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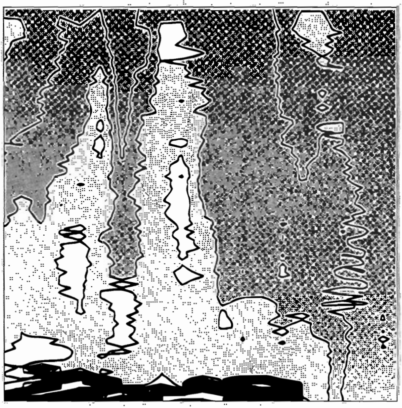

- Surround Sound
- Backscatter Profiles in Harbour
- Policy for Environmental Noise

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Editorial from the President

Our place in the bigger picture?

One of the issues which came up repeatedly at the recent Council Meeting in October was that of representation of the Society on other, umbrella organisations. Currently, The Australian Acoustical Society is a member of the Federation of Australian Science and Technological Societies (FASTS), the International Congress on Acoustics (ICA), the International Institute of Noise Control Engineers (I-INCE) and the Australian Foundation for Science. It also has several representatives on various Standards Australia committees and supports international conferences, such as the recent International Congress on the Biological effects of Noise (ICBEN). All these activities cost us money, your subscriptions and income from sustaining members and conferences, and we must ask from time to time whether we get value from these affiliations. But it is not all a one-way street. To paraphrase John F. Kennedy, we must also ask not only what these organisations can do for us, but what we can do for them. Do we want to be involved on the world stage? Should we be having a say in where acoustics goes in the next decade? Are we interested in influencing Government policy on science and technology? If so, we must channel to them the information they need act on our behalf. We must get involved instead of just asking each year what are we getting from our membership. And to get involved, Council must hear from you. Let us know what issues you see facing science and technology generally, and acoustics in particular. If you see a question emerging which should interest the Society as a whole, take it to your Division or directly to Council. Also you can widen the discussion by sending a Letter to the Editor of Acoustics Australia. It is only by taking action ourselves that can we influence the way ahead.

Graeme Yates

COUNCIL OF THE AUSTRALIAN ACOUSTICAL SOCIETY

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I'm sitting here because I have to.

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I find mathematics difficult.

I try to learn.

I try to concentrate, but I can't hear what you are saying.

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WHAT IS SURROUND SOUND ?

Glenn Dickins *
Telecommunications Engineering
Australian National University
Canberra ACT 0200

ABSTRACT: Surround sound now appears as a feature on a myriad of consumer audio products. Much confusion exists regarding the function and capabilities of such systems. This article discusses the range of 'surround sound' systems available and explains two fundamental principles of operation. This leads to a discussion of the capabilities and limitations of current systems and likely future trends.

1 INTRODUCTION

The term "Surround Sound" has been used to describe a number of products and systems. The frequent use of this term has watered down its impact. This article describes a range of past and present surround sound systems discussing their technical merit. It addresses the questions - What is "Surround Sound" ? What can it offer consumers, now and in the future?

Some simple systems merely aim to make a difference in the produced sound. The technical details of these so called 'surround sound' systems are often lost in the marketing hype. Many 'surround' or stereo expanders are little more than selective gain boosters, adding bass, treble and amplifying the stereo difference.

Other surround sound systems offer a complete new approach to the recording and reproduction of audio. They can create a listening experience well beyond that of standard two channel stereo – fully immersive audio. Several multi-channel audio systems and media formats have been developed and are now readily available at a consumer level.

Adoption of new technology requires a reason to change. In the past, advances beyond two-channel stereo, such as quadraphonic, have not had great consumer success. The reader may ask, what has changed now ?

- Consumer surround sound is being driven by 'home theatre' – recreating the movie sound track experience in the home.
- Advanced media such as the Digital Versatile Disc (DVD) has made multi-channel audio practical and convenient.
- The availability and capability of advanced digital signal processing has made the technology for recording and playback of surround audio more affordable.

The range of surround sound product on the market is growing rapidly and will continue to do so.

2 TYPES OF SYSTEM

Acoustical events generate sound pressure waves or variations at the point of observation. This can be described as a sound field – pressure variations about the mean air pressure. A listener at the observation point perceives this sound field through the senses (hearing, touch and perhaps sight through the effect on objects around the listener). To simulate or reproduce an acoustical event we can either attempt to recreate the sound field or just the effect on the senses.

2.1 Sound Field

A sound field system aims to recreate the acoustical pressure field over a region of space. Such a system is independent of the listener in the sense that a representation of an acoustical event is recreated even if no listener is present.

Sound field systems typically use a multitude of speakers to reproduce sounds originating from different directions. The goal may not always be to recreate the exact sound field, but rather something which will be perceived as similar or convey the appropriate information.

This type of system is well suited to delivering surround sound to a large audience. However to accurately represent a sound field over a large region of space a very large number of channels would be required [1].

2.2 Binaural

Rather than recreating an actual sound field, binaural systems attempt to reproduce an appropriate stimulation of the listener's auditory senses. By controlling the sound only in the region of the ears (as with headphones) it is possible to control the excitation of the listener's eardrums. This can result in the perception of complex spatial sound.

Binaural systems deal with only two channels of information. Through direct recording or appropriate processing, these two signals are constructed to represent the pressure variations experienced at the eardrums of a head placed in the desired sound field. When using headphones, the transmission path from the headphone driver to the eardrum can be measured and inverted to compensate for the effects of the ear canal.

Complexities arise with binaural systems due to the fact that each individual has a unique head related transfer function (HRTF) [2]. Psycho-acoustic effects can strongly bias the perceived sound when it is not consistent with visual cues. Despite these drawbacks it is still possible to control the perceived position of sound sources using binaural techniques.

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ULTIMO NSW 2007

Binaural systems have the advantage of a smaller signal space. Less information is required to produce a surround sound experience. However, once a signal is reduced to a binaural form, the listener is no longer free to experience the effect of moving in the sound field. Small rotations of the head are useful for resolving sound source locations – this mechanism is lost once a signal is reduced to static binaural form.

2.3 Hybrid Systems

The distinction between the two types of systems is not always easy. Hybrid systems may use a combination of the two.

The premise of a transaural system is to deliver a binaural signal using speakers [3, 4]. Processing of the binaural signals must be carried out to cancel the speaker cross talk and head related transfer functions. The goal is to achieve independent control of the pressure at each of the listener's eardrums using two or more speakers. There is a fundamental limitation of the region of control and the bandwidth. For full bandwidth, accurate transaural delivery the listener and speaker locations must be known to within a few centimetres.

A sound field audio signal can be monitored over headphones. By simulating the transfer functions of the speakers to the listener's ears, an appropriate binaural signal can be constructed from the sound field recording. The transfer functions model the interactions of the playback speakers, listening room acoustics and head related transfer functions.

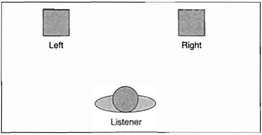

Figure 1. Two channel stereo configuration

3 CURRENT SYSTEMS

3.1 Stereo

Stereo is not confined to two channels [4] – cinema stereo in the 1950's employed four channels of audio [5]. The LP phonograph became the first major consumer stereo format and provided only two channels due to physical constraints. Since then the term stereo has become associated with two channel audio recording and playback. In its basic form a stereo system is a sound field type system which can create the illusion of virtual sound sources between the two speakers (Figure 1).

Depending on the recording techniques used, a stereo recording can contain binaurally encoded information and produce a larger sound image space over headphones or speakers.

The optimal listening position is along a line bisecting the two speakers. This area is known as the 'sweet spot'. As the listener moves away from this region, the quality of the sound field imaging will degrade – sound images initially between the speakers will become unstable and collapse to the nearest speaker.

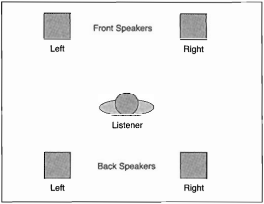

Figure 2. Quadraphonic configuration

3.2 QUADRAPHONIC

Several techniques were developed for delivering more than two channels of audio in the early 70s. Typically the additional two channels were encoded on top of the existing two channels. There were several standards, each requiring its own decoder.

Quad systems represent a sound field type surround system covering 360 degrees in a planar array (Figure 2). The 90-degree separation between speakers tends to leave holes in the sound imaging, particularly at the front centre.

Quad systems were not associated with movie program material and did not offer a significant advantage to consumers for audio program material. The presence of competing and incompatible standards created confusion in the market. As a result of this and other contributing factors, quad systems were not commercially successful.

3.3 Matrix Stereo

In the mid to late 70s, matrix techniques similar to those used for quadraphonic were used for film sound [5]. Four channels of audio information could be encoded on only two channels by exploiting the phase relationships between the channels.

The Dolby MP Matrix encodes two extra channels as matched phase and opposing phase additions to the left and right channels (Figure 3 [6]). In decoding, the centre channel is derived from the sum of the Lt and Rt channels while the surround is derived from the difference. The matrix encoding and decoding process is degenerative and can only achieve 3dB channel separation between adjacent channels [6].

A speaker layout suitable for film sound was adopted with left and right plus a centre dialog channel and a surround effects channel (Figure 4). Dolby Stereo became the standard distribution format for film sound using optical encoding of the Dolby MP Matrix two-channel soundtrack on the film [5].

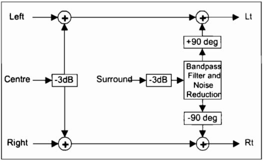

Figure 3. Dolby MP Matrix Encoder

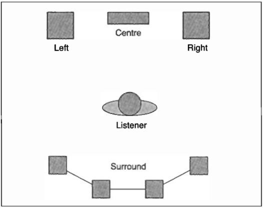

Figure 4. Dolby Surround configuration

Rather than creating an accurate sound field, these systems are concerned with reproducing a desired cinematic experience. The surround channel is used to create enveloping effects and ambience rather than exact sound source image locations. The centre channel is used to create a stable front sound image across the entire audience – a larger 'sweet spot'. This represents a significant improvement over two-channel stereo.

As video recorders became popular in the 80s, matrix stereo surround found its way into the home. Consumer Dolby Surround decoders allowed recreation of the four channel movie sound track from a two channel video source. A pair of diffuse radiating speakers is generally used to appropriately reproduce the surround channel.

Active steering was introduced to improve the decoding process. Through monitoring the relative levels of the decoded channels, the intended sound direction can be estimated. An additional gain stage is included in the decoder to 'steer' the sound in that direction, emphasizing the effective channel separation.

Dolby ProLogic incorporates active steering and became available in consumer products in 1987. This gave an effective channel separation for a steered sound source of 37dB [6]. The additional processing introduces artifacts as the active matrix responds to the input and steers the output – this is known as 'pumping'.

Even with steering, all channel matrixing processes, including Dolby ProLogic, suffer a fundamental limitation. The four channels derived from the matrix stereo signal are not fully independent. Both the surround and centre channels have reduced bandwidth [6]. Complicated acoustical events with many simultaneous dispersed sound sources cannot be accurately recreated.

Another matrixed surround format is Circle Surround. This process claims improved channel separation and steering over Dolby ProLogic [12].

3.4 Ambisonics

Ambisonics is a hierarchical system for the optimal representation of sound fields. It is based on spherical harmonic expansions of the wave equation [1, 7]. The techniques involved have been developed from a combination of acoustical control and psycho-acoustic principles to correctly match important auditory localisation cues.

Ambisonics is not tied to any particular speaker layout and represents a very flexible and generic way of recording, simulating and re-creating three dimensional sound. It has found applications in large audio displays for virtual reality, artistic presentations and theme park entertainment.

Several consumer surround decoders offer an Ambisonic decode mode. A limited amount of program material is available for these decoders in a matrixed stereo format. Although the system is well founded in theory and can deliver excellent results, in practice it has not found a market beyond surround enthusiasts. The process of correctly setting up an Ambisonic decoder and speaker array is quite complex. Hopefully support for this format will continue – it represents a good option for true sound field recordings on emerging multi-channel audio media.

3.5 Multi-channel Digital Formats

To overcome the limitations of matrix surround for movie soundtracks, multi-channel digital formats were introduced. Dolby Digital 5.1 (AC-3) and DTS were introduced as competing standards for theatre sound around 1992. Both use compression algorithms to reduce the multi-channel sound track to a manageable amount of digital data [8, 11, 13]. Dolby Digital typically uses a higher compression ratio than DTS. Qualitative comparison of the two compression schemes is a contentious issue.

Dolby Digital and DTS offer 6 independent channels of audio for a cinema configuration – three front channels, two rear or surround channels and a low frequency effect (LFE) channel (Figure 5). The rear channels are usually line arrays of speakers in a theatre to reproduce a diffuse sound field.

Both of these formats are now available in consumer products. Dolby Digital has secured a greater share of the market by leading the way in available media. More laser discs provide an AC-3 audio stream compared to DTS titles. The option of an AC-3 audio stream has been integrated into the DVD video standard around the world. Dolby Digital transmissions are expected to accompany digital TV broadcasting later this year in the US.

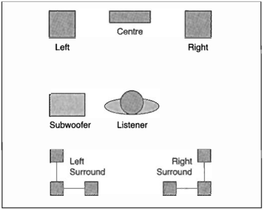

Figure 5. Speaker configuration 5.1

The sound quality is a significant improvement over analog matrix stereo. The overall audio experience can be more convincing and enveloping. With an installed base in place, the 5.1 configuration is also being used for audio only material. There are many DTS recordings of popular music now available on CD [13].

Movie material in the home is brought to life by multichannel digital audio. As directors and sound engineers are learning to take full advantage of the format, new release movies are delivering powerful and interesting surround sound.

3.6 Sound Enhancements

Many surround products and decoders offer proprietary modes for surround enhancement. Synthesizing additional surround channels can enhance conventional stereo recordings. Although such systems may produce a 'surround sound' effect, it is the result of a processing algorithm rather than the intention of the recording artist. While being a useful selling feature they are often fatiguing to listen to for extended periods.

