See the rough drawing that Barry made showing the use of Sonex near the horns.

4. Craftsmanship. In mammoth



North half of grandstand showing EVPI 100's under clubhouse, S200's for top level and hatches with Altec 816A/421 & Altec MR64A/299-16A as well as the location of 6 x servodrive SDL-4.



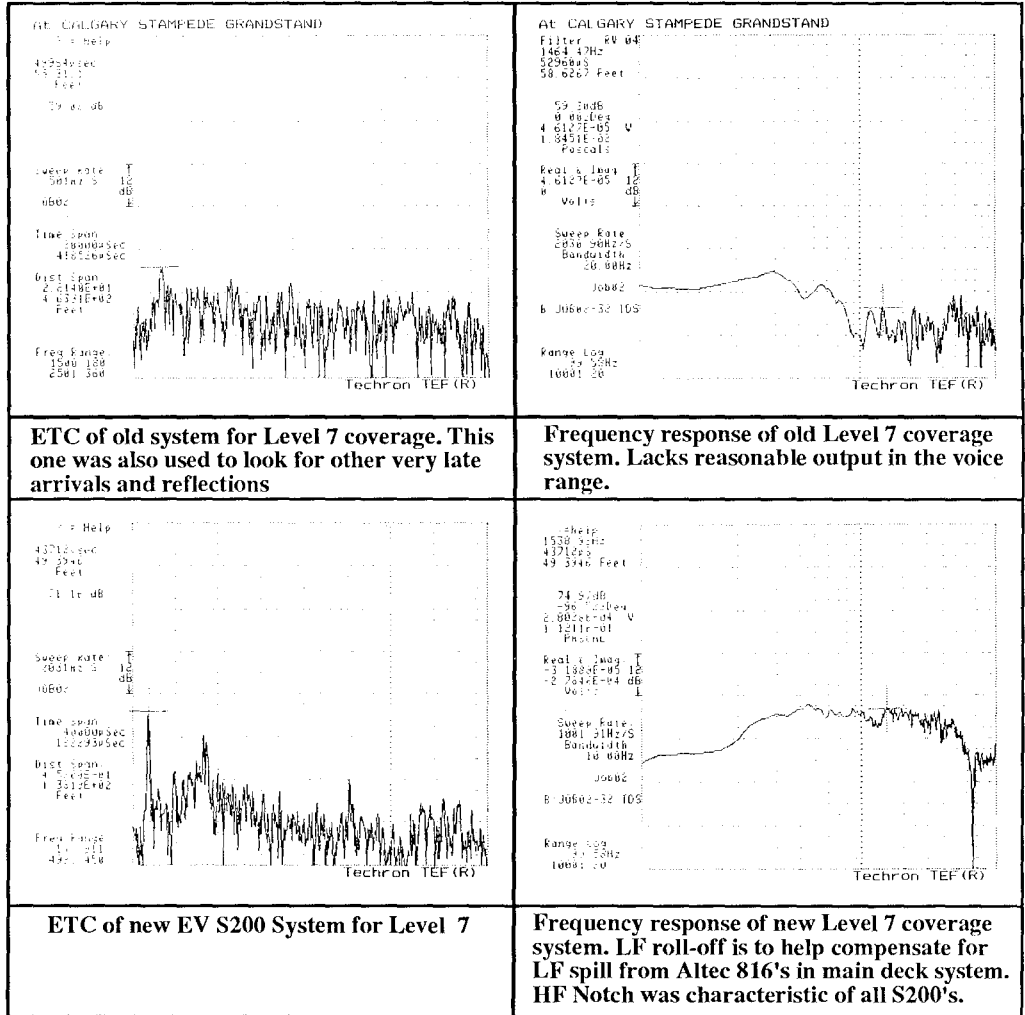
layouts you either use craftsmanship or create a total mess.

5. Innovation - the use of, in this case, ServoDrive SDL-4 subwoofers from Interasonics provided vastly improved bass performance according to those who have had a chance to hear the system. Barry said that the opening ceremonies was AWESOME, a very moving experience.

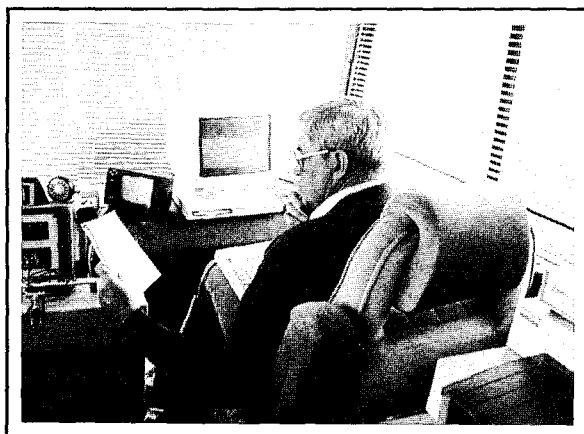
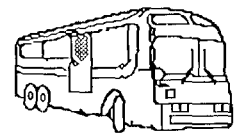
Multicells were replaced by Altec MR64A horns, and the 291 drivers were re-diaphragmed with the newer Altec 299-16 diaphragm. Electro-Voice PI100 and EV S200 loudspeakers were used for under balcony and fill systems. IRP 41 mainframes were used in place of separate delays, crossovers and equalizers.

I hope one day to hear this system during its annual major use - the Calgary Stampede.

Here are the before and after measurements. Barry said that the results don't really convey the major subjective improvement; you have to hear the binaural recordings for that. ■



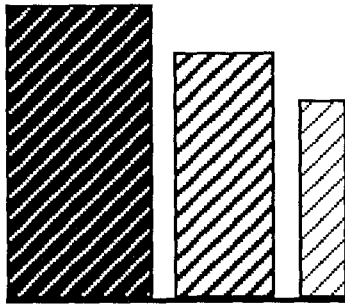
When We Are Not in Class, We Are Not on Vacation



Many who see our motor coach parked outside of the classes are surprised to find out that it is a mobile office, acoustic laboratory, and computer center. The 6.5 Kw Onan generator on board is sufficiently stable to allow its use with both our analyzers and our computers (these are rapidly becoming one and the same these days).

In addition to our computer and analysis work we do two newsletters a year while traveling.

Those who imagine that we simply pull away from a class and loll around until the next class haven't seen what goes on inside this traveling sweat shop—and there are always more classes than shows up on the published schedule as we do several "special" in-house seminars each year. ■



Advanced Acoustic Measurements Utilizing Computer Analyzers August 5-7, 1991

The Advanced Acoustic Measurements Utilizing Computer Analyzers Workshop will be a workshop with "hands on" measurements in a hostile environment of both adequate and inadequate sound systems, ambient noise, structural transmission, and architectural acoustic treatment. Measurement tools will include:

TEF-12
TEF-20
Ariel SYSid

Software from Techron, Renkus Heinz, Altec, JBL, PHD, Hyperception, Ariel plus many special programs by Syn-Aud-Con grads will be used. Measurements will include analysis of Noise Criteria (NC), Noise Level Analy-

sis (NLA) including LDN LEQ and L₉₀'s, STI, RASTI, %ALCONS, the analytic signal, auralizing from design data and measured data as well as correct use of the classic ETC's, EFC's, Nyquists, waterfalls and impulse responses.

In each case the analysis will be oriented towards its use in the solution of practical problems encountered in either the environment or the sound system.

The workshop is intended for those already well involved with both computers and analyzers and is an advanced workshop for those with previous experience.

Prequalification: You must know operationally how to run the analyzer you bring or have had at least the basic Syn-Aud-Con class so you are familiar with acoustic and audio practices. This is not a basics TEF class. ■

SYN-AUD-CON

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Sept. 19-21 — Oct. 17-19

❖ **3—Day Workshops—\$650**

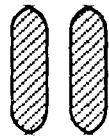
*Advanced Acoustic Measurements
Utilizing Computer Analyzers
August 5-7, 1991*

*Concert Sound Reinforcement
January 1992*

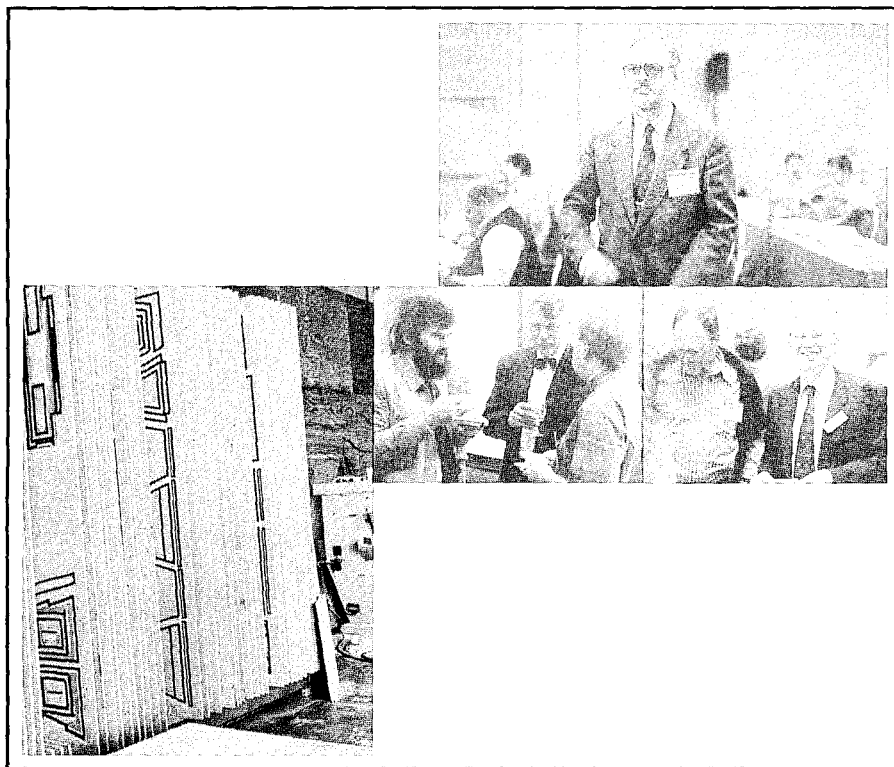
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Renkus—Heinz



A Company With a Tiger by the Tail



The Renkus Heinz meeting held in Irvine, CA in January 1991 brought in participants from around the world. The staff for the meeting was also international: Dr. Wolfgang Ahnert, Dr. Reiner Feistal (co-developers of the EASE program), Frans van der Meulen, senior application consultant for the Philips organization in the Netherlands, Mike Klasco and I, in addition

to the energetic and dedicated Renkus Heinz people—and 200 outstanding contractors and consultants from around the world.

