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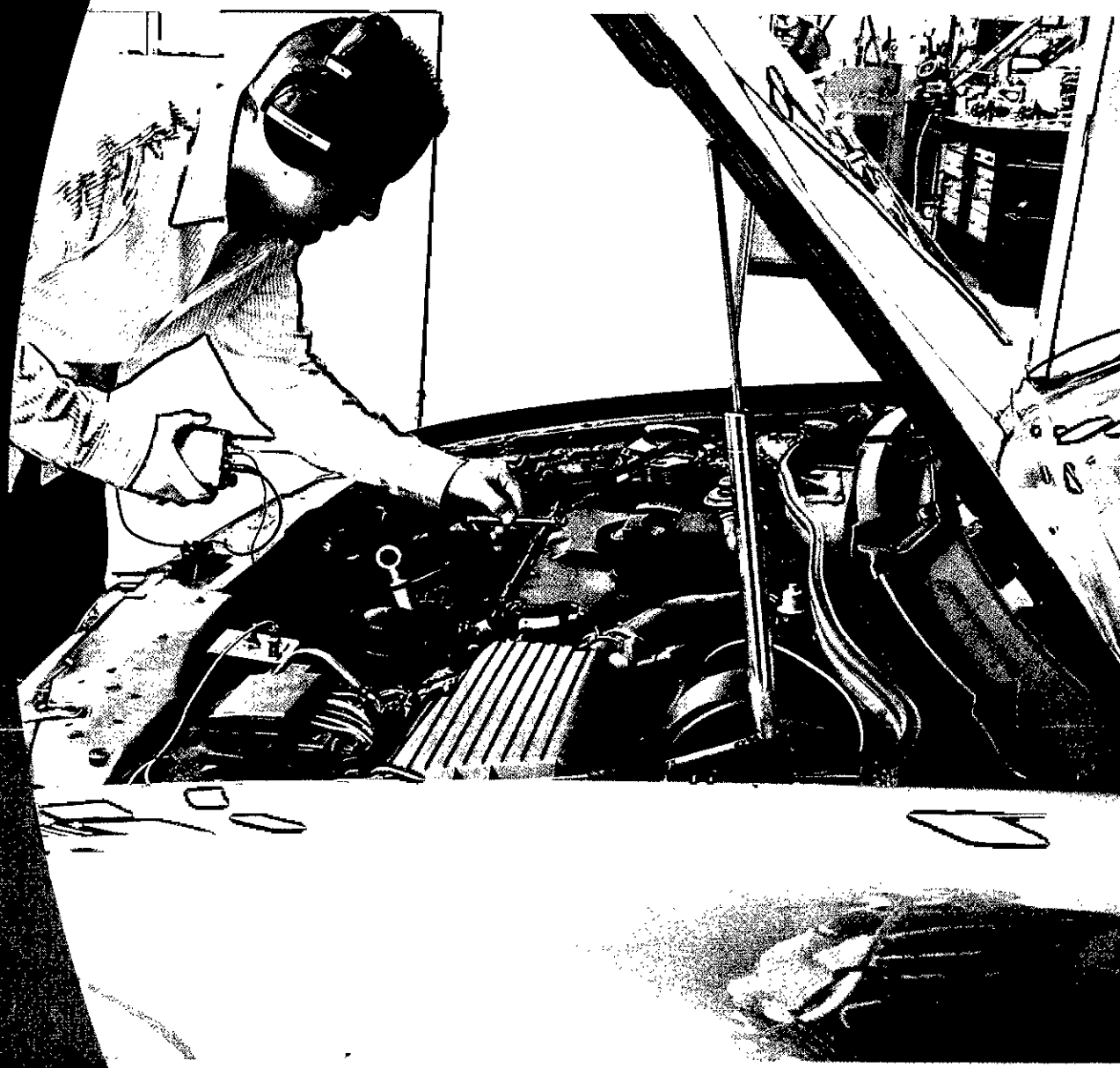
ACOUSTICS BULLETIN



in this issue... The Merits of Acoustic Particle Velocity as a Measurable Quantity

plus... Autumn Conference 2008

Artists and Scientists Working Together

iPod listening levels on London Underground for music and speech

Institute of Acoustics

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Contacts

Editor:
I F Bennett CEng MIOA

Associate Editor:
J W Tyler FIOA

Contributions, letters and information on new products to:
Ian Bennett, Editor, 39 Garners Lane, Stockport, SK3 8SD
tel: 0161 487 2225
fax: 0871 994 1778
e-mail: ian.bennett@ioa.org.uk

Advertising:
Enquiries to Dennis Baylis MIOA,
Peypouquet, 32320 Montesquiou, France
tel: 00 33 (0)5 62 70 99 25
e-mail: dennis.baylis@ioa.org.uk