For source material already in a surround sound format, the unit may add additional ambience or acoustical presence. Movie sound tracks are intended for playback in the environment of a large theatre. To recreate this sound in the home theatre, the system must be accurately set up and calibrated. Additional processing can be used to compensate for the difference in frequency response and acoustical properties of the smaller home theatre. The LucasFilm THX company offers a range of technology and certification of equipment for this purpose [14].

Advances in signal processing algorithms and hardware will continue to provide greater scope for sound enhancements. Consumer products will adopt these as product features and differentiators.

3.7 Virtual Surround Sound

Multi-channel surround formats raise an issue of convenience for consumers. Setting up a full speaker array can be costly and impractical in domestic situations. Some interesting technologies are now emerging in consumer products to address this.

The term 'virtual surround' is being used to describe products that create the impression of a surround sound system using headphones or two speakers [9]. The surround speaker feeds, which would normally be fed to a complete speaker array, are processed to add spatial information.

Over headphones a binaural signal can create the impression of virtual speakers around the listener. Binaural impulse responses can be convolved with the speaker feed signals adding directionality and spatial characteristics [15]. For headphone listening, binaurally processed virtual surround can be vastly superior to a simple 2 channel down mix.

Using two speakers, specially designed filters can be used to create the illusion of sound image locations beyond the span of the speakers. These filters consist of the head related transfer function of the desired virtual sound source position combined with the inverse of the head related transfer function of actual speaker. The net effect is to use the physical speakers to excite the listener's eardrums with a signal approximating that which would be experienced had the sound source been elsewhere (the virtual source location).

The rear surround channels are processed in this way and mixed into the front stereo channels to create the impression of a diffuse sound field to the side or behind the listener. With this type of system, there is a trade off between the quality of the effect and the range of listening locations it will cover ('sweet spot' size). These transaural systems are well suited to an individual listener in a known location [9].

4 FUTURE TRENDS

A significant force in the development of consumer surround sound is the available media. Home video material is the largest source of surround program material. Currently most of this is in matrix surround format (stereo VHS, cable or direct TV). The number of titles released on DVD will continue to increase and more of these will offer full surround audio tracks.

Without being an official standard, the 5.1 speaker configuration (Figure 5) is becoming the dominant consumer configuration. Consumer amplifiers supporting full surround decoding and speaker outputs will become more affordable. With a growing installed base of surround sound systems, more TV programs and audio only material will support the new multi-channel formats. Computer games and multi-media will also embrace and support this format as the computer becomes integrated into the home-entertainment system.

As media capacity and processing ability increase, the cost of multi-channel audio systems will decrease. It is likely that several audio formats will evolve for even more channels. Already higher order systems are used in custom installations like theme park rides and specialty theatres such as IMAX.

The installation of large speaker arrays will be justified for theatres and public spaces but will not be practical for the domestic market. Even five speakers present a logistics problem in the average home theatre. There will be an increasing trend in technologies for reproducing higher order surround formats over a reduced number of speakers.

High capacity sources, such as the DVD, will contain the individual speaker feeds to allow the use of a full array. In addition to decoding the surround sound, players and amplifiers will perform processing to make optimal use of the speaker setup the listener is using. Cordless headphones and personal speaker arrays will deliver high quality spatial sound. Personal computer or viewing terminals will use passive video techniques to locate the listener and optimize transaural audio delivery [10].

As the number of channels increases, multi-channel audio and true 3D sound begin to merge. Ultimately audio will be represented as sound events or samples with specified locations and acoustical environments. Intelligent players will render this audio information taking into account the listeners speaker configuration and listening environment. Audio compositions will become virtual audio landscapes in which the listener is free to roam and explore or simply pull up a virtual chair, sit down and listen.

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CALIBRATION AND INTERPRETATION OF ACOUSTIC BACKSCATTER MEASUREMENTS OF SUSPENDED SEDIMENT CONCENTRATION PROFILES IN SYDNEY HARBOUR

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ABSTRACT An 0.5 MHz acoustic backscatter (ABS) device developed and manufactured by Shanghai Acoustics Laboratory was used to infer vertical profiles of suspended sediment concentration (SSC) in Sydney Harbour. Dynamic suspension events induced by shipping, e.g. mobile suspension clouds caused by bottom stirring, were observed in real-time as images on a PC screen. ABS instruments have only been developed in the last decade and are not in widespread use. They have the advantage of being able to rapidly measure high resolution temporal and spatial SSC profiles remotely and non-intrusively, and thereby to image suspension processes. Time series of raw backscatter profiles can be obtained and displayed in real-time at the temporal and spatial scales of suspension processes, making ABS devices far superior to traditional point sampling methods using water bottles and optical instrumentation. Acoustic theory for this class of instrument is briefly outlined, and simple modelling is carried out to provide background information and to examine possible calibration methods. Of particular interest is the development of routine methods to calibrate ABS instruments in the field.

1. INTRODUCTION

Measurements of suspended sediment concentration (SSC) profiles in aquatic environments are used for diverse purposes e.g. examination of turbidity or water clarity, pollution studies, underwater visibility, sediment transport rates, and knowledge of the dynamics affecting turbidity e.g. wave processes. Profiles are usually obtained by point sampling, using water samplers or optical instrumentation, over time and space scales much greater than dynamic suspension processes ([3] discuss further details). In the last decade acoustic backscatter (ABS) instruments have been developed e.g. [4-7, 12-14] which are able to remotely monitor suspension events at the time and space scales of suspension events without affecting the processes. The ABS instruments infer near instantaneous undisturbed SSC profiles at high temporal (0.1-1 s) and spatial (1-10 cm) resolutions by emitting bursts of MHz frequency pulses, and recording the backscatter response from the suspended material in the water column as a function of range from the transducer. After allowance for transmission losses, and by making some simple assumptions about suspended sediment properties, the backscatter can be directly related to SSC.

In this paper we discuss measurements and calibration of SSC backscatter profiles taken in Sydney Harbour (Fig 1) using an Acoustic Suspended Sediment Monitor (ASSM) developed at Shanghai Acoustics Laboratory (see [14, 3] for a brief description of the instrument). The ASSM has previously been used to examine cohesive suspension profiles in the highly turbid waters of the Chang-jiang (Yangtze) estuary off Shanghai [10, 11]. Suspension profiles and dynamic suspension events in Sydney Harbour were monitored at 0.5 and 1.5 MHz. Only 0.5 MHz data are

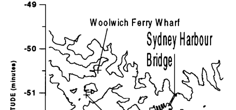

Fig 1. Locations in Sydney Harbour where an 0.5 MHz Acoustic Suspended Sediment Monitor (ASSM) and infrared wavelength nephelometer were deployed on 22 and 23 October 1997.

discussed. Independent low resolution inferences of turbidity profiles from nephelometer point measurements were used as proxy SSC calibration data. Actual measurements of SSC, which entails collection of water samples, then filtering, drying, and weighing to extract the suspended material, were not made. Modelling of backscatter profiles was carried out, based on theory provided in [13], to provide background information, to compare two calibration methods for the ASSM, and to develop calibration methods which could be applied routinely in the field. Calibration is presently performed after laboratory determinations of SSC have been obtained from water samples.

Although a specific ASSM is used, the modelling and applications are general to this class of instrument, and to the problem of inferring properties of particles suspended in a medium by means of acoustic backscatter measurements. The methods employed are not new, and no new theory is presented, but the general comparison of calibration methods, and the application of a calibration method which can be used in the field independent of laboratory measurements, should be of general interest. The paper complements an introduction to use of acoustic backscatter instrumentation to infer SSC presented by [3].

2. THEORY

To infer absolute values of SSC, acoustic backscatter measurements must be compensated for non-linear effects of spreading and absorption by water and suspended sediment, and a system constant incorporating the *in situ* suspended particle backscatter function must be determined. The backscatter processes may be described by single scattering theory [13]. Negligible grain shielding and negligible multiple scattering are assumed, with allowance for near and far-field transducer beam patterns, spreading, and absorption due to water and the suspended sediment itself. Absorption by suspended sediment is assumed to be proportional to SSC, a simple assumption which gives good results [13]. The attenuation constant for a particular sediment particle size may be calculated from formulae provided by [9], and absorption due to water may be calculated from temperature and salinity measurements [2].

If backscatter were sensitive to particle volume, then for constant particle density, changes in size distribution during measurements would not affect inferences of suspended sediment concentration [5]. However, in the Rayleigh region ($k_\lambda a << 1$, where k_λ is acoustic wave number and a is particle diameter), the size, shape, and density of irregularly shaped particles chiefly determine the backscatter, according to [9] and [8]. To overcome this it is commonly assumed the particle size distribution and particle backscatter function at a site are invariant during the measurements, and that only the total concentration varies at any depth in the column, a necessary but weak link in the calibration [5]. If calibration data show that size distribution does vary through the column in some deterministic manner, there is no reason to retain these two restrictions, and [4] used "calibration procedures (which) can accommodate variation of particle size with depth", but the assumptions of [5] will be used initially. The backscattered pressure or voltage signals received by the transducer from scatterers in a particular range bin are treated as incoherent [12], allowing them to be squared and summed without phase considerations. With the stated assumptions, backscatter from a particular range is linearly proportional only to concentration, and changes in raw backscatter at a particular range reflect changes in concentration. Under the assumptions, a twofold change in particle size in the Rayleigh region could cause a concentration overestimation of a factor of eight for irregularly sized particles [5]. However such large disagreements are not reported e.g. [5] quote factors of 2 to 3 for earlier work by others, and [13] and [3] found errors around 20%. Concentration estimates could also be in error if the relative concentrations of small and large particles vary [6]. For $k_\lambda a \sim 1$ to 2, [6] and [8] found indications that acoustic backscatter is proportional to particle volume, thus the assumption of invariant size distribution may not be overly limiting for all particle sizes. Modelling in section 6 supports this view if size distribution does not change greatly e.g. from mud to sand size.

The backscatter equation may be written (after [5], [7] and principally [13]):

$$M(r) = V^2(r) r^2 \psi^2(r) \left(1/\tau c(r)\right)\left(1/k^2\right) \exp\left[\int_0^r 4\alpha_w(r')dr' + \int_0^r 4\alpha_s M(r')dr'\right] \quad (1)$$

where k = a scaling factor which is a function of instrument response and of acoustic backscatter strength of the suspended sediment (the latter is assumed constant at a particular site to simplify the problem as mentioned previously);

r = one way range from transducer to scatterer (m);

$c(r)$ = sound-speed at range r (ms^{-1});

$M(r)$ = particle mass concentration per unit volume at range r (kgm^{-3});

$V(r)$ = transducer response (volts) to measured backscatter pressure from range r;

α_s = attenuation for unit sediment concentration ($m^2\ kg^{-1}$);

α_w = attenuation due to water (m^{-1}) (The integrals allow α_w and α_s to vary through the water column);

τ = pulse length (s);

$\psi(r)$ = a function to account for different beam patterns in the near and far-fields, and to allow for departures from the theoretical $1/r$ dependency in the nearfield [13]. $\psi(r) = 1$ in far-field for $r > \varepsilon\, r_n$ (farfield), and $\psi(r) = (2 + (\varepsilon r_n / r))/3$ for $r > \varepsilon\, r_n$ (nearfield), where $r_n = \pi a_t{}^2/\lambda$, with a_t the transducer radius and λ the acoustic wavelength. [13] chose $\varepsilon = 2$ for this definition of r_n, leading to the same definition as [5]. The 0.5 MHz ASSM has an external diameter of 18 cm, but actual transducer diameter is unknown, and was taken as 17 cm, giving r_n of 7.5 m.

Equation (1) has the same form in the near and far-fields if a cylindrical beam is assumed in the near-field and a directional beam (of constant beam angle) is assumed in the far-field. The transition region is not necessarily well defined by the expression. The expression is not in a closed form, since the required unknown $M(r)$ occurs on both sides of the equation. $M(r)$ may be solved for by iteration methods [15] or by direct solution [16]. For the direct solution the length of the first range interval must be chosen so the average SSC in the interval is non-zero, and the direct solution is sensitive to errors in this initial SSC value. The direct solution will not be used in this paper, but it is orders of magnitude faster than iteration, and with careful implementation this speed advantage should make it superior to iteration methods for real-time applications.

3. THE ASSM

Details of the ASSM may be found in [14] and [3]. In operation the downward looking 0.5 MHz ASSM is suspended about 2 m below the surface to avoid the effects of wave induced air bubbles, and may be raised and lowered if necessary to observe suspension processes. Trains of ten 40μsec pulses are transmitted, the return is time gated, and raw backscatter profiles are obtained and displayed. Beamwidth is 1.5°. To reduce variability in the Rayleigh distributed backscatter from a particular range bin, backscatter values are averages for the ten pulses. Range bins of 5 or 10 cm are used for the 0.5 MHz ASSM (with 2 cm for 1.5 MHz). The ASSM is driven by a PC, and raw backscatter profiles are displayed in real-time on the PC screen as a series of color-coded vertical bars, thus providing an image of suspension processes. Data may be obtained continuously for 15 minute bursts of about 900 profiles. Ranges of 2.2, 11, or 22 m may be selected during a deployment, and different output power selected to suit turbidity conditions. SSC range is 0.1 to 5-10 kgm^{-3} (0.1 kgm^{-3} is 100 mgL^{-1}). Raw data can be compensated for spherical spreading immediately after being obtained. Calibrated data are obtained in post processing by comparison against SSC determined from water samples, using software supplied with the ASSM in a "compensation method" approach discussed later.

Because of spreading losses, and attenuation by water and suspended sediment, raw backscatter values are a nonlinear function of range. Before data have been compensated for losses they must be interpreted with some care e.g. a uniform backscatter profile in the raw display indicates concentrations increasing with range. The advantage of the raw data display is that suspension processes can be observed in real-time. Increased processing speed opens the possibility of near real-time calibration from field measurements, and aspects necessary to achieve this are examined in this paper.