We were treated to a working demonstration of EASE interfacing with AutoCad followed by the playback through the EASE ETC of music convolved mathematically with the ETC via Hyperception and the Ariel

DSP so that we heard the difference between the anechoic recording and the room design.

I gave a talk on the Heysler spiral using measured material from electronic low pass, high pass, and band pass filters, as well as acoustic measurements of small rooms and of coupled spaces. The analytic signal viewed in its pure form reveals some unexpected insights with respect to the meaning of phase.

Harro Heinz gave an excellent and accurate talk on the various ways to approach processed systems. Such systems are here to stay and more than likely are barely out of their infancy. We await the use of processing for purposes other than maximum levels. Every lesson learned from and about such systems will eventually provide us with the knowledge required to generate artistic interfaces between advanced computer/synthesizers and complex arrays where frequency ranges are distributed within the array, directivity is a composer's choice; and automatic presets exist for signal delays, equalization and ensemble blends. Synthesizers still await their Handel, Bach and Mozart.

Meetings such as this one are the seed bed for improved products better related to actual in-the-field needs, and for greatly improved communication between the manufacturer and his contractors.

Another facet that attracted our attention is the fact that while many of our super large corporations can't see past the bottom line on this year's bonus generating financial statements, men like Harro Heinz are buying advanced tooling and making business commitments that show clearly that Renkus Heinz has faith in the United States and utter confidence in their own ingenuity to grow into something bigger and better.■

**Sorry
We're Late**

This issue of the Syn-Aud-Con Newsletter completes 17 years. The next issue will start our 18th year. We missed one issue and extended subscriptions in 1978 when we were all involved in preparing a week-long birthday celebration for our Uncle

Roy who was living with us.

We're late this time because we entertained an IRS agent for three days at our office here at the farm. Though there were only minor adjustments, the time preparing for our guest left us brain-drained.■

A Very Important Measurement

by
Doug Jones

The TEF measurement that Doug Jones of EASI, Evanston, IL has made provides an illuminating insight, to say the least. As Doug says, "It explains many a mystery." I know of no computer that competes with the Mac for ease of preparing presentations such as Doug's. On the negative side, at the present time, you can't use Hyperception with the Mac.



That's Doug Jones (L) talking with Dr. Patronis during the recent Loudspeaker Designers Workshop in Atlanta

How an Old TEF Dog Learned New Tricks by Doug Jones, EASI

I thought I knew everything about making TEF measurements in control rooms. After all, I've been doing it since 1984 or so in hundreds of control rooms all over the country and overseas.

On this particular job I decided to be brave and take the TEF-20 unit that I am currently BETA testing for TECHRON out to a real job. Since my trusty old TEF 10 was quite sick at the time, I had to rely on the 20.

My normal approach to control room measurement is to start with a series of ETC measurements behind the console usually in 9 positions. I start with just the left speaker then repeat the positions with the right. On this fateful day I had made measurement #1 (mix center, left speaker on) and everything looked great. Of course, the TEF display was somewhat unfamiliar, I was looking at a MAC IIsi with considerably more resolution than my trusty old 10. The other reason it looked unfamiliar was that I had the AUTO-SCALE feature on. The auto-scale gives you the maximum dynamic range possible. I was looking at an ETC where the bottom of the screen was around 0 dB SPL and the top was around 80 dB SPL. This sure looked different but I figured why not. Just because I usually used the 6dB per div setting on the TEF-10 giving me all of 48 dB on the screen. . . hey I can handle more than that! Anyway, back to the story.

Measurement #2 (mic to left of mix center, left speaker on) was fine. Measurement #3 is where the fun started (#3 is where the mic is to the right of mix center with the left speaker on). Figure 1 shows what I saw! Sound energy was getting there before it was getting there! My first thought was that the studio had stolen my recently patented Digital Advance Line (the signal comes out before it goes in), then I figured I'd better call Brian Flinn who is writing the TEF code for the MAC and report a 3rd position bug. Just to cover myself, I moved the mic back to position 2 and everything looked fine. Position 3, and the laws of physics were once again suspended. OK folks, enough of this nonsense! In checking

the distances I realized that the so called direct sound (the taller spike in the measurement) was in fact the left speaker, and the "early early sound" was the right distance for the right speaker! But signal was panned left so how could it be? Just to test my theory I went and stood in front of the speaker with my most precious measurement tool (my right ear) right in front of the HF driver, and instructed my helper to take a measurement. Nothing. But my early early sound was gone. To make a long story somewhat shorter, I finally realized that what I was looking at was crosstalk in the console, some 50dB down coming out of the right speaker! I couldn't hear it because it was masked by the sweep coming from the left speaker but the TEF "heard" it just fine. If I had been using my TEF10 with the 6dB/div setting I would have never seen it. I wonder how many consoles/systems with crosstalk I've measured without ever seeing it? I wonder if this is why LEDR occasionally doesn't work right even though my usual ETC's look fine. Guess what I'm going to be looking for in the future.

P.S. Another lesson that this experience taught me is to really look at the data and avoid simple pattern recognition.

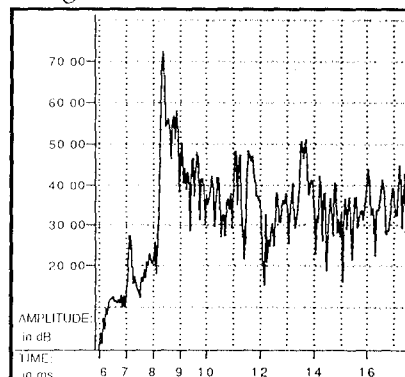


Figure 1

Test Parameters

Start Frequency	(Hz)	20.0
Stop Frequency	(Hz)	20000.0
Center Frequency	(Hz)	10010.0
Frequency Span	(Hz)	19980.0
Sweep Time	(Secs)	2.99
Receive Delay	(mSecs)	6.0000
ETC Time Span	(mSecs)	21.78
Number of Samples:		1024
HAMMING		

Proof That "Q" Does Count

Back in 1968 (23 years ago) yours truly was totally involved in using the early Hewlett Packard desk top computer-calculators. After developing a series of sound system design programs, whose algorithms are still in wide use today, I concentrated more on field measurements and less on calculations as a personal passion.

This winter I added a program called Mathcad to my computer and have found it as invigorating a challenge as the early HP machines.

As an illustration, let me take an example I discuss in every class. The situation is described as a listener sitting in a seat where the direct-to-reverberant sound field ratio is not adequate. Further, the direct sound field level would have been adequate if the reverberant sound field were not there as well. Figure 1 depicts this situation.

The L_D at 4' is 107 dB. At 150'

the L_T is 97 dB. Now if we change sound sources but continue to input the room with the same acoustic power (i.e., $L_W = 120$ dB) but our original source has a $Q = 1$ and our new source has a $Q = 10$, then Figure 2 describes this new set of conditions. L_D is now 10 dB higher at 116 dB while the L_T remains 97 dB. Note however that DC has gone from 14 feet to 44 feet.

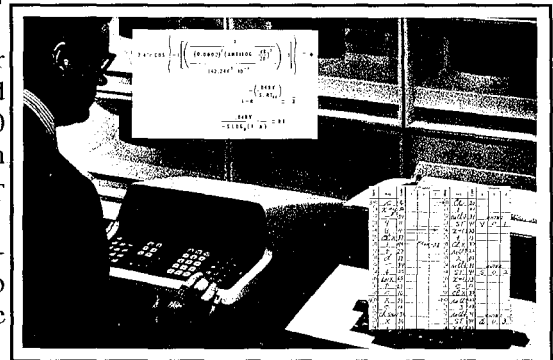
If we increase the Q for the higher value of L_D and then also decrease L_W by 10 dB down to 110 dB, we then have a $L_D = 107$ dB and an L_T at 150' of 87 dB.

We have not only increased the L_D-L_R by 10 dB to the good, but we also have lowered L_R by 10 dB.

Finally, let's do the same for a $Q = 50$ and also lower the

L_W by 10 log 50 or an $L_W = 103$ dB.

What's nice about Mathcad is once you enter your definitions and the operating equations, then all tables, plots, etc. are automatically accomplished. Yes! Mathcad's ad is correct—I would have done violence in order to have had access to it during my university days. ■



Altec uses the Hewlett Packard 9100B computer to design your Acousti-Voiced sound system (1970).