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The Institute of Acoustics,
77A St Peter's Street, St Albans,
Hertfordshire, AL1 3BN
tel: 01727 848195
fax: 01727 850553
e-mail: ian.bennett@ioa.org.uk
web site: www.ioa.org.uk

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e-mail: talk2us@point-one.co.uk
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Contents

Front cover photograph: The cover photograph depicts the Microflown Technologies 'scan and listen' device used to detect specific noise sources in a car engine compartment. Sound pressure transducers are susceptible to background noise from the factory environment, but acoustic particle velocity sensors are not. Acoustical end-of-line testing thus becomes feasible without the need for an anechoic room.

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Brüel & Kjær

Dear Members

I am pleased to tell you that we are very close to signing a new ten-year lease for our headquarters premises in St Albans. Once this matter has been satisfactorily concluded many of us will be more able to focus our attention on other matters including the preparations for Euronoise 2009.

The latest news on this conference is that the three plenary lectures are now confirmed, an international advisory network is up and running, and the session chairmen have sent out invitations for invited papers. The deadline for abstract submission for both invited and contributed papers is 16 February 2009. Submission is available via ***www.euronoise.org.uk*** *. Please get your abstracts rolling in!*

The European Acoustics Association is promoting the active participation of young researchers and students in Euronoise 2009 and is offering 20 grants for young European acousticians, ten of which are reserved for western Europeans. The application deadline for these grants is also 16 February 2009. If you wish to know more please visit the EEA website at ***www.european-acoustics.org*** *.*

I recently presented a number of medals and awards while I was at three IOA Conferences: Underwater Noise Measurement and Mitigation, the Autumn Conference, and Reproduced Sound 24 - Immersive Audio. They were all thoroughly enjoyable and I was reminded of the diversity of the subject of acoustics. The attendance figures at the Autumn Conference were slightly on the low side and this has highlighted how careful we have to be when planning meetings and conferences, particularly in the current economic climate.

With regard to consultations, the IOA was formally asked by the City of Westminster to comment on its Noise issues and options report that relates to the development of the Westminster Noise Strategy. The London branch has co-ordinated a response which is published in this issue of Acoustics Bulletin. My sincere thanks go to the members of the London branch who participated in this activity, and in particular, Ed Weston.

In my previous letter (November/December 2008) I referred to a letter I had written to Hilary Benn MP, Secretary of State for Environment, Food and Rural Affairs, concerning consultation documents. The reply from Lord Hunt, Minister for Sustainable Development and Energy Innovation and Deputy Leader of the House of Lords, contains an invitation to a meeting with him. I hope to take up this offer early in the New Year.

*Finally, the Institute tries to support liaison activities with schools and colleges as part of the wider science and engineering community. There are many charitable organizations involved, large and small, each playing an important role. For 2009, the Engineering and Technology Board and the Science Council are planning a more coordinated approach with a new science and engineering fair, branded the Big Bang, at the Queen Elizabeth Conference Centre in Westminster from 4 to 6 March 2009 (**www.thebigbangfair.co.uk**). The Institute has been invited to play a part in this event and plans for our interactive project are being put together now. Anyone interested in helping should make contact at* ***acousticsengineering@ioa.org.uk*** *.*

John Hinton

John Hinton OBE

PRESIDENT

Autumn Conference 2008: See it Hear!

Demonstrating current and emerging techniques for sound measurement

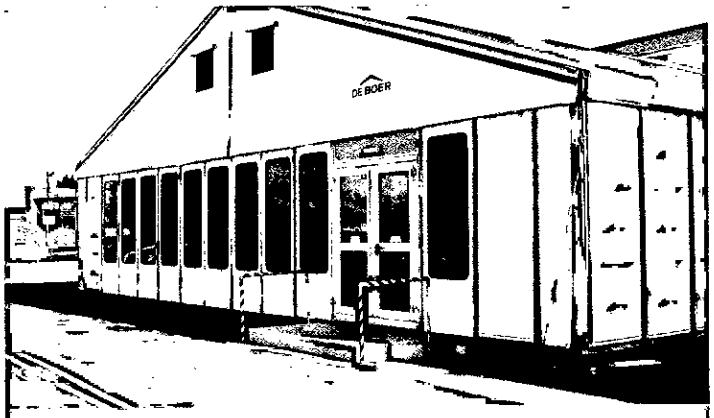
The Cranmer Suite at the Oxford Hotel, Wolvercote, Oxford yet again was the venue for the Institute's Autumn Conference, which was held on Tuesday 21 and Wednesday 22 October 2008 and attracted more than 80 delegates over the two days. Since the IOA's previous visit to the venue, it had been taken over by Barcelo Hotels and Resorts, but this did not seem to have made any appreciable difference to the quality of the accommodation or the cuisine. The chain operates some 17 hotels throughout England (including the Old Ship Hotel, Brighton, venue for RS24) as well as three in Scotland and one in Wales. All the papers were presented in the large, modern conference room, which was miraculously transformed into a dining room for the Conference Dinner early on the Tuesday evening. The hotel staff showed their usual skill and aplomb, and the lecture hall on Wednesday morning revealed no signs of the previous evening's jollity. The stands for the numerous exhibitors were again in the semi-permanent marquee: this has been in existence for at least two years, to the author's certain knowledge. Although it was well heated, light and airy by the time the conference proper began, the exhibitors had the usual problem of setting up the night before in excessively chilly surroundings. Perhaps the hotel's conference management team will have sorted out this particular problem by the time the IOA next visits them, which may well not be until 2010. The distant road traffic on the A44 was an acceptably quiet audible backdrop to the exhibition. Several instrumentation manufacturers and importers, consultancies and software companies supported the Institute by taking stands: their contribution to the success of the conference is, as always, gratefully acknowledged by the organising committee.