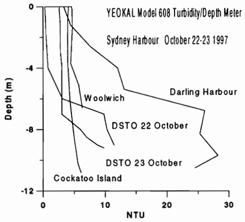

Fig 2. Nephelometer turbidity profiles for the sites of Fig 1. NTU = Nephelometric Turbidity Units. For the NTU range shown, 1 NTU is expected to indicate 1 to 2 mgL^{-1}.

4. CALIBRATION DATA

4.1 Nephelometer Data

A Yeokal model 608 Turbidity/Depth Meter (a nephelometer) was used to infer point measurements of SSC for use as calibration data for the ASSM (Fig 2). Brief comparisons of acoustic and optical turbidity instrumentation may be found in [3] and [7]. The nephelometer detects light from an 850 nm infra-red source scattered at 90° by suspended particles, and is lowered on a cable and held at particular depths until measurements stabilise, which takes several seconds. Data are reported as Nephelometric Turbidity Units (NTU). Optical sensors are subject to fouling by material in the water, the measurement is intrusive, and gives discrete points in slow time compared to the ASSM. The nephelometer is factory calibrated against a Formazin suspension, which has an unknown relation to optical backscatter response of *in situ* suspended sediment. However nephelometer output is usually linearly related to SSC, so reasonable profile shapes can be immediately available. Ideally the nephelometer should be calibrated against SSC obtained from water samples taken at the investigation site. There are potential difficulties with use of nephelometer data to calibrate ABS instruments, since nephelometers are sensitive to smaller particles, and ABS to larger. Nevertheless the real-time indications of average SSC at particular depths available from nephelometry could possibly be used to make a field calibration of the ASSM, one of the possibilities examined. Neither nephelometer nor ASSM provide estimates of suspended particle diameter, and for modelling we have assumed this from bottom type, which is soft mud. Data for nephelometer output as a function of concentration and particle size shown in [1] can be broadly interpreted as showing that for mud sizes the measured NTU approximate mgL^{-1} within a factor of 1 to 2. This indicates maximum SSC seen by the nephelometer at any site of 25 to 50 mgL^{-1} in Darling Harbour, whereas the nominal minimum ASSM capability of 100 mgL^{-1} is one quarter to one-half of these values. For the observed conditions the ASSM was operating below its nominal range, but some useful data were obtained which illustrate advantages and disadvantages of acoustic methods for measuring SSC.

4.2 Temperature and Salinity

Measurements of temperature and salinity profiles with a YeoKal Submersible Data Logger (SDL) yielded only a few near surface values of 18.2°C and salinity of 35. To calculate acoustic absorption due to water, homogenous temperature and salinity conditions were assumed. The harbour experiences tidal stirring and no recent rainfall had occurred, so high stratification was not expected. For 0.5 MHz the formulae of [2] give absorption differences over a 20 m path between 15° and 19°C at salinity 35 of only 0.025 dB. An SDL profile taken off Pyrmont Wharf (Fig 1) four days later showed a surface to bottom temperature difference of about 2.7°C over 10 m. Applying this profile made very little difference (less than 0.025 dB) compared to using homogenous conditions.

5. COMPENSATION METHOD OF CALIBRATION

In software supplied with the ASSM a modified form of the backscatter equation is used to invert the backscatter profile [3]:

$$M(r) = KV^2(r)r^{n(r)}\exp\left(4\underline{\alpha}(r)r\right) \qquad (2)$$

where $\underline{\alpha}(r) = \underline{\alpha}_w(r) + \underline{\alpha}_s(r)$, $\underline{\alpha}_s = \zeta\underline{M}(r)$, ζ is the attenuation coefficient for unit concentration, and underlining specifies a column average from the transducer to range r. K is a scaling factor related to k of equation (1) as $K = (1/\tau c(r))\ (1/k^2)$.

The exponent $n(r)$ is 1 in the near-field and 2 in the farfield to account for cylindrical and spherical spreading respectively, and varies between these limits in the transition range in an unknown manner. K and ζ are assumed constant at each site, as detailed in section 2, and must be determined in post-processing from actual SSC calibration data sampled at each site. For each range r to a calibration point, $\underline{\alpha}_s(r) = \zeta/r(\int_0^r M_{cal}(r')dr')$, where $M_{cal}(r')$ are calibration data, and the trapezoidal rule can be used to evaluate the integral. At calibration points in the near and far-fields, $r^{n(r)}$ is known, and K and ζ are the only unknowns if $\underline{\alpha}_w(r)$ is calculated from temperature and salinity measurements, (and the backscatter function subsumed in K is assumed constant). ζ can be calculated from a measured particle size distribution using the formulae of [9], and determinations of K can be made. Exponent n is then altered by trial and error to obtain a smooth compensation curve fitting calibration points in the transition region, a practical approach to the unknown form of $r^{n(r)}$ there. A compensation curve $f(r)$ is then formed to convert $V^2(r)$ to $M(r)$, where $M(r) = f(r)V^2(r)$ and $f(r) = K\,r^{n(r)}\exp(4\underline{\alpha}(r)r)$. The compensation curve is applied to all profiles in a burst. The method can only provide compensation to the deepest calibration point. Since absorption is not recalculated for each profile, the compensation curve method provides considerable saving in post processing, at the possible expense of accuracy under non-static turbidity conditions. By assuming statistical stationarity, ensemble averaging can then be used to improve signal to noise ratio, with the facility provided for user selectable time-depth windowing. The procedure produces concentrations with about 20% accuracy [3]. Apparent motion of the bottom caused by sensor movements is small under usual conditions, and is not allowed for.

6. MODELLING

A FORTRAN computer programme was written to model backscatter based on equation (1). In section 6.1 general modelling is used to examine the compensation method of calibration; in section 6.2 an iterative calibration technique working from the surface downwards is trialled to obtain individual calibration for each profile; in section 6.3 an iterative method is trialled to obtain system constant k. For the modelling, the *in situ* backscatter function at a particular range is taken to be linearly proportional only to concentration, rather than also to shape and size distributions. As discussed in section 2, this is not necessarily true, particularly for the Rayleigh region, but is not as gross an approximation as it might seem, as the modelling is meant to apply to a particular location, and is not meant to be transferred to another location, where the backscatter function could be different, or to be applied to the same location at a later time. Under these assumptions the modelling should give a good indication of results to be expected from use of a compensation profile approach. For the modelling, r_n of 1.5 m and ε of 2 were used with a range of 10 m. The value of r_n is much smaller than for the ASSM, resulting in increased spherical spreading, providing a more general test of the calibration techniques and associated computation errors.

6.1 Compensation Calibration Method

Principal results of general modelling for 0.5 MHz were as follows: (i) for particle sizes in the silt range 5 to 8ϕ, (where ϕ = -$\log_2$[particle diameter in mm] is a logarithmic scale), α_s is small, from formulae of [9], and most absorption is due to water, even for relatively high SSC. (The division from mud to sand size is at 62μm or 4ϕ). A compensation curve, formed from practically any shape or value profile of SSC for any ϕ value between 5 to 8, functions well to calibrate a wide range of test profile SSCs and shapes in this ϕ range, regardless of the exact ϕ value. Even the compensation profile for water alone will suffice. This means the compensation method should work well for this ϕ range in dynamic situations even though SSC changes greatly at a particular depth. (ii) Applying a compensation obtained from a constant value SSC profile, which laboratory calibrations typically provide, for values of ϕ greater than 5 (smaller particle diameter) to ϕ values of 4 or less (larger particles) does not always give correct results for lower measured SSC values, because increased particle absorption and non-linearity with range cause the exponentiation of equation (2) to dominate the inversion. For example spurious subsurface SSC maxima can be generated for some profile shapes which might be expected to occur naturally e.g. at the base of a mixed layer of constant concentration overlying a boundary layer with concentrations increasing towards bottom. (iii) For ϕ values lower than 5 (higher particle diameter) the inversion is also dominated by the exponentiation term for very high attenuation. Low backscatter returns for some profiles can be spuriously magnified by the compensation exponential to produce very high SSCs when zero SSC should be seen, because the signal does not penetrate effectively to this range. To remove such effects backscatter values below a threshold signal to noise ratio should be set to zero, and this threshold could vary with range.

Modelling further indicated that for 0.5 MHz the compensation calibration method should work well if ϕ at any particular depth does not change from mud to sand size, or from one sand size to another, and if concentration at a particular depth does not vary greatly for sand sizes. Consequently the compensation method for 0.5 MHz should yield reasonable results for mud suspensions of almost any concentration, and lower concentration sand suspensions in both static and dynamic situations. No allowance was made for multiple scattering or particle shielding in modelling, effects which may become important at high concentrations.

6.2 Iterative Calibration Method

Using the results of section 6.1 for mud suspensions, that practically any ϕ value in the mud range would be adequate to model absorption by sediment, representative ϕ values were chosen to obtain attenuation constant ζ. It was then assumed that SSC had a constant (but unknown) value over the first depth bin, and SSC was inferred from test backscatter profiles by iterating the following equation at each range r, working downwards from the first range bin:

$$M_{trial}(r) = V^2(r) r^2 \psi^2(r)(1/\tau c(r))(1/k^2)$$

$$\exp\left[\sum_0^r 4\alpha_w(r')\Delta r' + \sum_0^r 4\alpha_s(r')\Delta r'\right] \qquad (3)$$

where terms are as in equation (1), $\alpha_s(r') = 4\zeta(0.5(M(r'-\Delta r) + M_{trial}(r')))\Delta r$, and Δr is the length of the current range bin. The term $0.5(M(r'-\Delta r) + M_{trial}(r'))$ is simply the average SSC for the current range bin. $M_{trial}(r')$ is altered until the expression is satisfied to a required tolerance. For 0.5 MHz the iteration worked successfully for very high test SSC values (50 kgm^{-3}) for ranges to 10 m using nominal values of ϕ and k. Correct SSC values and profile shapes were returned without requiring prior knowledge of SSC magnitudes. An iterative method was used by [12] to calculate SSC and particle diameter for maximum range 1.28 m for frequencies 1, 2.5, and 5 MHz, and SSC of 0.001 to 2 kg.m^{-3}. Iterative methods are discussed by [15].

Under actual operating conditions results at high SSC could possibly be affected by multiple scattering and particle shielding, and the absorption profile for water should be well known (through temperature and salinity measurements) to ensure the particle backscatter contribution is accurately known. This latter point is emphasised by [4] for application of an iteration technique to Acoustic Doppler Current Profiler (ADCP) data in the Pearl River region of Hong Kong, where temperature and salinity gradients can be 1°C and 5 salinity units per metre.

6.3 Iterative Determination Of ASSM System Constant

Rearranging the backscatter equation (1) for system constant k gives:

$$k^2 = V^2(r) r^2 \psi^2(r)\left(M_{cal}(r)/\tau c(r)\right)$$

$$\exp\left[\sum_0^r 4\alpha_w(r')\Delta r' + \sum_0^r 4\alpha_s(r')\Delta r'\right] \qquad (4)$$

where M_{cal} are the SSC calibration values, and $\alpha_s(r') = 4\zeta(0.5(M_{cal}(r'-\Delta r) + M_{cal}(r')))\Delta r$ as before. For several pairs of $M_{cal}(r)$ this expression was evaluated by iterating on ζ until the pair of k values were closest in magnitude. For test data at 0.5 MHz, k was returned with little or no error up to ranges at least 10 m. With the usual assumptions the modelling of sections 6.2 and 6.3 indicates the possibility of automatically calibrating SSC data in the field against nephelometer or other field calibration data.

7. ASSM MEASUREMENTS IN SYDNEY HARBOUR

7.1 Despiking

Some measured time series showed intermittent strong high value spikes, apparently due to bubbles and occasional electrical interference. Strong spikes will distort simple ensemble averages. Instead smoothed profiles were formed from profile subsets as the average of the one-third lowest values at each depth, and also from medians. Medians provided better results for low numbers of profiles in a subset (Fig 3). This smoothed profile could be used directly as an averaged profile, with improved signal to noise ratio compared to individual profiles, or as a reference profile against which to despike individual profiles in the subset. Since spikes sometimes extended over several vertical depth intervals, simple replacement of spike values with reference profile values was preferred to interpolation in the vertical. Following despiking, profiles could be further smoothed to remove noise if necessary by two-point running vertical averages or other schemes.

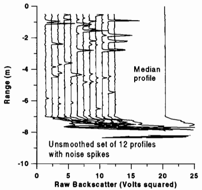

Fig 3. Example of despiking and averaging of raw acoustic backscatter profiles. The profile on the right is formed at each depth from the median of the values of the twelve profiles shown to its left. Profiles are offset from each other by 1 volt^2.

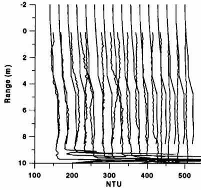

Fig 4. Calibrated ASSM data profiles calculated from medians of twelve raw profiles for Darling Harbour, overplotted on the nephelometer calibration profile. The nephelometer profile starts from the surface, which is at –2 m relative to the ASSM transducer, and it is overplotted separately with each ASSM profile. ASSM profile shapes and values show high general correspondence with the nephelometer data at the start of the ASSM time series, when the nephelometer data were obtained. Profiles are offset by 24 NTU, with the origin at 135 NTU.