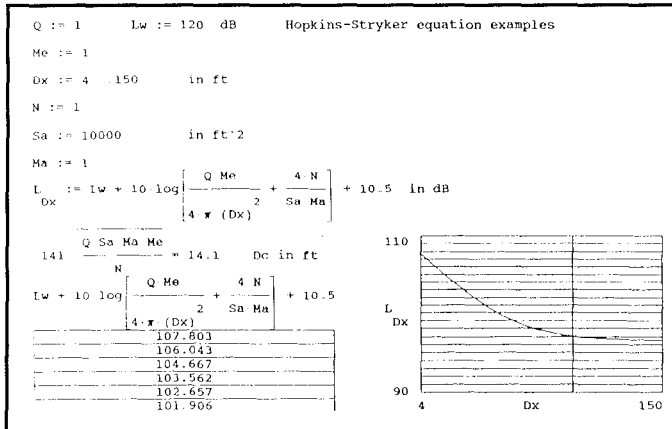


Figure 1

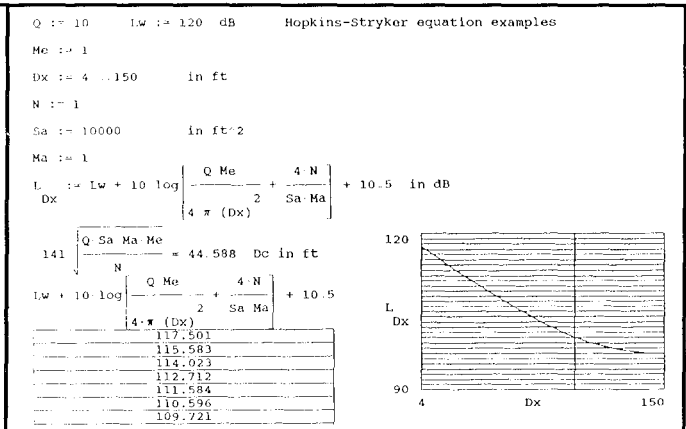


Figure 2

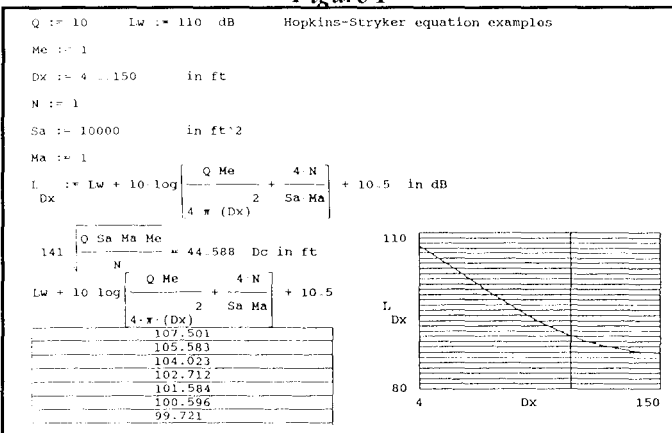


Figure 3

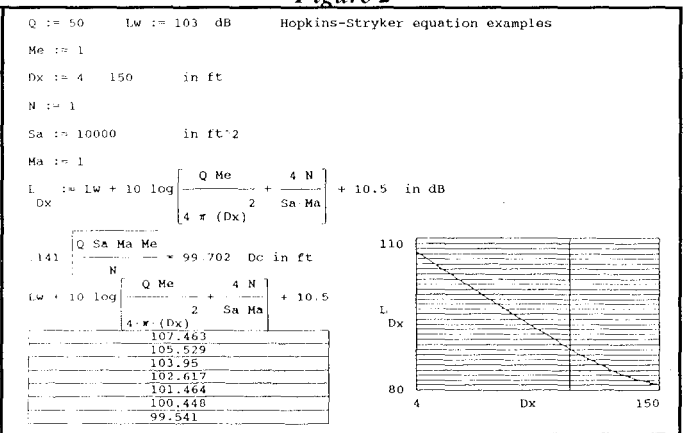


Figure 4

In-Car Early Reflection Studies Using In-The-Ear Microphone Techniques

by
Thomas D. Breithaupt

Thomas Breithaupt of Robert Bosch Corporation, Blaupunkt Division, has written and presented an outstanding paper to the Society of Automotive Engineers, SAE. (SAE Technical Paper Series #910892.)

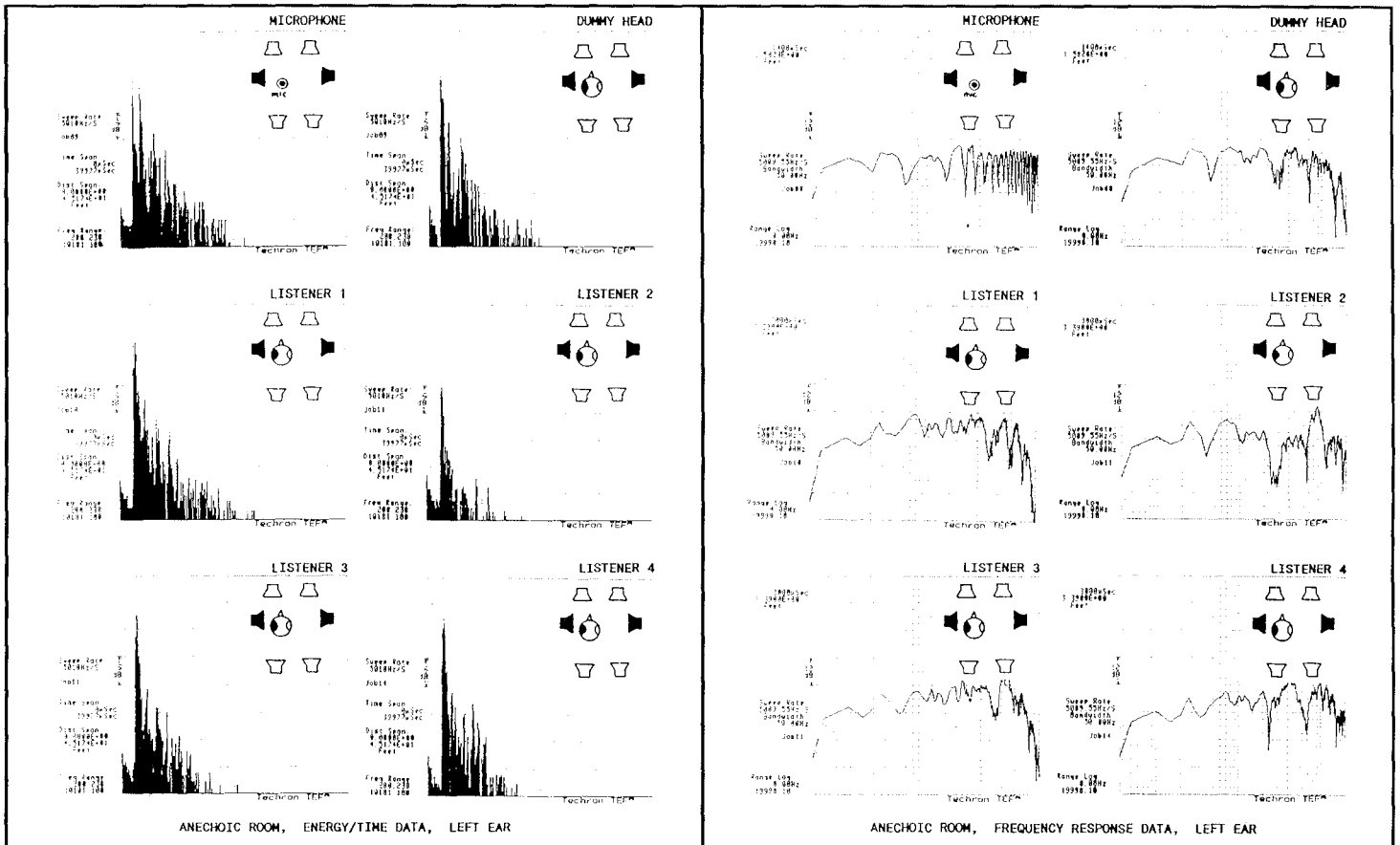
This unbelievably detailed paper utilized TEF measurements made with the Etymotic ER 7-D In-The-Ear microphones. He compared them to measurements using the six microphone array method and the dummy head technique. This paper contains 75 pages like the ones shown here.