The conference was called 'See it Hear! Demonstrating current and emerging techniques for sound measurement', showing that the Measurement and Instrumentation Group's organising committee was just as skilful at punning as were organisers in previous years. The committee was able to gather together an interesting and varied programme within the framework it had erected, with 19 presented papers including an invited lecture by Peter Mapp, and a popular audience participation workshop in which delegates were invited to create (the sound of) the car they really wanted. Unsurprisingly, opinions differed widely, with the young bloods going for a racy, high-revving road burner, whilst the more mature members of the audience preferred a sophisticated, barely audibly purring diesel. The Institute thanks all those involved for their hard work, especially Richard Tyler, chairman of the Measurement and Instrumentation group, who opened the conference proceedings promptly at ten o'clock.

A particular feature of this conference was the theme 'practical demonstration session included', meaning that several of the papers were accompanied by a real, live demonstration of the equipment or techniques under discussion. This idea was very well received by the audience, and their participation was enthusiastic in every case.

Presented papers - Tuesday

The first session was chaired by Susan Dowson (NPL) and focused on specialist measurement and environmental applications. *Measuring noise at work in the entertainment industry* was the title of the first paper, given by James Tingay (Cirrus Research plc), which was an assessment of the way in which the 2005 Noise at Work Regulations could practicably be worked to in the entertainment industry: the provisions of the latest legislation on noise at work have been in effect since April 2006, but were deferred for two years for venues and place of employment such as pubs and bars, nightclubs, stadia and outdoor music festivals, and in orchestras. The concept that noise levels should be measured and controlled was new to many employers in these fields, and the use of conventional noise survey methods was sometimes not a practicable option. James discussed the use of noise dosemeters and sound level meters, taking into account their relative ease of use, simple operation, and whether or not static noise measurements (over a representative period of time at a fixed location) were a valid option. He ended by describing some of the measurements and methods used at the Notting Hill carnival (see *Acoustics Bulletin*, vol.33 no.6), and gave a practical demonstration of the relevant equipment and measurements.



The infamous marquee housing the exhibition


Drinks reception - always a popular attraction

Next was *Practical considerations in sound power measurement* by **Daniel Simmons and R Payne** (NPL). Dan described the many practical considerations to be taken into account when making a sound power measurement on a machine. Examples included the choice between sequential measurements using a single microphone, or concurrent measurements using a microphone array. The power requirements of the machine under test could cause problems, not least in maintaining constant operating conditions during the test. Outdoors measurements brought a new set of problems including site location, security and weather protection. The presentation focused on two practical considerations highlighted by a recent industry survey. These were the prediction of the ground plane absorption coefficient from measurements of the K_2 factor, and the requirement for additional microphone positions for directional noise sources, both of which were mentioned in the relevant measurement standards. In the first case, it was proposed as a result of the experimental programme carried out by NPL that the 'A' weighted sound absorption coefficient of a ground covering material, $a(A)$, could be estimated from a measurement of $K_2(A)$ using the expression $a(A) = -0.6K_2(A)$. In the second, it was discovered that the ISO3744 requirement to double the number of microphone positions did not result in a significant improvement in the accuracy of the sound power level determination.