7.2 Calibration

The iteration procedure of 6.3 to determine k against the nephelometer data yielded k values between 250-500 for Darling Harbour, the site with highest nephelometric turbidity. SSC is then known through $1/k^2$ to a factor of 1 to 4, a rather large range. In a sensitivity test, k of 200 and 600 gave SSC values obviously too big and too small respectively, compared to nephelometer data. The best value of k was visually determined by overplotting SSC profiles obtained with various k on the nephelometer calibration profile. There is a conundrum here in that ABS instruments are good at observing dynamic processes, but field calibration under dynamic circumstances is difficult if turbidity changes markedly at any depth during measurements, as it is then difficult to relate ABS and calibration data in both time and space. A k of 400 gave good agreement with Darling Harbour nephelometer profile values and shapes at the start of the measurements, when the nephelometer data were taken (Fig 4), which is as good a result as can be expected, since turbidity conditions were changing during the nephelometer measurements. The point of note is that after a value is determined for k, then profile shapes and values returned by the iterative methods arise through the modelled physics. No prior assumptions are made about SSC profile shapes or values, but good agreements were found against the Darling Harbour nephelometer data. The harbour results mean correct functioning for the ASSM has apparently been established through physical theory and independent measurements. There is no real reason not to have k as a function of depth, to account for changing particle properties or other conditions through the column (including beam pattern if necessary), and the iterative methods can indicate if this is necessary, but a fixed k was sufficient. A fixed k removes some of the empiricism in the methods, and is physically pleasing, as it should indicate the assumption of near constant size distribution was not violated. Although the iterative methods seemed to work satisfactorily, some inadvertent experiments in changing the near-field parameter rn from the nominal value of 7.5 m to a value as low as 1.5 m showed that k values could be found for the Darling Harbour data which gave quite reasonable results, so caution is warranted. The Darling Harbour k value was used to calibrate data at all sites, as k values at other sites could not be established.

7.3 Observed Suspension Profiles

At Woolwich wharf the 0.5 MHz ASSM was deployed almost immediately after a ferry had departed. An apparent suspension cloud or buoyant plume was seen in the real-time ASSM raw backscatter display, rising quickly towards the surface. The nephelometer could not operate rapidly enough to show this detail, and could not provide useful calibration data, with data taken after the observed event had ceased. ASSM data calibrated using the k for Darling Harbour (Fig 5) showed highest SSC for the survey, with SSC generally decreasing with depth and with time. At the start of the time series SSC near the transducer was over 200 NTU, falling to about 30 NTU at the end of the measurements, but the interpretation is that the high values were mainly due to buoyant rising bubbles, not sediment. Bubbles are much more efficient at scattering than equivalent sized sediment, particularly at resonance [5]. As the turbulent stirring mechanism ceases, particles would be expected to fall after experiencing rises, with SSC then rising with depth and decreasing with time through the column, but this was not observed. This example illustrates the problems that bubbles can cause high frequency acoustic marine instruments. Optical instruments are similarly affected.

At Darling Harbour the opportunity was taken to drift over waters which had been disturbed by tugs assisting a ship to leave berth some minutes earlier. Bottom sediments could be seen by

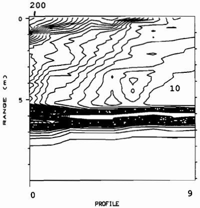

Fig 5. Woolwich Ferry Wharf 23 October. Contour plot of calibrated 0.5 MHz data (units are NTU) taken with the workboat stationary after a ferry departure. Time increases from left to right. Data are calculated from medians of twelve raw profiles. The pattern represents a rising bubble plume, possibly advecting suspended sediment. Contour clustering at 6 m range marks the bottom.

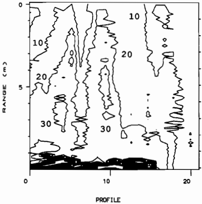

Fig 6. Darling Harbour 23 October. Contour plot of calibrated 0.5 MHz data (units are NTU) taken with the workboat drifting, calculated from medians of nine raw profiles. The pattern represents two turbid plumes at profiles 5 and 9 separated by clearer water at profile 6, caused by a tug stirring the bottom. The bottom is at 9 m range.

eye to have been entrained into the water column. Highest nephelometer levels for the survey were seen. The ASSM showed the boat to be drifting over suspension clouds, with the depth of the top of the clouds varying along track (Fig 6), consistent with visible surface indications of patchiness in the turbidity. The nephelometer could not operate rapidly enough to show this detail, and provided only broad indications of turbidity at the start of the ASSM measurements, but this was able to provide the calibration previously described in section 7.2. Column turbidity in Figure 6 is notably higher over shallower depths, as might be expected when turbidity is caused by a bottom stirring mechanism.

Off Cockatoo Island the nephelometer showed the concentration of suspended material to be very low and increasing slowly from surface to bottom. The iterative method broadly matched nephelometer data, however the increase in concentration with depth was possibly due to noise levels being amplified by the non-linear range-squared and absorption terms. At Pyrmont the nephelometer showed a two-layer system with low turbidity visibly clear water overlying a more turbid lower column. A 50 kHz Furuno echosounder showed an intermittent scattering layer about 6 m below the surface, apparently corresponding to the gradient seen by the nephelometer. Raw acoustic backscatter values were nearly constant through the column, and it appeared only noise levels were measured, resulting in calibrated ASSM values from the iterative method increasing approximately linearly from the transducer to bottom with the correct magnitude, but without the mid-column gradient region. The nephelometer indicated SSC far below the nominal lower level of the ASSM, and the ASSM could not be expected to function, but these two examples show the importance of obtaining calibration data at each site, and of subtracting noise. The ASSM correctly showed that SSC levels were low, and this could be considered a positive result for the iteration methods and the ASSM.

8. DISCUSSION

Rapid high resolution measurements of dynamic suspended sediment concentration profiles were obtained in Sydney Harbour with an Acoustic Suspended Sediment Monitor (ASSM) developed by Shanghai Acoustics Laboratory. The ASSM was used while stationary and drifting, in the latter case effectively showing a cross-section of suspended sediment concentration (SSC). The nominal lower limit of SSC for the 0.5 MHz ASSM of 100 mgL^{-1} indicates it is suited to quite turbid conditions, but suspension events were successfully observed at lower turbidity levels.

Modelling indicated a compensation method of calibration supplied in software with the ASSM should be reliable in dynamic situations for mud suspensions to very high concentrations, and lower concentration sand suspensions. The compensation technique applies a single calibration profile to all profiles in a data burst, and does not allow for absorption due to SSC to change with time through the column if SSC changes, as will happen for dynamic events. Modelling and field results indicated iterative calibration techniques could supplement or replace the compensation method, since they can calibrate the full measured profile, they can be applied to individual profiles, they can be applied semi-automatically, and they are much less empirical. If nephelometric or other estimates of SSC are available in the field, modelling and measurement indicate that useful ASSM near real-time calibration could be obtained routinely through application of iterative methods, which appear quite robust. The ASSM appears to be a highly versatile instrument able to be used routinely in the field to observe dynamic turbidity events and suspension profiles.

ACKNOWLEDGEMENTS

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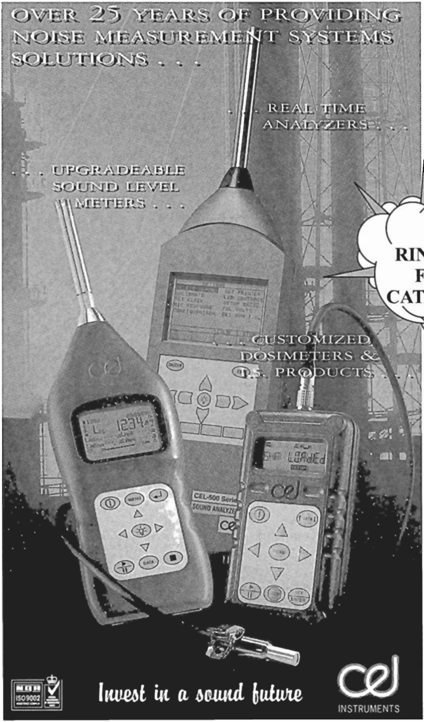

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TOWARDS A NORMATIVE MODEL OF PUBLIC POLICY FOR ENVIRONMENTAL NOISE

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Queensland, 4558

ABSTRACT: Environmental noise regulations can be analysed in terms of the public policy process used to develop and implement them. The policy process is best viewed as occurring in a series of stages and as being acted out by a range of different players. The role of 'technofficials' varies from totally controlling to fully facilitative. These two approaches are compared in terms of a technofficial-centred model and a collaborative model of the noise policy process. Two case studies from different Australian jurisdictions are compared. It is argued that the collaborative model of public policy is more appropriate and results in more effective noise control regulation.

1. INTRODUCTION

Throughout the world regulations for the control of environmental noise are the responsibility of elected or appointed representatives who comprise law-making assemblies. Australia has one national, six state and two territory legislatures that enact noise control regulations. In addition, there are 696 local councils that also have responsibilities for regulating noise in their local government areas. The elected representatives at all three levels of government depend on officials to advise them on the details of noise and other regulations.

The process used to develop environmental noise regulations is essentially the same as that used in all government decision-making, namely, the public policy process [1]. We can uncover the dynamics of this process by subjecting it to analysis [2,3]. The present paper aims to analyse the noise policy process in terms of the different stages and the different people involved at each stage. It assesses the value of a collaborative approach to noise policy with reference to case studies.

2. PUBLIC POLICY PROCESS IN NOISE REGULATION

The public policy process can be best understood as occurring in a series of stages [4,5]. Table 1 lists a generally accepted set of policy stages and the corresponding stages of noise regulation, namely: noise problem identification, noise impact assessment, noise control options, decision on noise regulation, operation of noise regulation, and evaluation of noise regulation.

Policy Stage	Noise Regulation Stage
1. Agenda setting	Noise problem identification
2. Problem analysis	Noise impact assessment
3. Policy formulation	Noise control options
4. Policy adoption	Decision on noise regulation
5. Implementation	Operation of noise regulation
6. Policy evaluation	Evaluation of noise regulation

Table 1. Stages of the policy process relating to noise regulation

We can also identify different 'policy players' who act out the noise policy process, namely: 1) politicians who are elected representatives in the law-making assembly or legislature, 2) political advisers engaged by politicians particularly government ministers, 3) policy analysts in government agencies, 4) 'technofficials' or technical experts on noise within the relevant government agencies, 5) noise researchers in universities and other institutions, 6) acoustics and environmental professionals, 7) interest groups representing both those who make noise and those affected by noise, and 8) the general community.

The theory in a 'Washminster' democracy such as Australia (based on elements of the US and UK systems) is that elected representatives make decisions about public policy based on advice from government officials [3]. In an ideal world government decision-makers would be presented with a range of options for any policy together with a thorough and balanced assessment of the pros and cons for each option. Policy decision-makers also expect that the options have been developed in consultation with all the relevant policy players. Further, given that the whole policy process is inherently political, the decision-makers will want information on how the different options would be received by their various constituencies (i.e., how the voters will react).

3. APPROACHES TO NOISE POLICY

There are two fundamentally different approaches to noise policy which can be distinguished in terms of the role played by technofficials, namely, the technofficial-centred approach and the collaborative approach. The former approach is evidenced in cases where technofficials play a gatekeeper role in the policy process controlling how the different players participate in the various stages. The collaborative approach, on the other hand, entails technofficials playing a facilitative role to ensure effective participation by all relevant players at each stage of the policy process. Let us examine these two approaches. Note that technofficials are public servants employed as technical experts in the various government agencies involved in noise control including environmental protection agencies, transport departments (e.g., aviation, road traffic, rail), planning departments, local government departments, and infrastructure agencies (e.g., main roads).

It is relevant to note that the author had three years experience as a senior 'technofficial' with overall responsibility for noise control and noise policy advice in the state of Victoria (1983-85). He also chaired a national committee providing noise policy advice to a council of Australian environment ministers.

Technofficial-centred Approach

Unlike most public policy areas, environmental noise is exceedingly complex. This complexity arises not only because of the technicalities of noise generation and propagation and the variety of noise sources in modern society, but more importantly, because of the nature of community reaction to noise. Policy-makers are faced with considerable uncertainty about the effectiveness of the different noise control options because the dose/response relationship is weak. Specifically, noise exposure explains less than 20% of community reaction, the remainder being mainly attitudinal [6]. Also, the available research data varies considerably across studies in where the community reaction curve is plotted relative to noise exposure [7]. This results in uncertainty on the key questions of how much noise causes what level of reaction and how much noise is too much.

This complexity of noise can lead technofficials to view themselves as the only ones capable of ensuring that the 'correct' noise control option is selected as policy and embodied in regulation. They come to dominate the policy process and adopt a gatekeeper role to control other policy players as depicted in the technofficial-centred model (see Figure 1). This model shows technofficials at the centre of the policy arena. The various players have an input to each of the policy stages only through the gatekeeper technofficials.

Let us briefly examine each of the stages and consider how the gatekeeper role is typically acted out. First, in agenda setting (noise problem identification), it will be technofficials who determine which noise problems are addressed. Even where politicians field community complaints and seek to have a specific noise problem put on the agenda, technofficials are usually able to control when and how it is addressed. The second policy stage is that of problem analysis (noise impact assessment). Here, the technofficial-centred approach is to rely on within-agency knowledge and experience rather than independent research to determine the seriousness of the noise problem. If specific studies are commissioned by researchers or acoustics professionals the results are still interpreted by the technofficials. Input from the community is typically regarded as spurious because they are seen as lacking technical expertise.

When it comes to the policy formulation stage (noise control options), the technofficial gatekeeper will endeavour to dictate which options are considered. They will also ensure that input from any policy players who might be consulted, does not cause difficulties for their preferred option. At the fourth stage of policy adoption (decision on noise regulation), the technofficial-centred approach is to influence the decision-makers (politicians) to adopt the technically correct option that the technofficials have already decided on. One tried-and-true technique is to 'snow' the relevant minister with complex technical detail so that the minister has no choice but to accept the pre-decided option of the technofficial.

The fifth stage is that of implementation where the noise regulation is put into operation. Depending on the particular situation the regulation can be implemented with bureaucratic rigidity or with democratic flexibility. The technofficial-centred approach is to opt for the former implementation strategy in every case. The sixth and final stage, that of policy evaluation (noise regulation evaluation), is often omitted by technofficials (as depicted by the dotted lines in Figure 1).