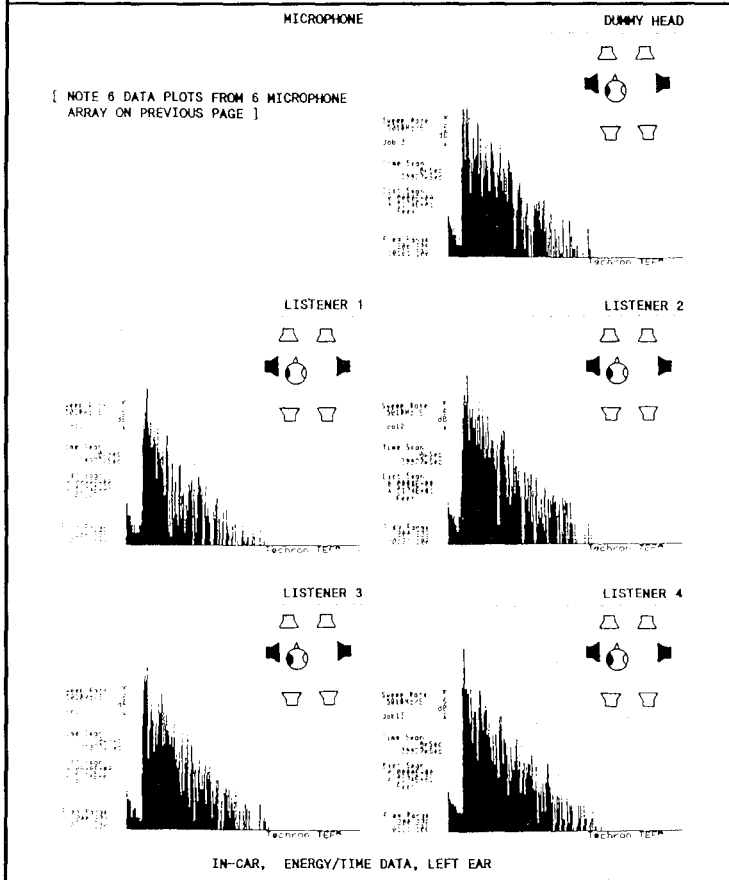
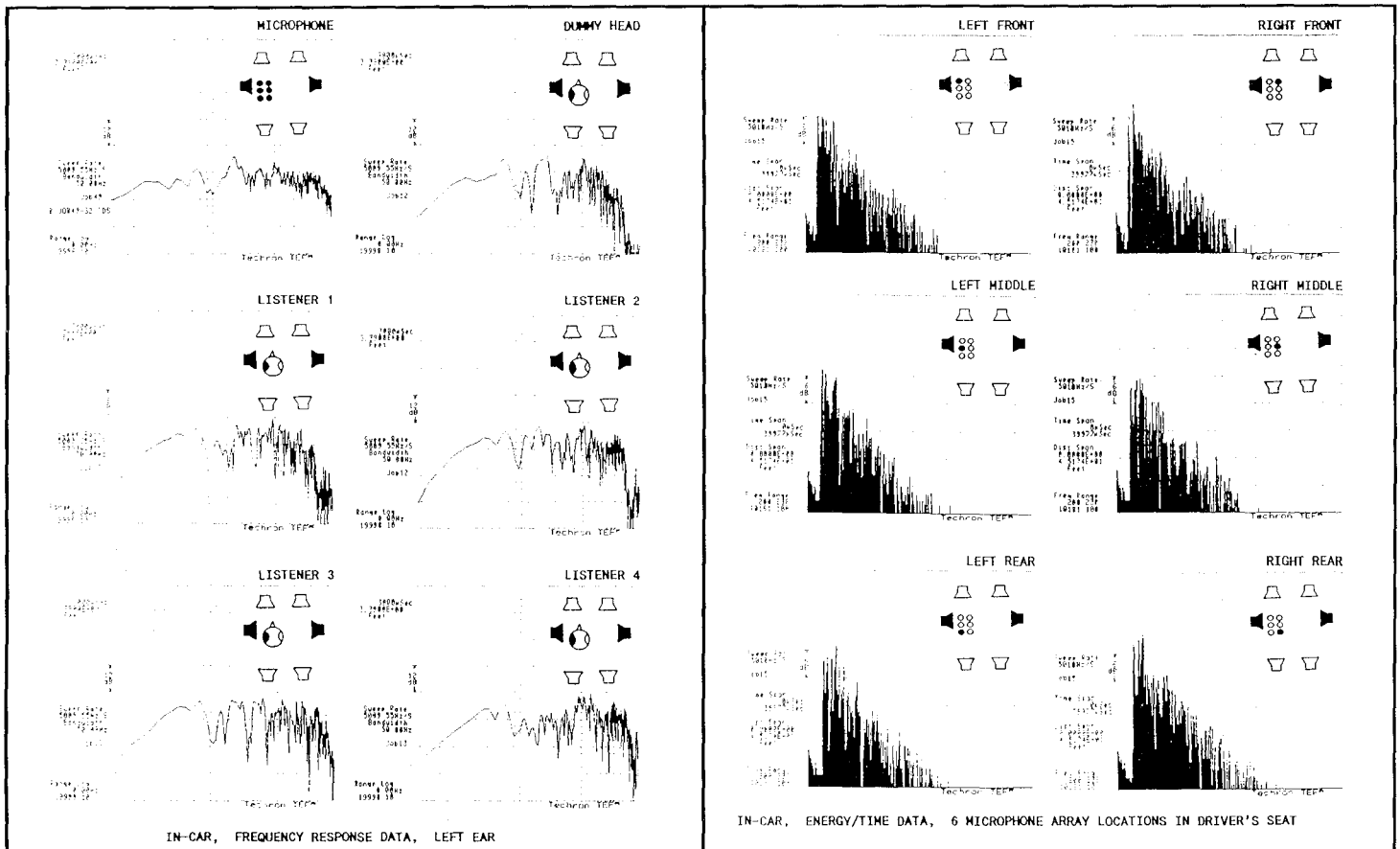
Mr. Breithaupt's summary written in a letter to us accurately characterizes the advances made:

"In summary, the ITE probe microphones confirmed the need for further research in how we really hear. It was interesting to note how remarkably directional some people's hearing is. This emphasizes the need for loud-speaker/listener system design and not a bunch of microphones, switchers, digital processors, computers, and closed minded monkeys using them."

The measurements were made first in an anechoic room, then in an automobile. We are reproducing measurements of one set of conditions: loudspeakers on both sides of the head. Listeners 1-4 are wearing ITE probe microphones. Note the difference in what each of the listeners heard, including the dummy head and the omni microphone.

Space does not allow us to reproduce the measurements with sufficient size to be completely readable. We hope, if you have an interest in knowing more about the measurements, that you will contact Mr. Breithaupt at Blaupunkt, 2800 S. 25th Ave., Broadview, IL 60153. Ph. 312-865-5200.



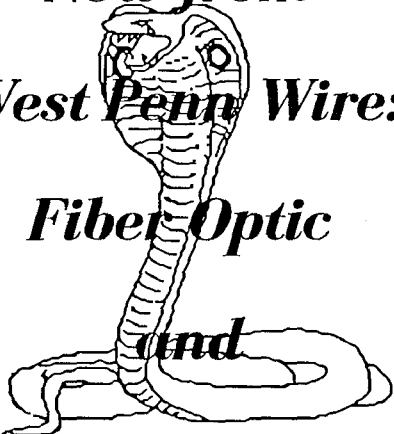


A Bit of Physics

The Leaning Tower of Pisa still stands because.

A vertical line drawn through its center of gravity passes within its base--Ganot, "Physics"

New from
West Penn Wire:
Fiber Optic
and
Audio Snake Cables



West Penn Wire now offers fiber optic cable. Smart money, on important repeat customer jobs, can pull in fiber optic cable for future use even when the present setup will use standard cable. When the customer buys those equipment updates that could materially benefit from fiber optic interconnect, they will be delighted with your foresight. The cable is not the expensive part of a fiber optic interconnect system. At the very least, be sure to obtain a copy of the West Penn Wire "Fiber Optic Cables" catalog.

Black Cobra Audio Snake Cable from West Penn Wire

Black Cobra cable interconnects console board equipment and other audio components for recording studios, radio and television stations, post-production facilities, and sound system installations. It is ideal for use as line level microphone snakes. Black Cobra audio snakes are individually jacketed and shielded pairs which provide top protection against signal interference. Call 800-245-4964 for further information.■

**Gentner's "People Link" —
 An Acoustic
 Telephone Interface**

Lew Barrett, super salesman and extraordinary friend, is shown here telling the Seattle class about Gentner's "People Link", an acoustic telephone interface (ATI).

Such devices are eagerly sought after in the booming teleconferencing market, especially fully digital, effective ones.

The specs show frequency response as 250 - 3300 Hz (-1 dB), signal-to-noise ≥ 60 dB ref. +4 dBm, THD $\leq 0.15\%$, and echo return loss. Telephone ≥ 40 dB - acoustic echo cancellation ≥ 30 dB, and acoustic echo suppression 18 dB.

Key features listed are:

- Full duplex conversations
- Privacy button
- Auto-answer/auto-disconnect
- 100% digital audio processing
- Dial up two wire or dedicated four wire connections
- Digital gain processing

One of these ATI's at each end along with microphones, mixers, power amplifiers, loudspeakers and telephones constitutes a complete teleconferencing system. The ATI assures integrity of the transmission over the telecom lines. Now, if you have done a good job with the acoustic transmission lines, success is assured.■



Lew Barrett telling the Seattle class about the Gentner's "People Link".



Ferdinand Boyce (R), Lew's partner and owner of a Miata with a license plate, "YNG AGN" talking with Steve Olszewski.

Electro-Voice S-40 Compact Monitors

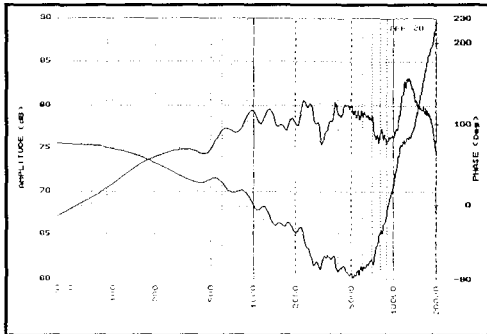


Figure 1—The magnitude (upper plot) and phase (lower plot) responses made by the TEF-20.

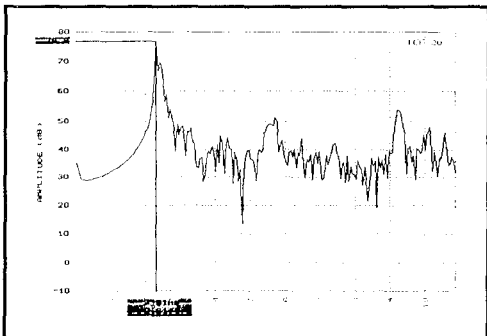


Figure 2a—An ETC from the TEF—20 with the cursor set on the tweeter.

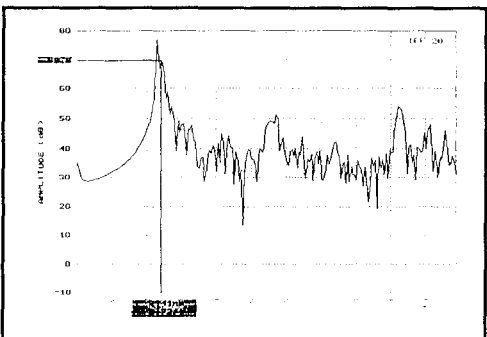


Figure 2b—The ETC with the cursor set on the woofer.

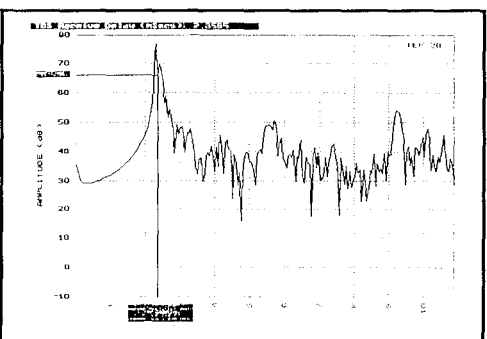


Figure 2c—The ETC with the cursor set halfway between the tweeter and woofer (note the TDS receive delay at the top of the plot).