After a coffee break, **Andy Watson** (Acoustic Consultancy Services) gave a characteristically enthusiastic and knowledgeable presentation on *A method to ensure positive control of the environmental impact from motor sport noise*. One of the most important aspects of operating any motor sport venue was to maximise its use, but this was often at odds with noise

Those wineglasses are pretty heavy

Let's go

Linda Canty takes control

Michael McKane is presented with his prize for the best performance in the Institute Diploma 2008

disturbance in the local community. In the UK this generally meant a restriction on the number of days when the venue was permitted to operate, and restrictions on the types of events permitted. The MSAUK (UK Motor Sports Association) imposed noise controls on most vehicle classes, but some international classes remained unsilenced, Formula 1 being the prime example. Here, we were treated to a stereophonic demonstration of an F1 Ferrari: music to some, intolerable to others! There were differences in the numbers of vehicles taking part in an event, as well as differences in the noise emitted by each type of vehicle. This made it difficult to control the overall level of community noise simply by controlling individual vehicle noise levels. Although it was important to have this control, it did not guarantee that community noise limits, usually in terms of L_{Aeq}, could be met. Some motor sport venues had therefore adopted control strategies based on the permitted hourly L_{Aeq} on a specified number of days in any year. For example, there might be ten days on which there was no limit at all, 50 days on which the $L_{Aeq,1h}$ was below 50dB, 100 days on which it was below 40dB, and no limitation provided that the $L_{Aeq,1h}$ remained below 35dB. This took into account not just major race days, but practice sessions, testing, and track days on which the general public were permitted to use their own vehicles. The noise limit in each case was applicable at an appropriate noise-sensitive location, such as the nearest downwind residential property.

The next 'practical demonstration included' was by **Simon Bull** (Castle Group) and **Richard Tyler** (AVI) who talked about and demonstrated *Environmental noise monitoring for noise mapping*. A system called 'DREAMSys', a distributed remote environmental array and monitoring system, was developmed because of the requirement for reliable, low-cost, environmental noise monitoring and mapping hardware. The independent Technology Strategy Board now ran a technology programme (initiated by the DTI) which supported the project, a joint venture of NPL, Qinetiq, Castle and Hoare Lea with AVI, Cardiff University and other NPL teams also being stakeholders. The commitment of the UK and other European nations to the production of strategic noise maps and mitigation strategies meant that there were several problems to solve, such as the fact that noise maps were based only on predictions, which required assumptions about traffic flows. The complexity of noise modelling led to limitations in accuracy, and the results were difficult to validate, so such validation was often missing. Only long-term average values were predicted. The first stage of the project was to develop the components of the system, which included a robust second-generation microphone, weatherproofed wireless hardware, and the software for data gathering, fusion and presentation. Stage two was to assemble and test DREAMSys with 100 measurement points, using MEMS microphones from Qinetiq, Knowles COTS microphones, a single conventional sound level meter monitoring station, a weather station, and the necessary mounting hardware. Step three would be to conduct a one-year field trial at a suitable site, resulting in a data set indication the reliability of noise predictions for the site and the daily and seasonal variations in noise levels. Finally, the findings would be used to develop guidance and policy recommendations for future noise mapping exercises. The masthead unit, base unit, wireless transmission system, and the real-time readout on a computer screen were then successfully demonstrated by Richard, as shown in the photographs. Possible spin-off products such as a new small environmental noise meter and a dosemeter were hinted at.

Lunch was followed by the second session of presented papers, under the general heading measurements of acoustic perception and response and the chairmanship of William Egan (Brüel & Kjær). A practical demonstration session by **Charles Greene** and **Dan Saunders** (both Brüel & Kjær) was entitled *How to make and analyse a tone assessment*. Charles described the implementation on the B&K type 2250/2270 platform of a tone assessment system, in order that the adjustment for tonal content called for by ISO1996 could be accurately determined. He discussed the need for an objective, rather than a subjective, assessment of tonal noise, recognising that the first evaluation was usually by the human ear: was there an audible 'tone' or not? Because this decision may provoke considerable expenditure, whether by the noise polluter or the recipient of noise, he took the view that some kind of proof or objective measurement was required. Reliable results were required, and this implied the use of FFT

continued on page 8

Autumn Conference 2008 - *continued from page 7*

analysis. Users of the equipment should be able to obtain a correct result without concerning themselves with detailed settings, although more advanced users would need more control. The implementation, demonstrated to the audience, put the FFT analysis onto the hand-held meter, performed the analysis, and showed the value of the adjustment to be applied to the rating level. First experiences with the new 'tone meter' had suggested that many more tones than expected were in fact found. However, those above 10kHz , and those below the threshold of hearing, could be disregarded: care was needed to identify the true cause of indicated results at very low noise levels. Nevertheless, the overall quality of tonal assessment was set to improve with the use of the instrument.