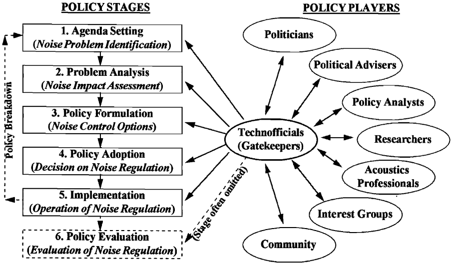

Figure 1. Technofficial-centred model of the noise policy process

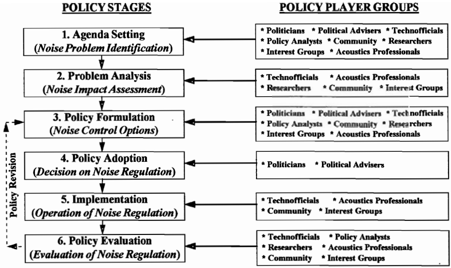

Figure 2. Collaborative model of the noise policy process

Here the gatekeeper attempts to prevent other policy players from providing feedback on the effectiveness of the noise policy. If the policy proves ineffective either in part or in total but is not amended or replaced as appropriate, there will eventually be 'policy breakdown' (see Figure 1). This may lead to community and political pressure to put the noise problem back on the policy agenda. Then, of course, the technofficial-centred approach would be to restrict when and how the issue gets addressed as the policy process begins again.

It is important to note that the intentions of technofficials in taking a gatekeeper role may be entirely honourable. In most cases the technofficial will simply intend that the noise regulation which is adopted and implemented is the best available in terms of technical criteria. It just so happens that their best of intentions have the effects of: 1) excluding other players from participation in the policy process, and 2) ensuring that non-technical issues are largely ignored.

Collaborative Approach

A fully participative approach to public policy requires technofficials to facilitate rather than restrict access to the process by the different players. Such an approach is illustrated in the collaborative model of noise policy (see Figure 2) which is offered as an ideal for a participative democracy such as Australia. The key feature of this model is that at each stage of the policy process the relevant players collaborate as depicted by the groupings shown in Figure 2. While not all players will want to have input at all stages, they are not specifically excluded from any stage except that of policy adoption (see discussion below). All of the policy players in each grouping can have a direct influence on each stage rather than via a gatekeeper.

At the first stage of the policy process, namely, agenda setting (noise problem identification), any of the major policy players could be involved depending on the particular noise problem. The role of the technofficial is to be responsive to the views of the other players particularly politicians and the community, regarding which problems are addressed. The second stage, that of problem analysis (noise impact assessment) would typically involve a reduced set of policy players (see Figure 2). The technofficials would ideally commission studies by independent researchers and seek independent technical advice from acoustics and environmental professionals.

Perhaps the most crucial stage in the process is that of policy formulation (noise control options) and here again all players have a role to play (see Figure 2). Ideally, there would be draft policy documents circulated widely to all players with an opportunity for discussion sessions open to the community. Here the role of the technofficial is to ensure: 1) that all players have an input, 2) that non-technical as well as technical issues are considered, 3) that a wide range of options is included, and 4) that the pros and cons of the different options are fully canvassed.

At the fourth stage, that of policy adoption (decision on noise regulation), the only players with a legitimate role are politicians and their immediate advisers. They make their decision having received a balanced assessment from technofficials and policy analysts of the relevant options and their implications. Under the collaborative approach, the technofficial gives impartial advice on all options and recommends on technical grounds without displaying a vested interest in any particular option. This decision-making stage defines the nature of the whole policy process as being essentially political, non-scientific, non-rational and value-based [3]. Technofficials have to resist any tendency to impose a technical or research framework (characterised as empirical, scientific, rational and value-independent) at the policy adoption stage.

The fifth stage (implementation – operation of noise regulation) should primarily involve interaction of technofficials, acoustics professionals, interest groups and the community (see Figure 2). Technofficials facilitate a process of solving noise problems using the relevant noise regulation. A key feature of the collaborative approach is that the sixth stage (policy evaluation – evaluation of noise regulation) is always included. Ideally, an evaluation plan will be designed into the regulation rather than being an after-thought or a forced response to implementation difficulties. Evaluation can lead to 'policy revision' whereby the noise control options are reconsidered and adjusted as appropriate by means of a return to the policy formulation stage (see Figure 2). This way the policy can be fine-tuned or reformulated without completely breaking down as occurs when the evaluation stage is omitted (compare Figure 1).

4. NOISE POLICY IN ACTION

How do actual cases of the noise policy process measure up against the above ideal model based on a collaborative approach? Let us consider two recent Australian cases of noise policy in action.

Queensland Comprehensive Noise Policy 1997

The key events in the development of a comprehensive noise policy in Queensland are as follows:

- drafting by the Department of Environment in late 1980s of an initial comprehensive noise policy covering all types of noise,
- establishment in mid-1991 of the Noise Policy Advisory Committee with representation from government departments, local councils, the acoustics profession, industry and academe,
- evaluation by the committee in mid-late 1991 of the Draft Provisional Noise Policy, consultation with relevant organisations, and review of public comment on the provisional policy,
- termination of the committee in early 1992 (with continued in-house policy development by Department of Environment technofficials),
- public distribution in mid-1996 of a draft noise policy and explanatory documents [8],
- broad-based consultation in late 1996 and early 1997 involving circulation over five rounds of revised drafts and related information to those who responded to the previous round,
- revision of the policy and adoption by Parliament under the relevant act in late 1997.

In this case, the agenda setting stage of the policy process seems to have been conducted by technofficials with little involvement of other policy players but with no indication of their specific exclusion. The problem analysis stage involved a wider group of players as members of the Noise Policy Advisory Committee. This stage was close to ideal though the collaborative model would suggest a role for community representatives as well (see Figure 2). It appears that the policy formulation stage was handled very much in a collaborative manner as evidenced by the five rounds of consultation. There were 910 questionnaires returned in response to the draft policy as well as 373 detailed submissions. In addition, 25 public meetings and 49 meetings with 'key-stakeholders' were held before the policy was finalised [9].

The policy adoption stage was controlled by politicians which is in accordance with the democratic collaborative model of the policy process advocated in this paper. It seems that there was a high level of intervention by politicians who substantially amended the draft policy before adoption by Parliament as subordinate legislation under the Environment Protection Act 1994. The policy implementation stage also appears to be proceeding in accordance with the collaborative model (see Figure 2). Finally, an early evaluation stage is currently being conducted in response to a direction by the new government elected in mid-1998.

NSW Road Traffic Noise Policy 1998

This case is currently at the policy formulation stage. It involves a policy under development for road traffic noise in New South Wales. The key events to date are as follows:

- establishment of a joint task force in 1989 by the two ministers responsible for environment and for roads (with the task force of technofficials reporting to a steering committee of officers from the two relevant authorities),
- establishment of working groups of technofficials to investigate technical issues,
- release of a progress report by the task force and conduct of a community consultation workshop in late 1991,
- release in late 1994 of the final task force report detailing traffic noise control options [10],
- establishment in late 1995 of the Road Traffic Noise Committee comprising technofficials from various government departments and authorities,
- release by the committee of a progress report in 1996,
- release by the Minister for Environment of the draft policy on traffic noise and a call for submissions in mid-1998 [11],
- conduct of several consultation seminars with local government officers and one with the general public in mid-1998.

We see in this case that the agenda setting stage involved politicians as well as technofficials. Although other players were not involved at this stage there is no evidence of exclusion (gatekeeping) by technofficials. The problem analysis stage appears to have been conducted exclusively by technofficials though broad technical input was sought across government agencies. There was an early attempt to consult the community with a workshop in 1991 and the task force membership was expanded to include community representatives at this time because of concerns raised at this workshop. Considering that the task force was subsequently engaged in selecting policy options, it is arguable that the process had entered the policy formulation at this time. The detailed assessment of the task force options was carried out by a new committee but again comprising only technofficials. The apparent exclusion of other players at this stage is inconsistent with the collaborative model.

However, full community consultation was initiated in mid-1998 with the public release of the draft policy, the call for submissions, and the consultation seminars. The planned process from here on is apparently that environment technofficials will prepare a report on the consultation feedback for consideration by the Road Traffic Noise Committee (comprising technofficials) [12]. The revised policy will then be submitted to the two ministers for adoption as government policy. In this case it is likely that the decision-makers will be presented with a final policy rather than a range of options - for a highly technical policy of this type the ministers could be expected to rely heavily on technofficial advice subject to confirmation by their own political advisers.

5. DISCUSSION

These two cases differ most notably in the level of consultation. Consultation was much more extensive in the case of Queensland's comprehensive noise policy under an act of Parliament than for the NSW traffic noise policy to be proclaimed by government ministers. It might be argued that the differences in the scope and the regulatory frameworks of the two policies explain and justify the difference in the respective approaches to consultation.

Another possible reason for the difference in consultation level is that in NSW consultation is viewed as a single separate stage of the policy process. Indeed, a NSW cabinet discussion paper released in early 1998 advocates an eight-stage 'policy cycle' with 'undertaking consultation' identified as one of the stages (the others being comparable to the stages used in the present paper except for the addition of 'coordination within government' as an extra stage prior to adoption/decision) [13]. The collaborative model offered here views consultation as an integral feature of the whole policy process not as a distinct stage. Groups of policy players should be able to participate at each policy stage rather than having their input restricted to a single stage just before policy adoption (see Figure 2). We can conclude that in terms of approach to consultation, the Queensland case aligns more closely with the collaborative model than does the NSW case. However, this does not of itself demonstrate any difference in the quality of the resultant noise policies.

A corollary to the level of consultation is the involvement of technofficials. In both cases it appears that the policy development was driven by technofficials which is entirely appropriate – policy is part of their job. The central question is whether the technofficials in the two cases adopted a controlling or a facilitative role in the process, that is, whether they operated as gatekeepers (technofficial-centred model) or as participation coordinators (collaborative model). The present paper poses but does not purport to answer this question as it would require a specific empirical investigation including interviews with all the relevant policy players. Nevertheless, it is clear that the Queensland case shows a more proactive attempt to include the different policy players in the developmental stages of the policy process.

One notable aspect of the two cases considered here is the length of time for the policy process to move through the second and third stages, namely, problem analysis and policy formulation. The technofficial-centred approach would reduce this timeframe from nine years to nine months! In fact, the protracted nature of the process in the two cases would suggest that they were both more collaborative than technofficial-centred in their approach. This raises the issue of the efficiency of the collaborative approach to policy-making. From a managerialist viewpoint it may appear much more efficient to restrict or even prevent the participation of the different policy players and to have technofficials use their expertise to come up with a workable policy in a relatively short time. Certainly, consultation takes considerable time and involves significant costs.

However, as we have seen, policy development is not a purely technical and rational process but rather is inherently political and to that extent is non-rational [2,4,5]. Nor should it be thought that consultation is simply the price of democracy. Input from the different policy players is essential for informed decision-making and for policy effectiveness. As with any public policy, noise policy development requires non-technical judgements about competing values in society [3,4]. While the technofficial-centred approach may seem efficient in the short-term, it cannot result in fully effective policies because of the restricted input from key players. This approach can easily give rise to a repeated cycle of policy development and policy breakdown (see Figure 1) thereby resulting in long-term inefficiency. The collaborative approach, on the other hand, takes longer and costs more but has a better chance of being effective because it ensures that noise policies are based on the full range of input available from all policy players (see Figure 2).

Possible criticisms of the present distinction between the technofficial-centred and collaborative approaches are that in reality noise public policy is not black-and-white but requires elements of both approaches, and in any case the former approach is outmoded [14]. On the latter criticism, it is a matter for empirical investigation whether technofficials in Australia's various jurisdictions play a gatekeeper role. The technofficial-centred model serves to highlight an approach which is certainly possible – if it is 'outmoded' then this must mean that technofficials today accept that this approach is inappropriate. The former criticism seems to suggest that collaboration is not always possible because of the greyness of the policy process. Again, the collaborative model serves to highlight an ideal which can be aimed for. Without such an ideal it would be easy to slip into a non-collaborative approach as typified by the technofficial-centred model.

6. CONCLUSION

The two models presented here highlight differences in the roles technofficials can take in the noise policy process. It is argued that technofficials should be required to adopt a facilitative role aimed at ensuring the participation of all relevant policy players at each stage of the policy process. They need to see consultation as desirable throughout the whole process not as a distraction or as a barrier to technical and managerial efficiency. Technofficials are usually trained only in the relevant technical areas. But if they are to function effectively in the policy process, they also must have an understanding of policy analysis and of the political nature of policy-making. Finally, they need to model their behaviour on the collaborative rather than the technofficial-centred approach to noise policy development and implementation.

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Books...

Architectural Acoustics

Y Ando

Springer 1998, 252 pages, hard cover; ISBN 0 387 98333 3. Australian Distributor: DA Information Services, 648 Whitehorse Rd, Mitcham Vic 3132, tel 03 9210 7777, fax 03 9210 7788. Price A$85

The AIP series on Modern Acoustics and Signal Processing is aimed at covering all areas of today's acoustics as an interdisciplinary field and this is a recent addition to the series. Yoichi Ando is certainly a worthy author to contribute to the series as he has studied concert hall acoustics for over 30 years. In the last ten years he has focused on auditory-brain function and so the secondary title of the book 'Blending sound sources, sound fields and listeners' is most appropriate.

While Ando states that the book has been written for both undergraduate and graduate students in fields such as, psychology, physiology and musical art, it is mainly those undertaking research in this area that are likely to find it of most interest. He does suggest that those interested in the applications of design for concert halls should read chapters 10 and 11 first. These chapters provide some case studies and the approaches to acoustical measurements.

The early chapters deal with topics such as physical properties of sound signals and the human hearing system. The remainder of the book concentrates on the topics that relate to the blending of sound fields and listeners including subjective attitudes and preferences for sound fields. In each of these chapters Ando includes data from research papers with the references included in the text. The extensive reference list is current as it includes publications up to the year this book was published.