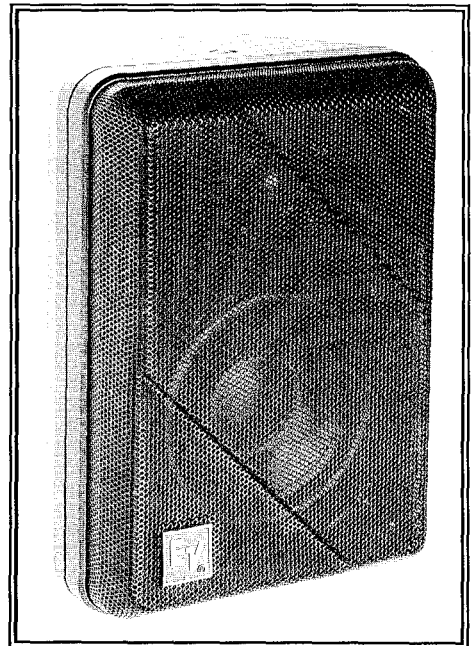
We recently had the opportunity to evaluate a pair of Electro-Voice Model S-40 compact monitors. Several features of these units recommend them for use in both recording and measurement systems.

1. Their Q in the 2 KHz region is 4.0. (A live talker is from 2.5 to 3.0 so this is close enough to be used in place of a live talker for intelligibility tests.)
2. Their coverage angle, (C \angle) 100° x 100° (again near enough the "average" live talker with 120° horizontally and 90° vertically.)
3. They have a 160 watt power handling capability.
4. Their claim of ± 3 dB from 85 Hz to 20,000 Hz is supportable from our independent measurements. (See Figure 1.)

The woofer and tweeter are slightly out of synchronization, viewed from 0° on-axis. (See Figure 2.) Their polarity markings are correct. See impulse response. (See Figure 3.)

At 5.7 lbs a piece and only 9.8" high, 7.0" wide and 5.9" deep, the S-40 truly represents highly useful acoustic measurement test tools.

The secret to their power handling capability is a new protective circuit



utilizing a solid state self-resetting switch to insert a high positive current coefficient resistor HPCCR in series with the woofer when a certain power level is exceeded. This unit glows as a light bulb to indicate it's time to lower the level. If you don't, power compression will occur.

The tweeter is handled in a similar manner with a fixed resistive value that lowers the power to the tweeter by 6 dB. All that is necessary to avoid power compression is to be sure that the HPCCR does not light.

We were able to play the Dorian "Pictures at an Exhibition" organ recording without distress over these units, and while the octave 30 to 60 Hz was not there, the loudspeakers stayed clean and undistorted for the remainder of the range.

In our opinion, these represent an outstanding buy with a multitude of musical and measuring uses. ■

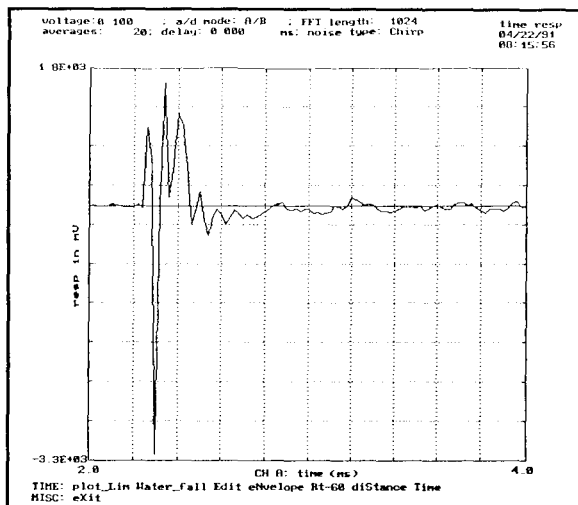


Figure 3—Impulse response made on our Ariel SYSid system. Note correct polarity.

Fun & Games

With the Ariel SYSid

Precision instrumentation has always had the same attraction to me that pressing down on the throttle of a Porsche Turbo has when sliding a high speed turn. Both require dedication and skill on the part of the user and allow performance unimaginable to laymen when handled properly.

The Ariel SYSid installed in a good computer is indeed a precision tool. While it is not the ideal choice for acoustic measurements (TEF is), it is ideal for electrical measurements. In evaluating SYSid, I went through some Syn-Aud-Con classroom exercises (which are acoustic measurements) to see how the system performed. The exercise I chose was two unsynchronized 4" loudspeakers looked at in as many different ways as possible. Having purchased, back in the late 70's, a very expensive one channel FFT from GenRad (which became the ETC display in an early version of the Heysler systems some of us built in those years), I was genuinely curious as to how these new computer based dual channel FFT's would perform. I must report that they do much better, thanks to the choice of Maximum Length Sequence and Chirp sources, in addition to the impulses we used in earlier years. We prefer the "chirp" signal as implemented by Ariel over either the MLS or the impulse techniques for any electroacoustic testing.

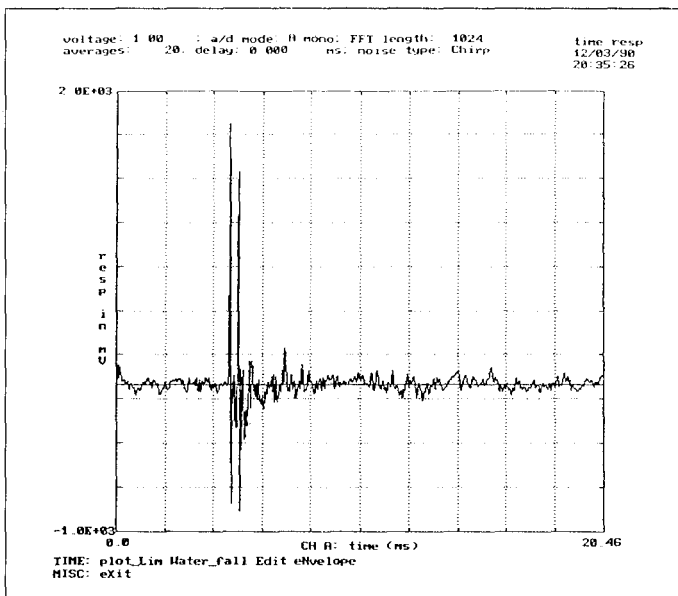


Figure 1—shows the computed impulse response revealing the two arrivals and their polarity (positive).

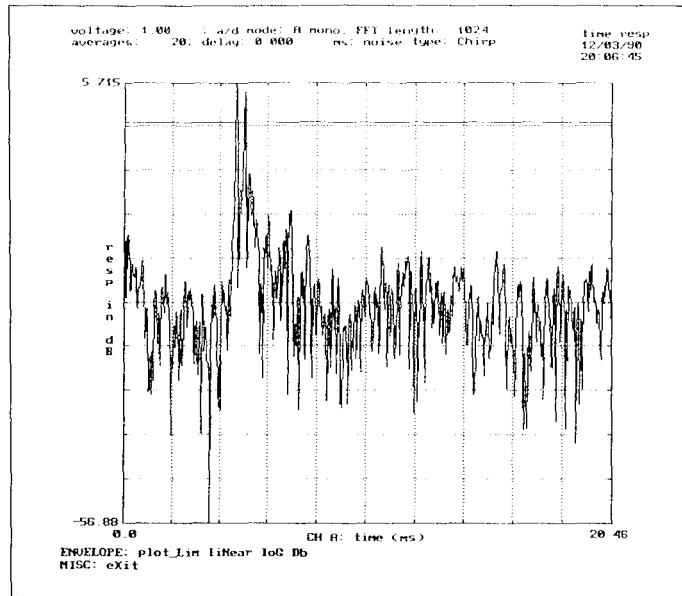


Figure 2—is the impulse response processed into an ETC. We found the Ariel SYSid ETC's to match TEF ETC's time and amplitude data with accuracy, but not with as much immunity to ambient noise.

Making the Tests

The test consists of taking the amplitude vs frequency of the two missynchronized loudspeakers. Thereafter, everything else except distortion measurements is post-processing. Let's, however, look at the data in TEF fashion (i.e. time domain information first).

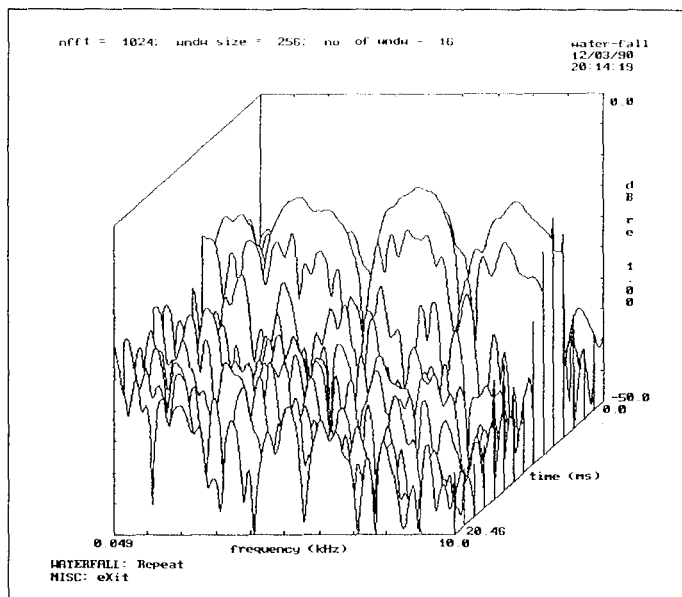


Figure 3—is the Waterfall display and the ability to vary the display resolution is a nice feature of this system. One drawback: you can't, at this time, reverse the displays front and back.

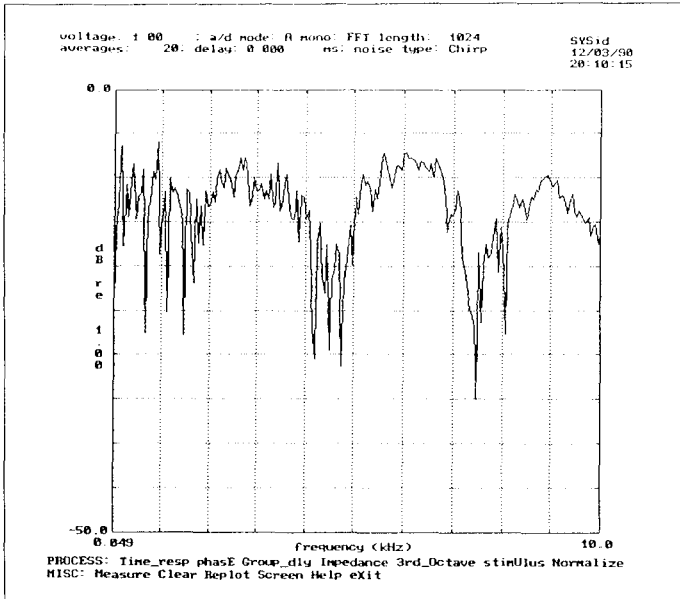


Figure 4—is the originally taken amplitude vs frequency data showing the comb filters generated by the two missynchronized loudspeakers.