Carsten Thomsen (Delta, Denmark) then presented *Methods of assessing tonal and impulsive components in environmental noise*, a paper he had prepared jointly with **Torben Holm Pedersen**. He have a brief overview of the development history of quantitative methods for the assessment of tonal and impulsive noise annoyance, and described the main concepts in the 'Nordic methods', showing how they had been validated. He suggested that there may be greater benefits, both socially and economically, in accelerating the standardisation process rather than continuing to seek the ideal method. The Joint Nordic Method (JNM) gave a measure, *P*, for the prominence of impulsive sounds. The term *impulse* was first defined, then the level different and onset rate was measured, and the prominence *P* and a graduated adjustment factor K_I were calculated and applied to the L_{Aeq}. The method had been tested by four Nordic laboratories and the mean standard deviation of K_I was 0.6dB. Carsten went on to describe the validation of a newer updated method, referred to as JNM2, and offered some suggestions for cooperation in the international community for the standardisation of appropriate methods in the field.

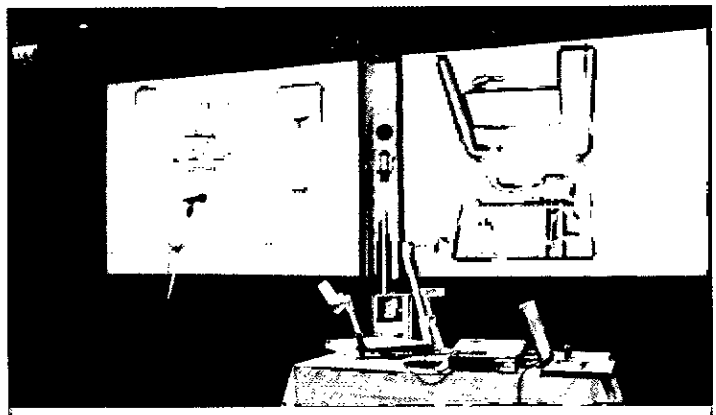
Charles Spence (Crossmodal Research Laboratory, Department of Experimental Psychology, University of Oxford) then presented *Auditory product design: new methods for evaluating the influence of changes in product sound on product evaluation.* The sounds elicited when a customer first uses a product (not 'oohs' and 'ahhs', but the noise the product made!) frequently provided useful information about the nature or functionality of the product, and recent studies had demonstrated how profoundly the auditory cues influenced people's multisensory (multimodal) evaluation of a variety of products. Such devices included food processors, vacuum cleaners, and perhaps more obviously, motor cars. The customer was often completely unaware that these responses incorporated input from their hearing. Charles described a novel experimental technique developed at the Crossmodal Research Laboratory, the basis of which was adopted from the field of cognitive psychology. The research involved an evaluation of the effect of changing the sound made by a product on how it was perceived. For example, changing the overall level and the spectral distribution of the sound of an electric toothbrush or an aerosol spray affected the perception of the pleasantness, force or power of the product. So-called 'signature' sounds were of particular interest in marketing a product, the distinct Harley-Davidson motorcycle sound being a prime example. Apparently this sounds like 'potato-potato-potato', although many of the audience thought it sounded just like a large vee-twin - oh, the burden of an analytical mind! In fact, much of the recent research on auditory design issues had been taking place in the automotive industry, such as jury evaluations of pairs of sounds for 'luxuriousness', 'power', or 'sportiness'. However, such jury testing was time-consuming and costly. A trend that appeared to be emerging where product sound design was popular was to move away from the evaluation and subsequent re-engineering of prototypes with a particular sound, to the increase use of simulation tools and techniques, and the greater use of synthesised product sound in the design cycle.

Following a question and discussion session, the eagerly-awaited audience participation workshop by **Garry Dunne** (Jaguar and Land Rover Vehicles) began. Under the title *Help us to create the car you really want* Garry demonstrated a driving simulator in which various aspects of the car engine, transmission and road noise could be varied, especially their relative prominence and their spectral content. He compared and

continued on page 10

A rapt and attentive audience for the presented papers

Bert Verberkmoes (Rion) shows a prototype palmtop SLM



DREAMSys masthead and base units as demonstrated live

Richard Tyler demonstrates the vital art of correct calibration

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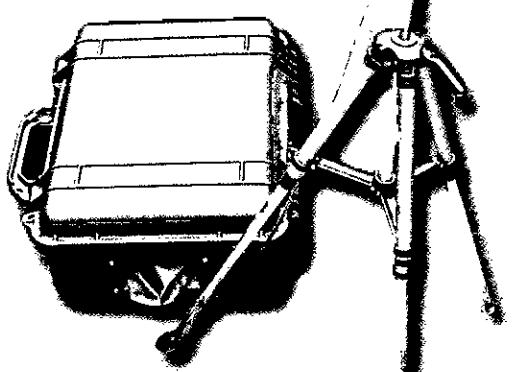