Those from architecture and other fields who are seeking information on general guidance for room design would probably find other books more useful. This book should clearly be essential reading for anyone undertaking research in any aspect of architectural acoustic design. The wealth of material is presented clearly—it is understood the author has paid special attention to stimulating the left and right hemispheres of the brain with both text and illustrations. In summary, this is recommended as a reference book for the libraries of universities, research institutions and acoustic consultants.

Marion Burgess

Marion Burgess is a Research Officer in the Acoustics and Vibration Unit at the Aust Defence Force Academy in Canberra.

Mechanical Vibrations, Theory and Applications to Structural Dynamics

M Geradin & D Rixen

John Wiley 1997, 425 pages; soft cover; ISBN 0 471 97546 X. Australian Distributor: Jackaranda Wiley PO Box 174 Sydney NSW 2113, tel 02 9805 1100 fax 02 9805 1597. Price: A$89.95

This book addresses a good variety of topics in Dynamics albeit in a rather overwhelmingly mathematically rigorous way. The book comprises helpful lists of figures and tables, a good index and 7 chapters. The first two chapters are devoted to the usual topics in single and multiple degree of freedom systems. Chapter 3 concentrates on modal testing. Chapter 4 focuses on elements (bars, beams and thin plates) which are commonly used in finite element (FE) analysis. The last two chapters are almost entirely devoted to solution methods which are coded in FE analysis packages to find natural modes and responses to forcing in the time domain.

There are other books which deal with the theory vibration of single and mutiple degree of freedom systems in a manner which would probably better suit the undergraduate Engineering student than this one. However, the book under review is ideally suited to an Engineer who is involved with the use and development of the Leuven Measurement Systems (LMS) package or other packages of this kind. The LMS package is developed and supplied by a company which started in the picturesque Belgian town of Leuven which is about 70 kilometers North West of LiËge where the authors of the book are based. There is, incidentally, no need to worry about the standard of English which is used by these authors. The LMS package is a powerful measurement-and-analysis tool which can be used to validate and optimise structural FE models which, in turn, can be used for the prediction of internal loads due to applied forcing. LMS has arranged short courses for Engineers who intend to use the package. I attended one of these courses a year or two ago and would have found this book a useful source of reference.

Mark Tate

Mark Tate worked as a Dynamicist for GKN Westland Helicopters on development of the coupled rotor/fuselage dynamics model, ground resonance models, transmission models, a wing flutter model, decklock stability models and quasi-static and non-linear dynamic landing-load models. He is now a Lecturer at the School of Aerospace & Mechanical Engineering at ADFA.

Auditory User Interfaces

T V Raman

Kluwer Academic Publishers, 1997, pp 142, Hard cover, ISBN 0 7923 9984 6, Australian Distributor, DA Information Services, 648 Whitehorse Rd, Mitcham Vic 3132, tel 03 9210 7777, fax 03 9210 7788. Price A$166

This slim and physically attractive volume is directed towards practitioners in the design of human computer interfaces. It is dedicated to the author's guide dog whose name, Aster, provides a creative and functional link to the author's 1994 PhD thesis on an "Audio System for Technical Readings". This book clearly arises from a significant personal journey of discovery by the author and this background contributes both to its strengths and weaknesses.

The book comprises five chapters, the first three of which attempt to motivate and then analyse the distinctive characteristics of the auditory interface. The concept of speech-enabled applications is introduced with helpful contrasts between auditory and graphical user interfaces. "Speaking screen" software is used as a whipping-boy to illustrate the need for modularity in user interface design - modularity which isolates both the user interface from the application and also different modes of user interface from each other.

It is instructive to reflect that in the chapter on the components that go to make up an auditory interface, that the several diagrams used are in general poorly conceived and captioned - perhaps emphasising one message of this book, that auditory communication and graphical communication are very different and that a book created by means of a speech interface cannot be expected to excel in graphic arts.

In contrast to the use of graphics these introductory chapters provide a excellent use of textual structure and layout which emphasises the author's desire for rigour in presenting an adequate taxonomy for his ground-breaking topic. This also assists effective evaluation of tools such as speech synthesis and recognition, audio input and auditory output, auditory icons and audio formatting. The treatment of these tools is rather brief and in places rather uneven but is helped by reference to both literature and WWW sources.

After a brief third chapter motivating the concept of an "auditory desktop" we are treated to the longest chapter (nearly half the size of the book) on Emacspeak as a concrete example of the implementation of the principles of auditory desktop design. Throughout this material and the final chapter on the WWW, the reader is challenged to look beneath the familiar surface forms to the essence of their functionality and to transform this functionality from the two static dimensions of graphics into the single dynamic dimension of acoustics.

This book presents a fascinating intellectual exercise in modality transfer to us all, but the essence of survival for the sight-impaired who would progress in our computerised future.

Bruce Millar

Bruce Millar is Acting Head of the Computer Sciences Laboratory of the Research School of Information Sciences and Engineering at the Australian National University. His main research interest is in modelling spoken language processing and in the use of speech in human computer interfaces.

Obituary...

Dr John M Pickles

(20/11/37 – 18/8/97)

John Pickles completed his first degree, Bachelor of Science in Mechanical Engineering, with First Class Honours, at the University of Bristol in 1959. After graduation, he worked for a short period as an engineer with Associated Electrical Industries in Manchester, before proceeding to research in the Engineering Department in the University of Cambridge which led to the degree of Ph.D. in 1966. During his Ph.D. studies, he gained further industrial experience through an association, as a research engineer, with Spirax Sarco Ltd. of Cheltenham. On completion of his Ph.D. , he spent two years as Senior Lecturer in the Royal Naval College, Greenwich. In 1967, he came to Adelaide to take up his appointment in the Mechanical Engineering Dept., University of Adelaide.

John was a foundation member of the Australian Acoustical Society with a strong interest in acoustics and noise control. However acoustics was only one of his many interests. He also had a keen sense of history and was vitally interested in engineering heritage and in industrial archaeology, interests manifested in his membership of the Heritage Committee of the Institution of Engineers, Australia. He was a dedicated advocate for preservation of engineering heritage and he cultivated these attitudes in the community at large through the Institution, and in students through directed projects in their final undergraduate year.

He was a remarkable combination of academic and professional engineer, with a commensurate breadth of outlook. That breadth of outlook was epitomised by the range of outstanding courses he gave in the Mechanical Engineering Department, extending from the more formal engineering science subjects on the one hand to professionally-oriented engineering design on the other. He was also involved in a long series of research projects in the Department, on thermodynamics, fluid mechanics, acoustics, the development of expert systems for the diagnosis of faults in machinery, and the application of computers to new learning systems. All these were approached with his characteristic logic and rigour.

John Pickles could well be described as the archetypal dedicated engineering academic, and those are attributes that will be sadly missed. But, above all, we shall miss a loyal and supportive colleague, a man of great dignity, great integrity, great humour and great humanity.

Max Bull and Colin Hansen.

Letter...

I am a French student in Mechanical Engineering at the "Université de Technologie de Compiègne", in Compiègne, France. I am currently studying as an exchange student at McGill University, Montreal.

I am seeking a six month placement in an industrial environment or in a school or university from February to July 1999. This placement is included in my academic course of study.

I have had experience with the following: MLSSA, Pro/Engineer, C, PASCAL, FORTRAN, Matlab. Excel, Quark X-Press Word and have a working knowledge of Internet and the B&K 2012. I intend to specialise in acoustics and industrial vibrations and am currently studying Electroacoustic Techniques and Measurements.

I look forward to the opportunity to undertake this placement in Australia.

Sincerely yours,

Thomas BOXOEN
boxoenth@hotmail.com,
1 rue de la Gendarmerie 59600
MAUBEUGE France

New Members...

NSW Member	Mr M Bridges,
	Mr G Downey,
	Mr S Brady,
	Mr N. Pennington
WA Member	Mr M Cake
QLD Member	Mr M. Kanowski
VIC Member	Dr E. Lindqvist

News...

Noise Effects 98

The 7th conference in the series on Noise as a Public Heath Problem by International Commission on the Biological Effects of Noise (ICBEN) was the first to be held in the Southern Hemisphere. Noise Effects 98 was held in Sydney, Australia, in late November, shortly after the Internoise 98 in New Zealand.

Noise Effects 98 was a great success on all the performance indicators for a conference. Over 300 delegates from around the world attended during the four and half days. Over 270 papers were presented as key note papers, plenary sessions, contributed sessions and poster sessions. Workshops allowed for free discussion on each of the nine subject areas covered by ICBEN which include the effects of noise on sleep, on communication, on the community, on hearing loss, on performance, on physiology, on animals and the implications for regulations & standards.

The venue, near the center of the city, was excellent and many delegates enjoyed the opportunity to continue discussions while walking alongside Darling Harbour. The conference dinner, on a cruise boat, also capitalised on the location. The buffet dinner allowed all to sample authentic Australian food and wine. The welcome and farewell receptions were held in areas with views over the harbour and city.

This conference provided the opportunity for the presentation of papers on current findings and research and a full report on the conference will be included in the next issue of the journal. The Conference proceedings provide a valuable resource on the current knowledge on noise effects. For purchase of the proceedings, A$110 plus post and packing,
Contact Australian Acoustical Society, fax +61 03 9887 9400 or watkins@melbpc.org.au.

Internoise 98

Internoise 98, held in Christchurch, New Zealand, in November has been hailed as a great success. With an attendance over 500 and close to 400 contributed papers, the technical program, in up to eight parallel streams, was very extensive. Dr Birgitta Berglund, Dr Colin Hansen and Professor Jeremy Astley presented the Plenary Distinguished Lectures and many of the contributed papers were arranged within the 22 special sessions with a special introduction paper.

The venue for the conference was excellent. The provision of the teas and lunches adjacent to the conference rooms encouraged discussions to continue after the formal sessions. The social program with the opening and closing receptions and the conference dinner allowed for informal discussions with friends and colleagues. All in all it was a most successful conference.

The proceedings are available as CD-ROM for US$35 and printed version is US$75 (including postage and packing).
Further details from Internoise 98 Secretary, NZ Acoustical Society, PO Box 1181, Auckland 1001, New Zealand, Fax: +64 9 623 3248 or can be ordered directly via http://www.auckland.ac.nz/internoise98

Recreational Noise

Following Internoise 98, the one day symposium on Recreational Noise, held at Queenstown, was attended by around 100. The technical program was in three streams; aircraft in national parks, effects of music and motor sports. The location was most appropriate and many delegates tried the various recreational activities that are available in the area before and after the symposium. Abstracts were provided at the conference and the proceedings will be available.
Further details from Conference Secretary, Grant Morgan, ECS, PO Box 76-068, Manukua City, New Zealand, Fax +64 9279 8833, grantm@bitz.co.nz

1999 AAS Conference

Acoustics Today is the title for the 1999 Australian Acoustical Society Conference to be held at the Hilton Hotel, Melbourne from 26 - 28 November, 1999. An invitation to attend and call for papers is included as insert in this issue of the Journal.

Acoustic practice today depends heavily on the foundations which have been laid during past years. One of the pioneering members of the Australian acoustics fraternity, was H. Vivian Taylor, M.B.E. Because of his notable achievements, the Victoria Division decided to dedicate this conference to his memory and two notable Australian acousticians will be asked to briefly reflect on how acoustics has developed in Australia during recent decades. However, Acoustics Today is not about the past, but about current developments and expectations and the Victoria Division seeks papers from any area of Acoustics which demonstrate the exciting advances currently being made.

The President's Prize will be awarded for the best paper submitted to the conference. A Conference Dinner will be held on Thursday Night. As part of the Conference, there will be an exhibition of products relating to the acoustics industry.

Further information: Mr Geoff Barnes, c/o Acoustical Design Pty. Ltd., 2/72 Bayfield Road, Bayswater, Victoria 3153, tel: 03 9720 8666, fax: 03 9720 6952, Acousticdes@bigpond.com

Future AAS Conferences

For those who like to plan well ahead, the current schedule (subject to alteration) for future AAS conferences is 1999 Victoria, 2000 West Aust, 2001 NSW, 2002 South Aust and 2003 Qld (hopefully Internoise).

Congress on Sound & Vibration

The 6th International Congress on Sound and Vibration will be held on 5-8 July 1999 in Copenhagen, Denmark. The Congress is sponsored by International Institute of Acoustics and Vibration, the Technical University of Denmark, the Danish Acoustical Society, Brüel & Kjær, and Ødegaard & Danneskiold-Samsøe. The programme includes invited and contributed papers in specialised sessions organised by the 49 members of the Scientific Committee, and tutorials and workshops.

There will be a number of keynote and specialist keynote presentations by well-known experts, including the following: Dennis Bernstein (USA), Per Brüel (Denmark), David Crighton (England), Ann Dowling (England), David Ewins (England), Stewart Glegg (USA), Jean-Louis Guyader (France), Kazutatsu Hatakeyama (Japan), Nickolay Ivanov (Russia), Colin Hansen (Australia), G. Krishnappa (Canada), Yasuo Mitani (Japan), M.L. Munjal (India), Wolfgang Neise (Germany), Philip Nelson (England), Kam Ng (USA), Terry Scharton (USA), Aldo Sestieri (Italy), Andrew Seybert (USA), Osman Tokhi (England) and R.G. White (England).

Information : Congress Secretariat, Department of Acoustic Technology, Technical University of Denmark Building 352, DK-2800 Lyngby, Denmark; tel: +45 4588 1622; fax: +45 4588 0577; icsv6@dat.dtu.dk, http://icsv6.dat.dtu.dk.