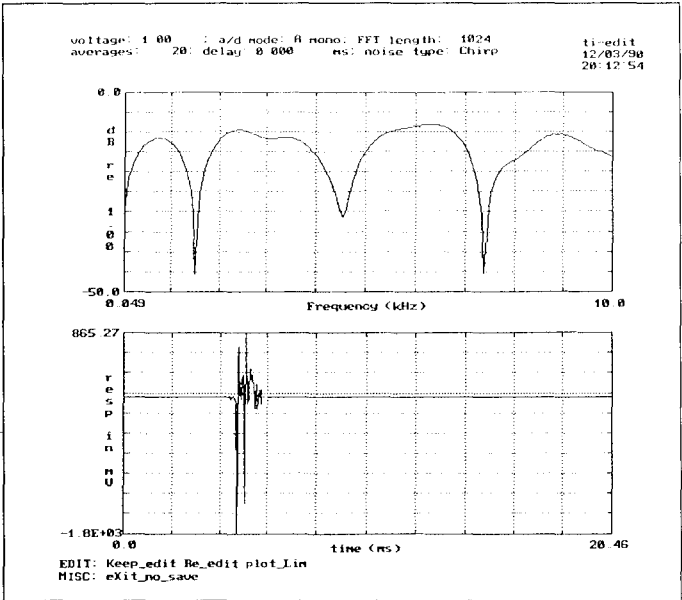


Figure 5—shows one of the really desirable features of this system called "editing" whereby you can post process the exact amount of time domain data you want displayed as frequency domain data. In this case we looked at the direct sound only.

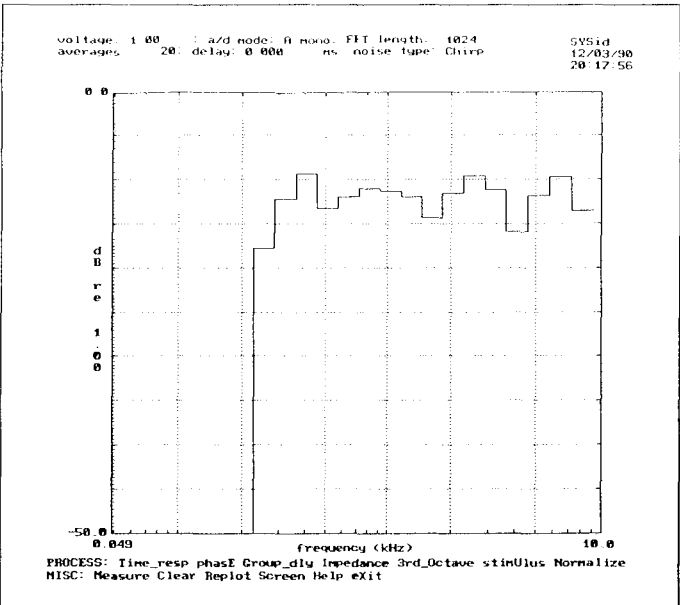


Figure 6—is the same plot as a 1/3-octave display.

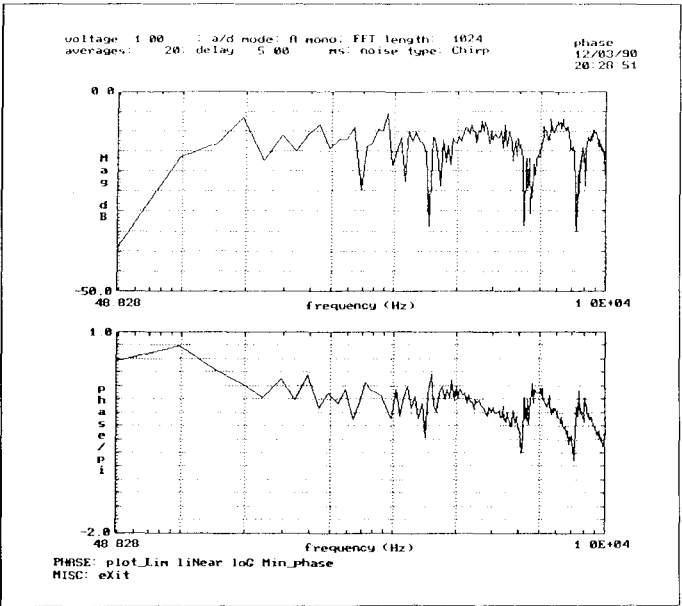


Figure 7—shows how they handle the display of amplitude vs frequency and phase vs frequency with, in this case, the minimum phase computed. (This system also allows the measurement of the actual phase.)

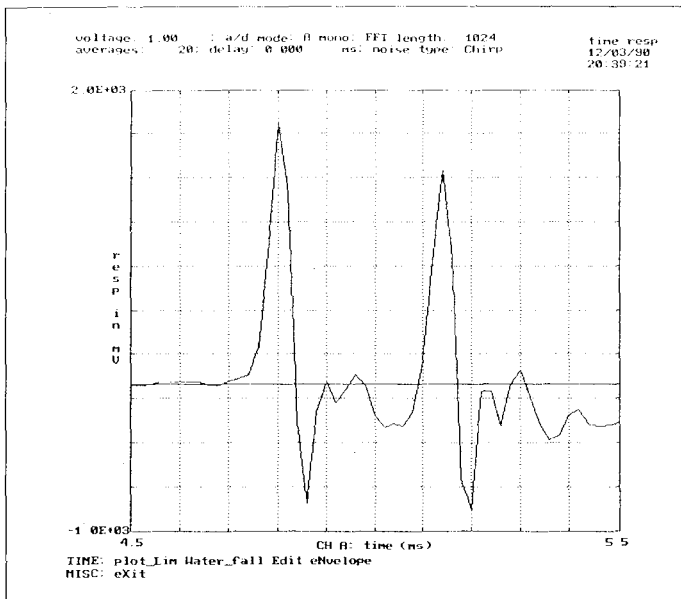


Figure 8

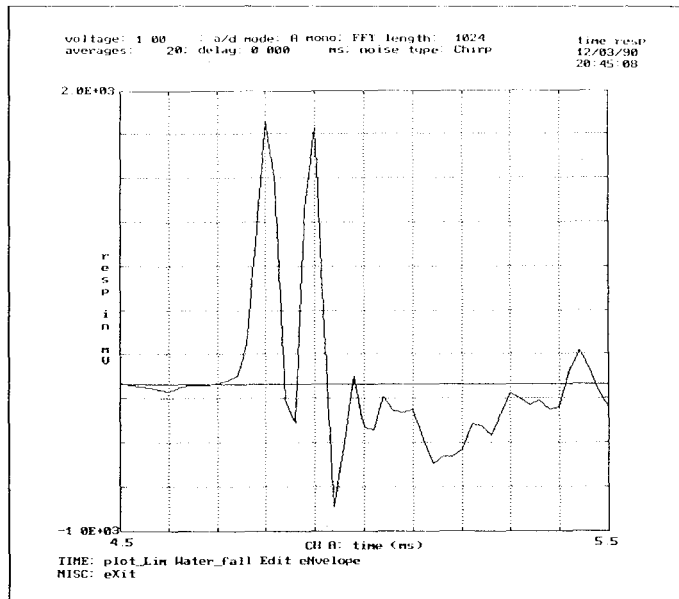


Figure 9

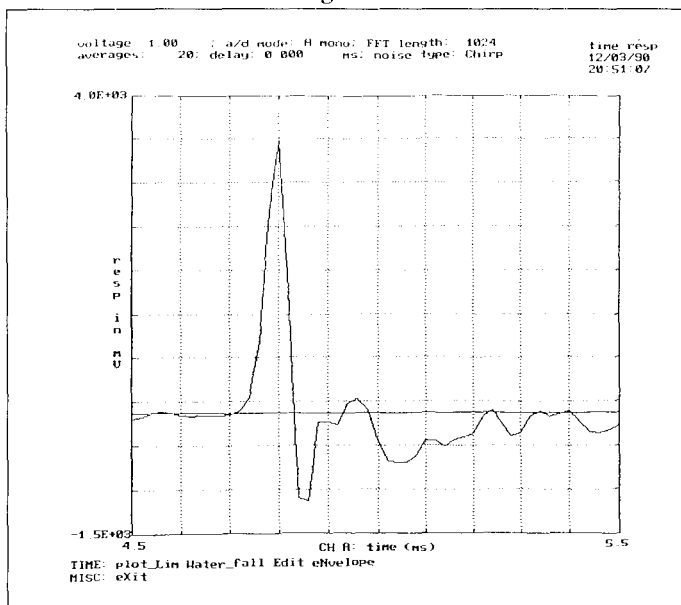


Figure 10

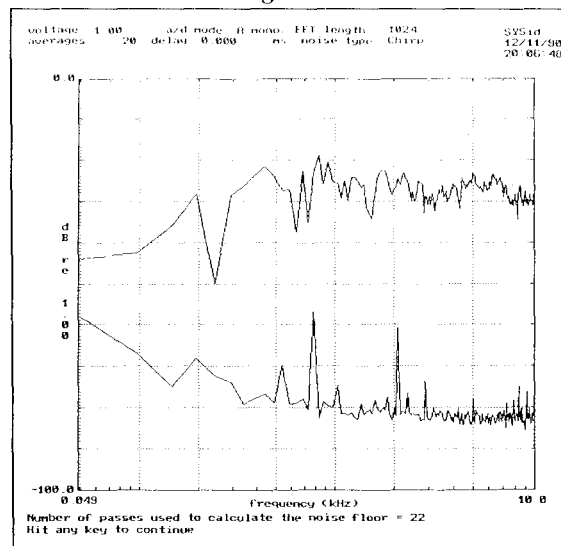


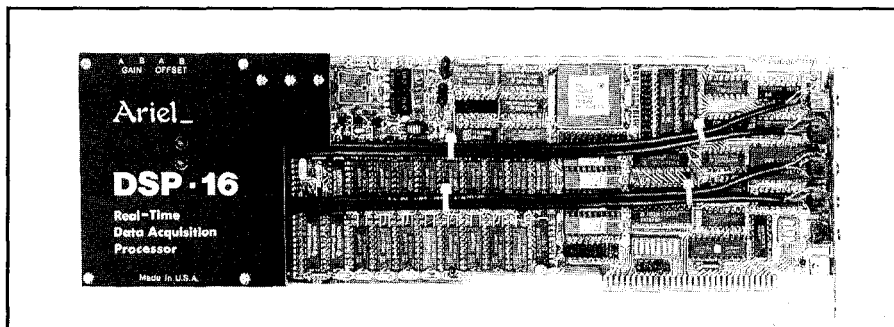
Figure 11

Figures 8—10 show the progression towards synchronization. Be careful to note that the vertical scale in Fig. 10 is double that of previous figures because of the 6 dB increase for synchronization.