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Product specification subject to change

Autumn Conference 2008 - *continued from page 8*

contrasted different engine types (V8, straight 4) and different characteristics (sports, luxury, utility), revealing how the overall character and desirability of the car was influenced by these parameters. Having been given this tutorial in the capabilities and potential of the system, the audience participation was centred around the creation of a new 'sound' for a four-door family hatchback (VW Golf class) with a four-cylinder petrol engine. It should be noted here that the sound of the accelerating car did not seem at all calculated to conserve virtual fuel: the author was inwardly screaming 'change up! change up!' when the tachometer indication went past 5000 in second gear. Another notable feature of the driving simulator was the way a rapid acceleration quickly caused a delinquent red Volvo estate car to appear on the virtual road ahead: in that respect at least, the simulator was eerily accurate. In all, this was a fascinating and popular presentation, and precipitated a good deal of animated discussion on the technical and psycho-acoustical topics raised.

Evening programme

The Annual General Meeting of the Measurement and Instrumentation group followed the excitement of the driving and sound simulator.

A drinks reception in the exhibition marquee was followed by the Conference Dinner on the Tuesday evening. Those of us who had previously experienced the catering at this hotel had high expectations of the quality of the food and the service, and we were not disappointed. After dinner John Hinton, attending his first Autumn Conference in the capacity of President of the Institute, gave a brief speech and then acted as Master of Ceremonies for the presentation of a number of awards and honours.

Bob White received the Engineering Medal of the Institute of Acoustics, and Richard Collman an Award for Promoting Acoustics to the Public. Keith Broughton, Andy Watson and Richard Tyler all received commemorative awards for Distinguished Service to the Institute of Acoustics, this being in Richard's case a closely-guarded secret until the actual citation was read - as readers will see! Michael McKane received the prize for the best IOA Diploma performance 2008, and three Honorary Fellowships (HonFIOA) were then presented, to David Bull, Geoff Kerry and Ian Campbell. Many of these eminent names happen to be longstanding colleagues, and so read citations for each other.

The celebrations and speechmaking having been completed, there was a general exodus in the direction of the mezzanine bar for further discussion and analysis of the world at large.

Presented papers - Wednesday

The Wednesday sessions got under way with the invited paper from **Peter Mapp** (Peter Mapp Associates), *The future of STI and intelligibility measurement: extending the horizon.* Peter described the history of the development of speech transmission index (STI), rapid speech transmission index (RaSTI) and speech transmission index for public address systems (STIPA), starting with ancient Greek and Roman amphitheatres and passing through cathedral architecture to Henry's investigations of lecture hall acoustics at the Smithsonian Institute, and the well-known pioneering work by Sabine. From the introduction of 'talking pictures' in the late 1920s and early 1930s the study of intelligibility could be divided into three distinct areas of interest: telecommunications, architectural acoustics, and sound systems. He suggested that the sound systems field had often 'borrowed' from the other two, using techniques that may not have been entirely appropriate. However, whereas there was now reasonably good agreement between the simplified and easy-to-use STIPA and full STI, there remained many problems to be solved with the relationship of STI to intelligibility. The discrepancies among three commercial STIPA meters as a function of signal-to-noise ratio (under fixed reverberation conditions) were demonstrated. Peter then went on to demonstrate the potential for making and implementing binaural STI measurements, in the expectation that better predictions of intelligibility might result. It remained to be seen whether the direct measurement of speech intelligibility could replace STO

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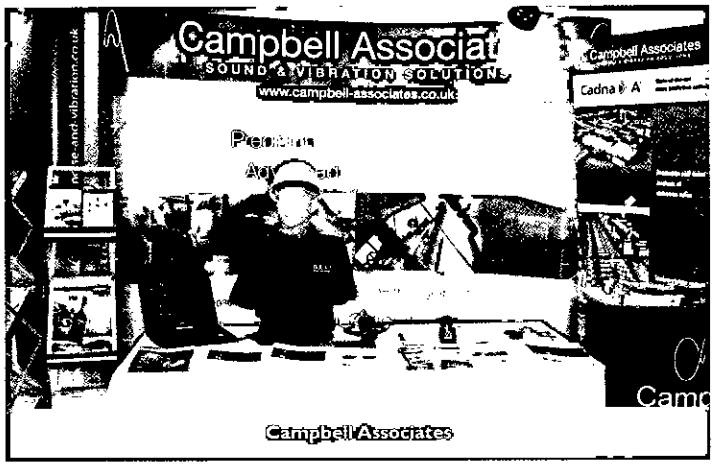