Active 99 Inter-noise 99

ACTIVE 99, the 1999 International Symposium on Active Control of Sound and Vibration, will be held at the Marina Marriott hotel in Fort Lauderdale, Florida, USA, 2-4 Dec 1999. This will be the fifth in a series of symposia on active control. Prof Scott Sommerfeldt of the Brigham Young University (BYU) in Provo, Utah, USA will serve as General Chairman and co-chair of the technical program with Prof Jiri Tichy of Pennsylvania State University. The proceedings will be edited by Prof Scott Douglas of the University of Utah. Cheryl Van Ausdal of BYU will serve as the secretariat for the technical program. The Call for Papers is available so check on the www.

INTER-NOISE 99, will immediately follow ACTIVE 99 in the same hotel. Registration will open on Dec 5 and the congress will run through to Dec 8. Prof Joseph Cuschieri of the Florida Atlantic University (FAU) and Dr. David Yeager of Motorola in Fort Lauderdale, Florida will be the general co-chairs. Prof Stuart Glegg of FAU will serve as Technical Program Chair, and will be the editor of the Congress Proceedings. The technical program secretariat will be operated by Susan Fish of FAU. A major exposition of instruments, software, facilities, and materials for noise control will be held in conjunction with INTER-NOISE 99. The Call for Papers is available so check on the www

Information: INTER-NOISE 99 Congress Secretariat, INCE, P.O. Box 3206 Arlington Branch, Poughkeepsie, NY 12603, USA, Fax +1 914 4624006, INCEUSA@aol.com, http://ince.org

Australian ICA Commissioner

At 16th ICA meeting in Seattle, former past president of the AAS, Charles Don, was elected to the board of International Commission on Acoustics (ICA) at the first General Assembly of the newly constituted Commission. This is a considerable honour for Australia and for Charles.

The ICA board consists of 15 members: 9 seats for countries/regions with large numbers of members (2 from North America and one each from China, France, Germany, Japan, Italy, Russia and U.K.) and 6 open seats for other countries. After a ballot, the five open seats which were contested at Seattle went to Australia, Brazil, India, Korea and Spain. Each appointment is for three years. The newly elected President is Larry Crum from the University of Washington, USA, while the immediate Past President, Tor Kihlman is from Sweden. The Secretary-General, Gilles Daigle comes from Canada. The board is to meet once each year, the next scheduled meeting being in March, 1999, in conjunction with a joint ASA/EAA conference in Berlin. A main objective of the board is to oversee the smooth running of the next ICA meeting, scheduled for Rome in 2001. However, it is anticipated that the newly constituted Commission, through its board, will in the future play a more dynamic role in representing and setting the directions for Acoustics Societies throughout the world.

ICA Funding

The International Commission on Acoustics (ICA) will consider requests for sponsorship of Specialty Conferences in Acoustics during the 1999-2002 triennium. This is in addition to the sponsorship that can be obtained from IUPAP, the International Union For Pure and Applied Physics. The ICA-sponsored conferences must be limited to a single, specialized topic and be restricted to no more than 100 attendees. Conferences sponsored by ICA will be awarded seed-funding Grants. The size of the Grants will depend on ICA budgetary considerations but will be of the order of $US2000 and up to ten "Speciality Conferences" may be supported.

Further information: http://gold.sao.nrc.ca/ims/ica/ or Charles Don, tel 03 9905 3695, fax 03 9905 3637, Charles.Don@sci.monash.edu.au

Fine for Nightclub

Venues Unlimited Pty Ltd pleaded guilty and was fined $3 000, and a conviction recorded against the company, in the Brisbane Central Magistrate Court on 8 September 1998 for a breach of the Workplace Health and Safety (Noise) Compliance Standard 1995. Director of the Division of Workplace Health and Safety, Gary Chaplin, said the case was an Australian first for the entertainment industry but with wider ramifications for all industries.

The Department of Employment, Training and Industrial Relations' Workplace Health and Safety Inspectorate instigated the prosecution following a series of noise exposure surveys at the company's "Underground Nightclub" in Petrie Terrace between May 1996 and August 1997. A random audit was initially conducted in May 1996 and was followed up by providing the company with written reports, consultation and information on the control of noise and its obligations under the Act. Improvement Notices were also issued.

Workplace Health and Safety Inspectors found that bar attendants, security personnel, a disc jockey and patrons were being exposed to excessive noise levels (amplified music) and were without ear protection. After the survey in August 1997, which found no reduction in noise levels had been made since the earlier surveys, prosecution action was instigated.

"Noise levels averaged at 93.9 dB(A) over a period of 3 hours 6 minutes, when the allowable exposure time for this level of noise for workers is 60 minutes," Mr Chaplin said. "Although hearing protection devices were made available for workers at the nightclub, the company failed to instruct and enforce the use of these devices. This is the first time a conviction has been recorded against a nightclub for exposure to excessive noise under the Workplace Health and Safety Act."

A report on the Division of Workplace Health and Safety's investigation into noise levels and other health and safety issues in Brisbane's nightclubs and hotels has been completed and will be released later this year. A Guide for the control of noise in the music entertainment industry is also due to be released later this year.

Night Time Noise Levels

Australian Road Research Board has recently released a research report, ARR 323 on 'Night time noise levels: a state-of-the-art review'. This was commissioned by Main Roads Dept WA and prepared by Heidi Lansdell and Catriona Cameron. The objectives of the study included a review of worldwide practices for criteria and modelling techniques, issues related to night-time noise and the potential for revision of exisitng noise control objectives and guidelines.

Almost half the report comprises the worlwide review and this includes a very useful comparative summary table. As with the production of any document it is difficult to be completely up to date as agencies frequently revise legislation, eg recent release of NSW Draft policy on traffic noise. The chapter on the Human Perspective summarises the findings of relevant studies both in Australia and around the world. The final recommendation in the chapter 'Where do we go from here?' is that the only solution to this problem is for public agencies to develop a set of nationally recognised noise objectives and guidelines for planning purposes.

Report available for $A40+$3.50 post from ARRB, 500 Burwood Hwy, Vermont South, Vic 3133. Fax 03 9887 8144, don@arrb.org.au, http://www.arrb.org.au/pubs/order.htm

Journal of Occupational Hearing Loss

A new journal, to be published quarterly, has been released by the Singular Publishing Group. The chief editors of the Journal of Occupational Hearing Loss are Robert and Joseph Sataloff and the Editorial Consultant Board includes Donald Woolford from Australia. The editorial for this first issue defines occupational hearing loss as an interdiciplinary challenge. This is reflected in the range of topics covered by the eight papers. The annual subscription is a modest $US100 for individuals and $US150 for institutions.

Further information: Singular Publishing, 410 West A St, Suite 325, San Diego, CA 92101-7904, Fax + 1 619 238 6789.

AUSTRALIAN STANDARDS

Standards to be withdrawn

To ensure that Standard remain up to date and viable, a long-term sunset withdrawal policy has been established by Standards Australia. Under this system, all Standards over 15 years old will be automatically withdrawn.

The following Acoustics and Vibration Standards are due for withdrawal not because they are being replaced by recent standards - they are being withdrawn solely because they are over 15 years old.

Should there be a reason for retaining a Standard, either in its current form or as an obsolescent or available superseded Standard, please contact Standards Australia.

AS 1276-1979 Methods for determination of sound transmission class and noise isolation class of building partitions.

AS 2221.1-1979 Methods for measurements of airborne sound emitted by compressor units including primemovers and by pneumatic tools and machines - Engineering method for measurement of airborne sound emitted by compressor/primemover units intended for outdoor use.

AS 2221.2-1979 Methods for measurements of airborne sounds emitted by compressor units including primemovers and by pneumatic tools and machines - Engineering method for measurement of airborne sound emitted by pneumatic tools and machines.

AS 2253-1979 Methods for field measurement of the reduction of airborne sound transmission in buildings.

AS 2436-1981 Guide to noise control on construction, maintenance and demolition sites.

AS 2574-1982 Non-destructive testing - Ultrasonic testing of steel castings and classification of quality.

further information from Standards Australia

ASA Standards

The following standards have been recently released by the Acoustical Society of America Standards Program.

Quantities And Procedures For Description And Measurement Of Environmental Sound - Part 5: Sound Level Descriptors For Determination Of Compatible Land Use, ANSI S12.9-1998/Part 5

Methods For Determining The Insertion Loss Of Outdoor Noise Barriers, ANSI S12.8-1998

Specifications For Integrating-Averaging Sound Level Meters, ANSI S1.43-1997

Vibratory Noise Measurements And Acceptance Criteria Of Shipboard Equipment, ANSI S2.16-1997.

Method For Preparation Of A Standard Material For Dynamic Mechanical Measurements, ANSI S2.21-1998.

Resonance Method For Measuring The Dynamic Mechanical Properties Of Viscoelastic Materials, ANSI S2.22 - 1998.

Single Cantilever Beam Method For Measuring The Dynamic Mechanical Properties Of Viscoelastic Materials, ANSI S2.23 - 1998.

Further information Standards Manager, ASA, 120 Wall Street, 32nd Floor, New York, NY 10005-3993,USA Fax +1 212 2480146, asastds@aip.org, http://asa.aip.org.

Glass and Glazing

AS 1288 Glass in buildings - Selection and installation, NZS 4223 Code of practice for glazing in buildings and AS/NZS 2208 Safety glazing materials in buildings are in process of revision and public review documents will be available soon. The new draft for Glossary of Terms used in the glass and glazing industry should be ready for public review/comment soon.

A handbook on glazing is also being prepared, which will cover the different glass products, safety and security glazing, noise reducing glass, glazing for comfort and energy efficiency and glazing to reduce fading. The Handbook also covers bathroom glazing, glass, blocks, mirrors, glass in furniture aquaria and edge finishing.

From 'The Australian Standard' 19(9)

Trans-Tasman Arrangement

On 1 May this year the Trans-Tasman Mutual Recognition Arrangement (TTMRA) came into effect in Australia and New Zealand. The TTMRA is based on two key principles in relation to goods and occupations: if goods may be legally sold in Australia they may be sold in a New Zealand jurisdiction, and vice versa; and if a person is registered to practise an occupation in Australia he or she will be entitled to practise an equivalent occupation in a New Zealand jurisdiction.

This Arrangement builds on the trading relationship established between Australia and New Zealand through the Closer Economic Relation (CER) Agreement, which came into being in 1980. The Agreement established between the two countries and it initially concentrated on the removal of tariff and quota barriers.

The TTMRA will provide an effective way to eliminate the remaining non-tariff barriers. In the past, regulations applying to goods in the Australian States and Territories varied significantly between jurisdictions. Laws relating to customs controls, tariffs, international property, taxation and international obligations are not covered by the TTMRA. The TTMRA will serve to highliight differences in New Zealand and Australian regulatory requirements. This will tend to drive an analysis of the desired outcomes of regulations, leading to consistent, performance-based regulations, which in turn provide a sound platform for Standards as a means of compliance.

From 'The Australian Standard' 19(10)

Assoc Prof Colin Hansen has recently been awarded the Dave Bies Prize for 1998 by the South Australian Division. Colin has clearly done a great deal for acoustics, and to further the interests of the Australian Acoustical Society. He has served as a long standing committee member, and is a past Chairperson for the Division. His teaching and research interests in acoustics have continued to inspire an interest in this area. His professionalism and capacity have earned him an international profile. He serves as a commendable role model. In 1997, inspired by Colin's involvement, the Fifth International Congress of Sound and Vibration held in Adelaide was a tremendous success. The Dave Bies Prize was awarded in recognition of Colin's contribution to this congress, and to acoustics generally.

Prof Jack Pettigrew, Professor of Physiology and Director of the Vision, Touch and Hearing Reserch Centre at the University of Queensland has recently been elected to the govering council of the Australian Academy of Science.

Prof Graeme Clark, Professor of Otolaryngology, University of Melbourne has been honoured by an election to Fellowship of the Australian Academy of Science. For the past 30 years, Prof Clark has devoted his efforts to the development of a cochlear implant system which gives children who have been profoundly deaf since birth the ability ot recognise speech. More than 15,000 people worldwide have now received implants.

Prof Robert Chivers has been awarded the inaugural RWB Stevens Medal by the Institute of Acoustics in the UK. This acknowledges his outstanding contribution to research and education in the field of acoustics. Prof Chivers has been involved in a wide range of acoustics research including physical acoustics, ultrasonics, underwater acoustics, musical acoustics and perceptual acoustics. While he has spent most of his career in UK, he has spent some time with the CSIRO in Sydney, supervised a PhD student and is a member of the AAS.

Acoustic Research Laboratories has appointed Stephen Childs as their NSW Sales Manager. Stephen has been involved in the acoustics industry for many years with Nylex and is looking forward to assisting many past customers. Stephen can be contacted at ARL Sydney on 02 9484 0800

Electronic Reverberation Control

The HK$468 million Kwai Tsing Theatre in Hong Kong is now at the final stage of construction. Scheduled to open in autumn 1999, the theatre is expected to become a new focal point in the Hong Kong community, increasing its access to the arts and providing local and overseas performing artists with the opportunity to showcase their rich and diverse talent. The new theatre has a seating capacity of up to 904 seats, with ancillary facilities encompassing a lecture room, an exhibition gallery, a rehearsal room, a dance studio as well as an open-air plaza.

The auditorium is specially designed for drama, dance and opera. The theatre stage is equipped with computerised power fly sets, revolving "stage-onstage" wagon and convertible acoustic panels. Its multi-functional stage facilities can accommodate different types of performances such as classical concerts or operas, community functions, films or even pop concerts. To be able to house all these different performances, the acoustical environment has to be varied dramatically.

Vipac Engineers & Scientists Ltd, the appointed acoustical consultant for the Kwai Tsing Theatre, therefore designed the hall for "dry" acoustics. An Electronic Reverberation Enhancement System (ERES) was installed to Vipac's specifications to overcome the problem of different acoustic needs for the different usages in the same performance hall.

An ERES is a recent innovation allowing the acoustics of the auditorium to be varied electronically changing the reverberation, using digital signal processing. The objective is to provide a natural sounding reflection pattern, by adjusting reflection sequences of the sound to suit various requirements.