Figure 11—shows a highly desirable feature namely the ability to measure the noise floor directly after your measurement by pressing a key on the keyboard.

These displays do not include the SYSid RT60 measurements nor its exceptional ability to measure THD as well as CCIR, SMPTE and DIN intermodulation distortions.

Our overall response is that we're very impressed with an excellent DSP based dual channel FFT at a very reasonable price, and from a manufacturer with every potential for continued updating of the highest order. ■



This is the board that is in our computer. What distinguishes Ariel from many others in this field is the care with which they bring the audio signal in and out of the processor in order to avoid the hazard inherent in such a high inference environment.

Dr. Patronis' Speaker Design for AMC Theaters

Dr. Patronis' loudspeaker design for the AMC theater chain (an Electro-Voice product) has literally leapt to the forefront of the current theater systems. These systems are a variation of the basic Pataxial design. Having now had a chance to hear them in operation in two different theater locations (Kansas City and Nashville) where we also were able to step from auditorium to auditorium within the theater complex and compare the quality of the differing systems offered today, we can say without equivocation that the Patronis/EV system is remarkably good. What a difference proper synchronization makes to dialogue, to say nothing of the music quality! By getting the loudspeaker from behind the screen, coverage is quite noticeably improved as well as eliminating the high frequency comb filters caused by the screen reflections.

Dan Sweeney's article, "The Sound of Theaters", Part II in The Perfect Vision Journal comes to much the same conclusion:

"As I indicated earlier, the Torus screen (AMC theaters) looks great. Conventional screens simply aren't competitive. But what penalty do you pay in terms of

sonics to get that superb image. Very little. In fact the AMC HIT sound quality would be impressive enough even without the accompanying image. With it the synergy is amazing.

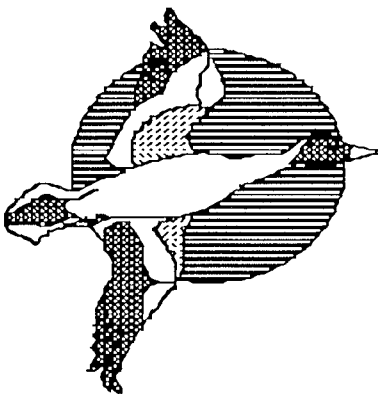
"The absence of diffractive effects seems to make voices sound more natural....The increase in realism is evident with all kinds of sounds. The timbres of both environmental noises and musical instruments on music tracks are better rendered than in any competing system.."

Sweeney makes a final remark that seems appropriate,

"The man who designed this system knows at least as much about sound reproduction in the home as he does about pro sound."

Anyone interested in motion picture sound should get a copy of Part II of Mr. Sweeney's 24 page report discussing ALL of the theater sound systems: THX, Bose, High Performance Stereo, Altec, JBL, EV, Klipsch & Intersonics—to name a few.■

Geese Breaks



When we need 5', no-climb horse fencing on the farm, we call on Troy and Shannon McBride, a father and son team that live on a farm down near Orleans (pronounced in this neck of the woods as "ore-leens" with the accent on "ore").

Their farm is in Orange county down on the "lost river." That part of Indiana is riddled with subterranean caves and waterways and the "lost river" wanders in and out of its bed at the whim of heavy rains and dry spells.

Troy and Shannon are a remarkable pair worthy of a lengthy novel. Troy is fragile in appearance, but not in actuality. Shannon is built like a Sumo wrestler and just as strong. I have never witnessed a more gentle, loving son who worked as closely with his father in total harmony all the time. Shannon is as large as his father is fragile-looking. One visitor remarked on how Shannon was manually pounding seven foot fence posts as if the heavy pounder was a piece of tissue paper.

The work these two do defies the term work ethic. One feels ashamed to

pay them only what they ask and occasionally we add a bonus to their bill.

Recently, after we paid them for the latest fence, Troy confessed they had spent part of the time watching wild geese fly over. But, he reassured me, just like some men take a break to smoke, they had taken one to watch the geese. I kidded them, though, that I had paid them for a geese break.

Shannon would cock an ear and say, "Can you hear them?" Anyone with normal hearing would pick up the sounds later - it seemed like much later. At one point Shannon said, "Here comes about 100 of them in a big 'V'." Literally a minute passed before they flew into view to my better than normal eyesight.

The McBride's are one of the assets of southern Indiana I wouldn't have wanted to miss.■

Teacher

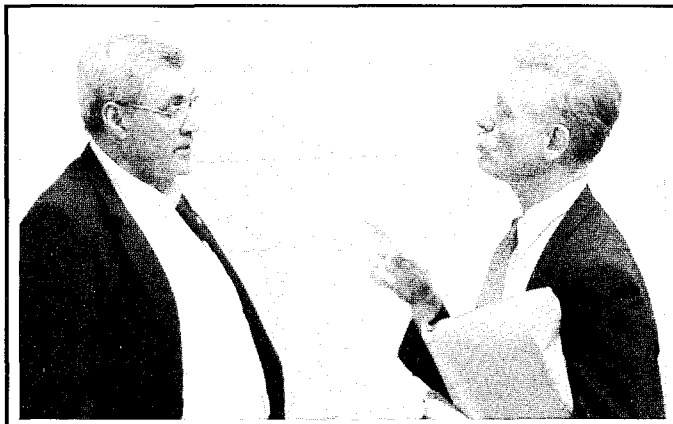
Gets

Taught

That's Dave Klepper playing a familiar role with Don, namely teacher, good friend, and respected colleague. Dave has always been willing to share generously from his truly vast experience in sound system and room acoustic design.

We have now known David for thirty years, and friends, like

fine wins, appreciate with age. Our friendship began when he encouraged me in my early acoustic measurement efforts and his guidance has many times led us to new and deeper insights into audio and acoustic problems and their optimum solutions.■



Seattle Class—March 19-20, 1991



Advertising Discovery Award Goes to Hartley Peavey

Hartley Peavey gets the Advertising Discovery Award for sending in the most outrageous Scam of the Year from a publication called "Audio Adviser". Hartley was as underwhelmed as we were, and I leave his revealing notes intact on the illustration.

I know where the "temporal force" ought to be applied, but there are laws that forbid its proper application. Hartley and I are working on the "Keating Five" modem for banking from our PC, and if successful, we will advertise it in the "Audio Adviser." In the meantime, we are both still making an honest living.

Our sympathy goes out to any rational engineer working hard to produce legitimate products and then finding out that this "dark ages technology" is selling at these prices.

Send to Tony Davis *From JDP*

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Ultimate fine-tuning for bi-wired speakers.

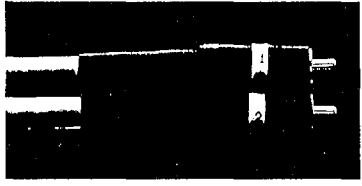
With bi-wired speakers, you can enjoy incredible control with two sets of Temporal Continium speaker cables. Simply adjust one set of Temporal Controllers for sweet, clear mids and highs, and adjust the

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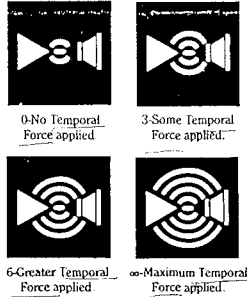


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2.0M	\$635.00	(\$5.95)			

↑ GREAT PAGES! JP



HELL I'D BE SATISFIED EVEN W/ JUST A LITTLE!

13

Den - you probably haven't seen this yet!

OBVIOUSLY A BARGAIN!

John Prohs

Arranged a Very Special Day for Us

John and Melissa Prohs arranged a very special day for us just before our Anaheim class. Through their friend, Mrs. J. Brooks, who personally handled the public relations with each of the astronauts involved in the space shuttles, we were invited to see the Endeavour under construction at the Rockwell facility in the high desert at Palmdale, CA. Before we started the tour, we went to Mrs. Brooks' home where she let us look at the many scrapbooks that she treasured.

The main security officer, J. G. Nixon, escorted us throughout the facility and up on the scaffold surrounding the space ship's cargo bay. We saw the heat protection tiles being tested and handled them. They are very light in weight and very complex in actual application.

Working with the space shuttle can be very dangerous even during the construction stage as each compartment is constructed to be totally airtight. If you happen to be working in a remote compartment and the door is accidentally closed, you will be asphyxiated. Therefore, most areas within the shuttle require two-man teams plus an outside observer.