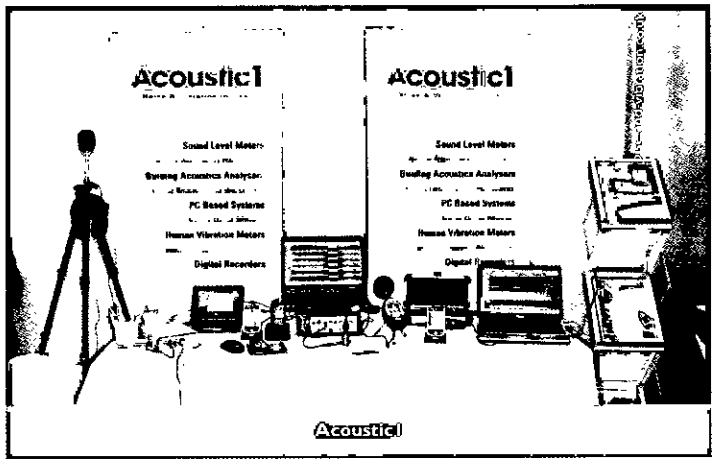

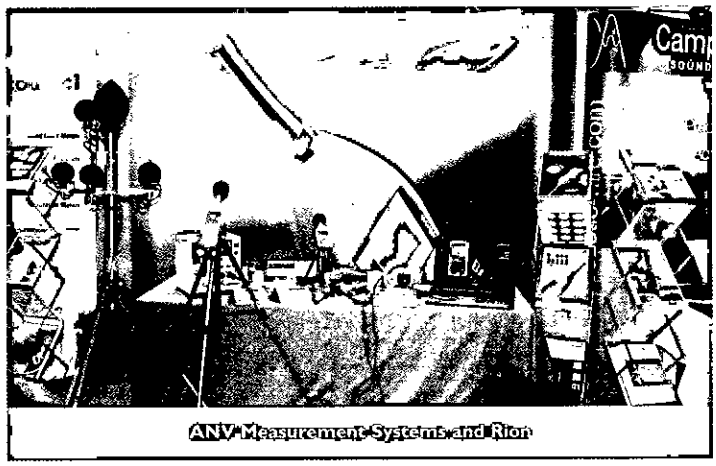

Autumn Conference 2008 - *continued from page 10*

determinations in the foreseeable future.

Session 3 then began. This was a session on source location and acoustic imaging, under the chairmanship of John Shelton, with four papers on this processing-intensive topic. First, **Roger Upton** (Brüel & Kjær) gave a practical demonstration of *Fast, effective noise source identification inside vehicles*. This was centred on the Brüel & Kjær spherical beamforming technique using arrays, in which research, benchmarking, troubleshooting and target setting could all be carried out on the same measurement platform. Exterior vehicle noise, interior vehicle noise, engine, powertrain and component noise could all be investigated, as well as wider applications covering (for example) construction equipment, industrial machinery, aircraft, office equipment, consumer goods and even hearing aids. The spherical beamforming technique provided a fast omni-directional noise 'map' of sound pressure or sound intensity, which is largely independent of the acoustical environment and was therefore equally valuable indoors or out-of-doors. The sphere could be placed directly at a listening position, and a noise source ranking made by measuring the contribution of each source directly. The technique could be combined with conformal mapping to enhance the resolution at low frequencies. It was based on the SHARP system (spherical harmonics angularly resolved pressure) meaning that any sound field could be decomposed into its harmonic components on the sphere, and the actual strength of each harmonic determined from the measurements. The pressure levels at the target distance were then estimated by combining the components, and in comparison with standard delay and sum beamforming, around fives times better resolution could be achieved. Roger showed some particularly interesting case studies, including interior vehicle noise at 80mph, the identification and control of a door seal leak, the noise from a door slam, and the location of squeaks and rattles.

Real-time source localisation for industrial applications were then described by **Sandro Giudati** (HEAD Acoustics, Germany). This paper was concerned with how the basic theory of array technology, known and used since the beginning of the last century, could now be applied with large numbers of microphones measuring simultaneously, and with the advances in computer technology, the processing and visualisation of high-resolution acoustic images was possible online with very low latency. Time-domain and frequency-domain beamforming were compared, but because the former required significantly greater computation time, frequency-domain beamforming was the focus of most of the presentation. Multiband beamforming, and coherence/incoherence filtering were described, and their application to the detection of vehicle damage at a car door or window seal was investigated. The annoying noises produced by such blemishes could be eliminated by test checks after manufacture, in which a powerful loudspeaker was placed inside the cabin and the external noise emissions scanned and compared with a 'perfect' example. Although time-consuming when an operator with a sound level meter was the method, a real-time beamforming array could do the job much faster: leakage due to damaged seals registered as additional noise sources and could be rectified immediately.