Multiple inputs from microphones located adjacent to the poscenium are fed into a digital signal processing unit (DSP). These inputs are then processed digitally through the DSP processor to provide a multi-channel digital frequency shift. This prevents feedback and provides the necessary time and magnitude shift determining the variation of reverberation within the auditorium. The result is the ideal RT to make any performance sound right in the Kwai Tsing Theatre by just "flicking the switch".

Further information:
Vipac Engineers & Scientists,
Tel 03 9647 9700 Fax 03 96464370.

Victoria Division News

The Victoria Division AGM was held on 30 September 1998, in conjunction with its September technical meeting at the Melbourne Exhibition Centre IMAX cinema. As with most such new developments, the current emphasis was on a maximum of impressiveness, both visual and audible. A sound level meter would have been useful for checking how often during the film the sound level exceeded 85dB(A).

On 29 October, Victoria division held a technical meeting at the Melbourne Crown Complex. This was arranged as a site visit to inspect the Crown Complex plant rooms, and the various measures required to reduce the noise and vibration generated by the standby electricity generators and air-conditioning plant, and to prevent their transmission to other parts of the building and the exterior.

Notable noise and vibration reduction characteristics of the stanby generator room were: its completely floating spring-supported seismic-snubbed floor and lower wall structure, with air gap of 50 mm above the main building floor, giving an STC of 75; the six reciprocating gas engine-driven MW generator units, each mounted on six 1.5Hz airsprings with seismic snubbers, and which when running each contributed a sound level of NR 90 to the noise in this reverberant room; the numerous pipe joints consisting of twin-sphere expansion joints designed to withstand temperatures of up to 130°C and give an attenuation of 20 dB; the vibration isolation of all electric cables at points where they passed out from the generator room; the treatment of all ventilation ducts to ensure that sound levels of the exterior noise from this room did not exceed EPA residential area requirements; and the whole noise and vibration reduction system (including that at doorways) giving the generator room a seismic isolation of 5.9 m/s² [= 0.6g] from the main building structure.

Unfortunately, it was not possible to experience the noise in this room with one or more generators running. Also, the important question was raised, though not then answered, as to whether the springs supporting the floating floor and the generator units had been designed as a connected system. This tour of inspection was, however, a most interesting one.

Louis Fouvy.

New Products...

ARL

Software for Rion SLM

The Rion NA-27 Precision Integrating Type 1 sound level meter is proving popular in the market place. Download software is now available to make this already user friendly meter even more useful. This software enables information stored in the meter to be downloaded via a standard RS-232 cable to any computer running Windows 95 or later for processing. A demonstration version of the software is available.

Further information: Acoustic Research Laboratories Tel 02 9484 0800, Fax 02 9484 0884 or your local branch of ARL.

NICOLET

Vibrometer.

The "Orion" Laser Doppler vibrometer is a new release for Nicolet. This eliminates the bulky optics normally found in standard LDVs. With the "Orion" unit, the beam passes through the Acoustic-Optical Modulator (AOM), or Bragg Cell where it has a carrier frequency impressed upon it. The beam is then emitted and it strikes the target. The light bounces off the target, back through the AOM. Then the signal is demodulated, and the Doppler frequency is extracted.

This results in an LDV that offers greater performance and a smaller package at half the cost of competitive units.

Key specifications included; accurate measurements from 5Hz to 80kHz, velocity measurements from 40μm/s to 0.1m/s, works on almost any surface without special surface preparation, user selectable filtering, and no mass loading and small spot size.

Further information: Emona Instruments, Po Box 15 Camperdown 2050, Tel 02 9519 3933, Fax 02 95501378, http://www.emona.com.au, testinst@emona.com.au

LARSON DAVIS

Sound Level Meter

Larson Davis Laboratories have been designing and manufacturing precision instruments for the measurement and analysis of sound and vibration since 1981. They now have released in Australia their latest model, the 824 sound level meter/real time analyser. The 824 is the only handheld SLM/Real-time Analyser on the market that is truly designed for handheld operations. This small, lightweight, totally digital instrument is 25%-60% lighter and 20% thinner than competitive models, setting new standards of performance in terms of digital signal processing and user-interface technology.

The instrument provides 1/3 octave real-time analysis from 12.5Hz to 20kHz and permits the user to switch from measuring SPL with 3 frequency weighting's and 3 RMS detectors simultaneously over a 100dB dynamic range to performing real-time 1/3 octave analysis and multiple weighting/detector SPL measurements over an 80dB dynamics range on the spot. It features a back-lit display and keys for crisp, easy to read and well annotated presentation of data.

Further information: Vipac Engineers & Scientists, Tel 03 9647 9700, Fax 03 96464370.

DATA PHYSICS

Multichannel Analyser

SignalCalc 620 is a multi-channel dynamic signal analyser using Hewlett-Packard VXI front end hardware. It features an intuitive Windows-based user interface, a network remote interface, application specific data displays and SignalCalc software layered on top of Hewlett-Packard VSI dynamic measurement hardware. SignalCalc exports measurements results in the form of signals, waterfalls and other test parameters to a number of standard formats and is easily embedded in test systems managed by Visual Basic, LabVIEW, or Visual C++. Connectivity in the larger test environment is assured by the use of active technology, which for example allows on line transfer of measurements to a MATLAB environment.

SignalCalc 620 supports the H-P 16-channel 23 kHz input module, the H-P 8-channel kHz input module and the H-P 4-channel output module for waveform generation. Either embedded or external Windows NT or Windows95 PC controllers are offered along with various hardware and software options. The SignalCalc Studio family provide an extensive Sound & Vibration coverage for engineers and scientists using ACE the powerful 2 channel analyser in notebook computers, SignalCalc430 the portable analyser with 16 channel and SignalCalc 620 with up to 128 channels.

Further information: Kingdom Pty Ltd, Tel 02 99753272.

CEL

1/3 Octave SLM

The CEL-553C is a sound level meter which includes a real time 1/3 octave analyser. The use of Digital Signal processing technology allows the CEL-553 to simultaneously measure with 2 frequency weightings, 2 time weightings and 2 amplitude weightings up to 12 simultaneous noise parameters in broad band mode. The internal non-volatile memory allows storage of up to 100,000 broad band results, 9999 octave spectra or 5700 1/3 octave spectra. Optional download software is available for export of results into Windows 95 and 3.1x software or a direct screen dump to printers via centronic interface. The meter is easy to use due to an intuitive user interface design for new and experienced users. Its modular design provides easy upgrade path for future applications.

Further information: Stantron Australia, Tel 02 98942377 Fax 02 98942386 stantron@internet-australia.com

OROS

Real Time Analyser

The OR25 PC-Pack is a brand new concept that adds the benefits of the PC integrated instruments approach to the qualities of stand alone instruments. Features include: greater than 90 dB dynamic range, 1/3 octave, order tracking and off line analysis, 2-16 analogue input, 1 trigger/RPM inputs and 2 generator outputs for MIMO testing, and switchable cooling fan for silent operation. The interface software, 32 bit DLL for Windows 95 and Windows NT gives fast data exchange between PC and analyser.

DACTRON

Shaker Control

Whether your simulations require Random, Sine, Shock, or Advanced Environments, the Dactron Dual DSP Shaker Control System delivers revolutionary accuracy using 20-bit inputs and outputs. Its unprecedented control dynamic range of >90 dB, provides safe control of large accelerations to tight tolerances - protecting your test articles. Other features include: multi tasking and true continuous control, dual high speed DSPs handle control loop quickly avoiding PC latency, PC handles graphical interface and networking functions, Windows 95 Plug and Play - simple card insertion into PC. Expandable options include: additional input and COLA channels, additional applications software and Windows NT operating system.

Further information: MB & KJ Davidson Pty Ltd, Tel 03 95557277 Fax 03 9555 7956 info@davidson.com.au, www.davidson.com.au

Diary...

1999

March 15-19, BERLIN
Forum Acusticum & ASA Meeting
Details: ASA, 500 Sunnyside Blvd., Woodbury, NY 11797 USA. Fax +1 516 576 2377, asa@aip.org, http://forum99-asa.tu-berlin.de

April 27-29, VENICE
Int. Conf. Vib. Noise & Struct Dynamics
Details: D. Hill, Staffordshire Uni, PO Box 333, BeaconsideST18 ODF, UK Fax: +44 1785 353552

May 10-14, TRIESTE
4th Int. Conf. Theory & Comput Acoustics
Details: Fax: +39 40 327040, ictca99@ogs.trieste.it

May 24-26, ATHENS
2nd Int. Conf. On Emerging Technolgies in NDT.
Details: Ms. M. Bourlau, Free University Brussels, TW-KB, Pleinlann 2, 1050 Brussels, Belgium, Fax: +32 2 6292928, mbourlau@vub.ac.be

May 30 - June 3, NORWAY
16th Int. Evoked Response Audiometry Study Group Symposium
Details: Otorhinolaryngology Dept, University Hospital, PO Box 34, 9038 Tromso, Norway, Fax: +47 77627369, einar.laukli@rito.no

June 28-30, RUSSIA
EEAA Congress - 1st Int. Cong. East European Acoustical Society
Details: EEAA, Moskovskoe Shosse 44, St Petersburg 196158, Russia, Fax: +7 812 1279323, krylspb@sovam.com

June 28-July 1, LYNGBY
Joint Conf. Ultrasonics Int '99 & World Congress Ultrasonics '99
Details: Dept Industrial Acoustis, Denmark's Technical University, Bldg 425, 2800 Lyngby, Denmark, Fax: +45 45 930190, lb@ipt.dtu.dk, www.msc.cornell.edu/~ui99/

July 5-8 DENMARK
6th Int. Congress on Sound & Vibration
Details: Dept Acoustic Tech, Tech Uni of Denmark, Bldg 352, DK-2800 Lyngby, Denmark. Tel: +45 45 881622 Fax: +45 45 880577 icsv6@dat.dtu.dk, http://www.icsv6.dat.dtu.dk

September 1-4 GERMANY
15th Int. Symp. Nonlinear Acoustics (ISNA-15)
Details: W. Lauterborn, Drittes Physikalisches Inst., Universitat Gottingen, Burgerstr 42-44, 37073 Gottingen, Germany, Fax: +49 551 39 7720, lb@physik3.gwdg.de

***September 22-24, SYDNEY**
Metrology Conference
Details: Dr Suszanne Thwaites, National Measurement Laboratory, PO Box 218, Lindfield NSW. Tel; (02) 9413 7416, Fax; (02) 9413 7161, suszanne.thwaites@tip.csiro.au

November 1-5, COLUMBUS
138th Meeting of ASA
Details: ASA, 500 Sunnyside Blvd., Woodbury, NY 11797 USA. Fax +1 516 576 2377, asa@aip.org

***November 24-26, MELBOURNE**
Acoustics Today
AAS Annual Conference
Details: Acoustical Design, 2/72 Bayfield Rd, Bayswater, Vic 3153. Tel: (03) 9720 8606, Fax:(03) 9720 6952, Acousticdes@bigpond.com

December 2-4, FORT LAUDERDALE
ACTIVE 99

December 5-9, FORT LAUDERDALE
INTER-NOISE 99
Details: INCE, PO Box 3206 Arlington Branch, Poughkeepsie, NY 12603, USA, Fax: +1 914 4624006, inceusa@aol.com http://ince.org

December 3-5, AUCKLAND
Taking OH+S into 21st Century.
Details: F. lamm, Dept Management & Employment Relations, University Auckland, Private Bag, 92019 Auckland, New Zealand, Fax: +64 9373 7402, f.lamm@auckland.ac.nz

2000

May 30 - June 3, ATLANTA
139th Meeting of ASA.
Details: Fax: +1 516 5762377, Web: asa.aip.org

July 4-7, GERMANY
7th Int. Cong. on Sound and Vibration
Details: H. Heller, DLR, Lilienthalplatz 7, 38108 Braunschweig, Germany Fax: +49 531 2952320, hanno.hellor@dir.de, http://www.liav.org/icsv7.html

August 28-30, NICE
INTER-NOISE 2000
Details: M. Vallet, INRETS-LEN, 25 avenue François Mitterand, Case 24, 69675 Bron Cedex, France. Fax: +33 04 7214 2480, mvallet@inrets.fr

October 3-5 KUMAMOTO
WESTPRAC VII
Details: Dept Computer Science, Kumamoto Uni. 2-39-1 Kurokami, Kumamoto, 860-0862. Tel: +81 96 3423622 Fax: +81 96 3423630 westprac7@cogfni.eecs.kumamoto-u.ac.jp http://cogni.eecs.kumamoto-u.ac.jp/others/westprac7

October 16-20 BEIJING
6th Int. Conf. on Spoken Language Processing
Details: ICSLP 2000 Secretariat, Institute of Acoustics, PO Box 2712, 17 Zhong Guan Cun Rd, Beijing 100 080, China, Fax: +86 10 6256 9079, mchu@plum.ioa.ac.cn

December 4-8, NEWPORT BEACH
Meeting of the ASA
Details: ASA, 500 Sunnyside Blvd., Woodbury, NY 11797 USA. Fax +1 516 576 2377, asa@aip.org

2001

June 4-8, CHICAGO
141th Meeting of the Acoustical Society of America
Details: ASA, 500 Sunnyside Blvd, Woodbury, NY 11797-2999, USA, Fax: +1 516 576 2377, Web: asa.aip.org

September 2-7, ROME
17th Int. Cong. on Acoustics
Details: A. Alippi, 17th ICA Secretariat, Dipartimento di Energetica, Universitá di Roma "La Sapienza", Via A. Scarpa 14, 00161 Roma, Italy, Fax: +39 6 4424 0183, www.uniroma1.it/energ/ica/html

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A. ARTICLES

B. NOTES

AUSTRALIAN ACOUSTICAL SOCIETY ENQUIRIES

NATIONAL MATTERS

* Notification of change of address
* Payment of annual subscription
* Proceedings of annual conferences

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AAS– Professional Centre of Australia
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