Parked at one corner of the airfield on public display was one of the special SR 71 "spy planes" originally

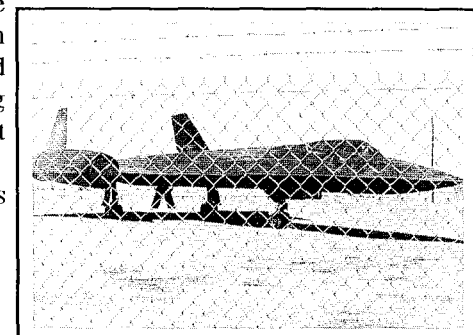
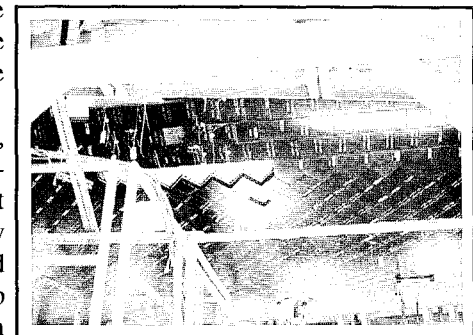
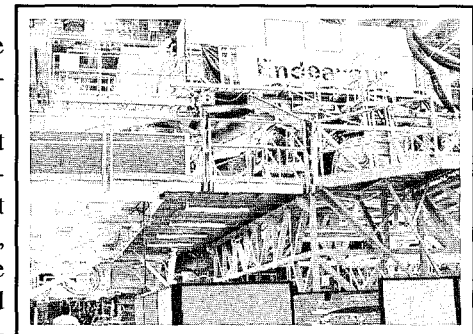
built there. Piloting a "near space" craft up where there is almost no atmosphere calls for unusual skills and endurance.

The next week everywhere we had visited became "off limits" because of the "sandbox".

To me, the most interesting part of the visit was not the hardware, fascinating and challenging as it is, but the people. The people we were with, our escort, and a large number of the key workers have spent a dedicated *lifetime* on this project from conception to successful completion. We stand in awe of what dedicated people can do. They can literally move worlds.

Least you feel we exaggerate, think about the critics of Tom Clancy's novels wherein he writes about the precision and deadline of highly trained military personnel. Critics said he drew portraits no one could live up to, but then along came Desert Storm - the professionals referred to it as the sandbox because they got to play with their toys. Suddenly the whole world saw that what Tom Clancy was trying to depict was too conservative, not too fanciful.

The vast majority of humans has a tale to tell if only we will listen. ■



More Excitement at FSR

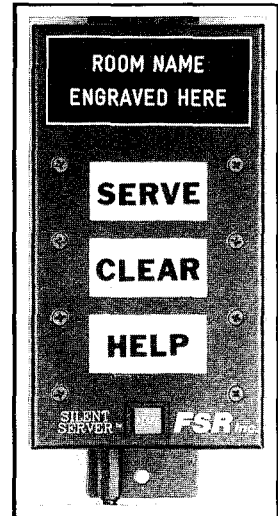
A manufacturer whose primary business is supplying audio equipment for the hotel industry has to do some very fancy toe work to stay even in our current economy. FSR, who is celebrating their 10th anniversary this year, is just such a company. Every product is an answer to a specific need which they very uniquely fill: The "Silent Server" - an infrared wire paging system that lets the guest or catering manager silently (or audibly) signal the catering staff is just such a product.

FSR has grown from a few modules to over 150 products and systems, as well as a fully computerized metal fabrication department.

Another indication of FSR superiority is the IBM contract with them for 20,000 Keypad Response Systems for use with the Academic Information System of IBM.

This IBM system provides an individual keypad per student, which is used to answer questions, ask for help, or participate in discussions. The system gathers the information and displays the results on a monitor or projector screen; thus, the instructor has immediate feedback on the student's acquisition of basic knowledge, an evaluation of course material, and increased student interest and participation.

For more details on these items, call FSR at 201-785-4347 or fax 201-785-3318. ■



Anaheim Class—March 12-13, 1991



Beard Meets Beast



Pancho, our kissing llama, finally met his match. David Andrews, the creature with the cap, stood still and let Pancho look him over. Usually Pancho looks you in the eye, but as you can see from the first photo, he's trying to see if all that hair is a tail and if he has the wrong end in view. Pan-

cho then moved around to the side to see what might be behind all that foliage.

Finally, locating a trace of flesh (David's nose) Pancho, with great caution (note the laid back ears) gave David a buss on the end of the nose. ■

Orlando Class—Jan.31 & Feb. 1, 1991



"Introduction

to

3-D Sound"

From HEAR—the

Newsletter of the

Department of

Radio/Sound,

Columbia College,

Chicago

Doug Jones sent us HEAR which contained this very interesting article on 3-D sound by Marcos Sueiro.

We are excerpting from the article:

"Since the introduction of stereo, sound recording and reproduction have not changed much in terms of spatial accuracy, while steadily improving in other areas. Recent developments, however, seem to indicate that the future of stereo is about to change radically, without any added cost to consu-

mers. New systems allow sound sources to be realistically located anywhere in space around the listener through a standard stereo system. This has been achieved thanks to a computer manipulation of sound, and a better understanding of how the ear locates sound using three basic methods: amplitude differences, time differences, and the so-called "pinna cues."

One of the ways in which we detect the position of sound source is from the difference in amplitude (level) between two ears. This works particularly well for high frequencies, because their wavelength is small enough so that the wave will not diffract (bend) around the head. Thus, the sound will be louder at the ear that it is closer to. Stereophonic reproduction and recording uses this method: positional information is given by differences in amplitude between speakers. The obvious limitation is that the apparent position of a sound source is limited to the line connecting the two speakers. (Quadraphonic systems used the same principle, only using more speakers.)

For lower frequencies, amplitude difference between ears does not yield much positional information, because their larger wavelength bend around the head and are almost equally loud. Instead, differences in time (so called Delta-timing) of the order of nanoseconds are used. Different arrival times of the sound wave to each ear are detected as phase differences, thus providing a clue as to the direction of the sound source. When applying this principle to two speakers, the sound field is expanded beyond the speakers.

The latest development in the psychology of spatial hearing relates to the effect of the outer ear, or pinna, on sound localization. It has been revealed that through a combination of

reflections, diffractions, and resonances, changes of the frequency response of the outer ear (so-called pinna cues) provide an accurate description of the position of a sound source. Although the tremendous role of the outer ear as a sound localization had been suggested as early as the late 1960's by some (see Moore 159), it is understood now that the asymmetrically corrugated interior of the pinna provides multiple paths for sound arriving at the ear, creating reinforcements and cancellations of specific frequencies. The result is that some frequencies are "filtered out," the effect being called a

"comb filter" because of the similarity of its graphic representation to a comb.

There is technology today that—using amplitude difference, phase difference, and pinna cue—allows us to reproduce sound through a standard stereo system and create the illusion of three-

dimensional sound. The most successful system that this writer has heard is the one developed by Auris Perceptual Engineering of Evanston, founded by Kendall & Martens. In a demonstration held at a classroom at Columbia College (hardly the best listening environment) the results were quite astounding: sounds were made to circle the room, go behind the listener's head, and "fill the room."

Some problems remain to be sorted out. Among them is the sensitivity of these systems to the playback hardware and listening environment; head phone compatibility; and timbre changes resulting from the application of the filters imitating the pinna cues. But, the future looks exciting and bright."■

Editor's Note: The phase response of overall systems will take on fundamental importance in this decade.

The latest development in the psychology of spatial hearing relates to the effect of the outer ear, or pinna, on sound localization

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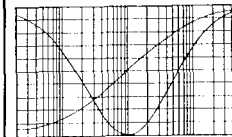
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Hyperception, Mike Klasco, &

Sound & Communications

Mike Klasco has written a very useful article entitled "Audio Analysis" in the March 1991 issue of Sound & Communications discussing some of the audio and acoustic uses of Hyperception's digital signal processing workstation. This article is without

question the most complete overview of what Hyperception offers to audio and acoustic interests, especially those centered on sound contracting work.

"Audio Analysis" is extremely well organized and illustrated. Mike makes a thorough comparison of Hy-

perception and any "would be" competition. He makes an extremely persuasive case for going the Hyperception; TEF-20; Ariel SYSid route in preference to all others and Syn-Aud-Con totally concurs.

While we are talking about Mike Klasco and Sound & Communications, we want to say that we think Mike is doing an outstanding job for S&C. Often when we finish tearing out articles we want to save, there is little left of the issue.

A subscription to S&C is free to sound contractors. If you are not subscribing, start now with the April issue containing Mike's Hyperception review. The issue also contains an excellent article by Mary Gruszka on outdoor stadiums and leading consultants' design philosophy. ■



Classified Ads

WANTED: Crown RTA. CONTACT: Greg Young, 333 S. Main St., Mt. Holly, NC 28120. PH 704-827-3879

EMPLOYMENT WANTED: Audio/Telecommunications engineer with 24 years of experience in the design and development of analog, digital and microprocessor circuitry, transducers, their interface with each other and with the acoustical and electrical environments. CONTACT: Ray A. Rayburn, 106 Woodbridge Rd., Glastonbury, CT 06033, PH 203-633-7273

EMPLOYMENT WANTED: Qualified sound system designer, estimator, bidder, installer, tester, serviceman and salesman. CONTACT: Steve Roth, 508 N. Lansing St., Mt. Pleasant, MI 48858, PH 517-773-0237.

LOOKING FOR: A company called C.W. Cole who makes a recessed floor connection box. I need their address and/or phone number. CONTACT: Bill Goodwin, 305 Concord Rd., Billerica, MA 01821. PH 508-671-0125.

Ken (the Great) Wahrenbrock

We receive frequent requests about the well-being of Ken Wahrenbrock so it's with delight that we show you these pictures of him at work in our Anaheim class. Ken is presently heavily involved in Ham radio and computers. He's still bicycling one hundred miles at a time and can counter my politician opinions with the vigor of an eighteen year old.

His interest in and knowledge of the PZM technology continues unabated, and if we should last so long, we will be talking about him in this same manner when he is 100. ■



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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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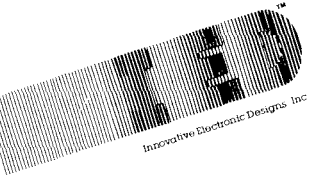
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