Gunnar Heilmann (gfaitech, Germany) presented the next 'practical demonstration included' with his *Applications of time-domain beamforming using three-dimensional microphone arrays*. This was particularly interesting in contrast to the previous paper, given the limitations of computing and processing time. Next, **Peter Blaschke** (HEAD Acoustics, Germany) gave a paper co-written with his colleague **Bernhard Müller-Held**, on *Binaural transfer path analysis and synthesis embedded in an acoustic design process*. This was an interesting treatment of the tools used for troubleshooting and design in vehicle interiors, using binaural transfer path analysis and synthesis (BTPA and BTPS). The sound quality inside a car was becoming a more and more important product feature, and one which significantly affected the perceived quality of the product. The great variety of new models in recent years had resulted in increased competition, and this in turn led to greater customer demands in terms of noise, vibration and harshness (NVH). Troubleshooting was a central part of the acoustician's work, but design engineering of NVH was nowadays a quite usual extension of the acoustician's responsibilities. The causal mechanisms of noise transfer could be investigated with BTPA and BTPS, whereby source strengths and the corresponding structureborne and airborne transfer paths could be identified. The results were a significant step forward in acoustic simulation and auralisation, because the engineer could not only analyse and listen to the overall sound, but also separate out individual components of the noise in order to identify particularly annoying or disturbing elements. The author presented an extension of the time domain transfer path analysis method where structureborne transmission paths were described as four-pole networks and the results simulated immediately and audibly. As an example, changes in engine mount geometry and material properties could be predicted using FEA, and the vehicle interior sound auralised using only engine dynamometer input data. This was particularly important where a specific 'brand sound' was desirable, as it could be approximated relatively early in the design process.

After the lunch interval, the fourth and final technical session was introduced by the chairman, Mike Swanwick, with five papers falling under the heading of general measurement practices and techniques. **Robert Oldfield** (University of Salford) presented *An unusual solution to acoustic impedance measurement* in a paper co-written with his colleague **Fouad Bechwati**. This was concerned with the design, construction and commissioning of a low-frequency impedance tube for the assessment of acoustically absorbing materials, particularly the evaluation of the complex surface impedance of different materials and absorber types. It was built in an upright orientation so that granular materials could be tested, and had a large cross-sectional area so that some extended reacting materials could also be tested. The tube was built with to operate over the widest possible frequency range by using four microphones, with the results being processed using a least squares optimisation technique, which increased the accuracy by combining the measurements from all four microphones into a single curve across the frequency range of the measurement: in the case he presented, this was 17 to 500 Hz. Problems resulting from exterior noise were minimised by the thick wall construction of the tube, and the use of a deterministic test signal even at the lowest frequencies. The effects of background noise were further circumvented by using a pair of phase-matched microphones to measure pressures at two locations simultaneously, making the transfer function between the two microphone signals independent of background noise. A level of 137dB was used for the lowest frequency measurements, always provided that the loudspeaker was not operating non-linearly, which would mean it was not producing plane waves. The rigidity of tube backing was also highlighted as a possible detriment to the accuracy of measurements.

Richard Tyler (AVI) was next, with a fascinating presentation on an apparently mundane subject, called *Have you been set up? A workshop on the art of coupling an acoustic calibrator to a sound level meter*. In order to make sound pressure level measurements with a sound level meter, it was necessary to ensure that the meter was correctly adjusted for the conditions under which it would be used. This was normally effected by applying an acoustic calibrator to the microphone in the configuration to be used, and adjusting the meter as required to match the level of the calibrator. The act of adjustment was usually simple: knowing the level to adjust to was not always so simple. The workshop session ('practical demonstration included', number six!) was intended to show all the factors that should be considered, and what could happen when they were not considered. There were five principal factors that influenced the performance of acoustic calibrators, all if which were considered in the relevant international standards: these were the output level of the calibrator; environmental effects such as temperature, humidity and atmospheric pressure; the use of adaptors (one-inch to half-inch, for example); the correction for pressure to free-field measurements; and the settling time, meaning that the calibrator should always be fitted and removed slowly and sufficient time allowed for the system to stabilise. Richard gave a checklist for applying a calibrator to an instrument - with the help of real instruments and a closed-circuit close-up camera - and perhaps more interestingly, told the audience 'what not to do'! These 'do nots' included using more than one adaptor in a calibrator (unless specifically allowed by the manufacturer); using one manufacturer's adaptor in another manufacturer's calibrator cavity; ignoring the difference between the nominal level of the calibrator and its actual level; ignoring atmospheric conditions (if required); wrongly assuming that pressure to free-field corrections for one type of microphone applied to any other microphone

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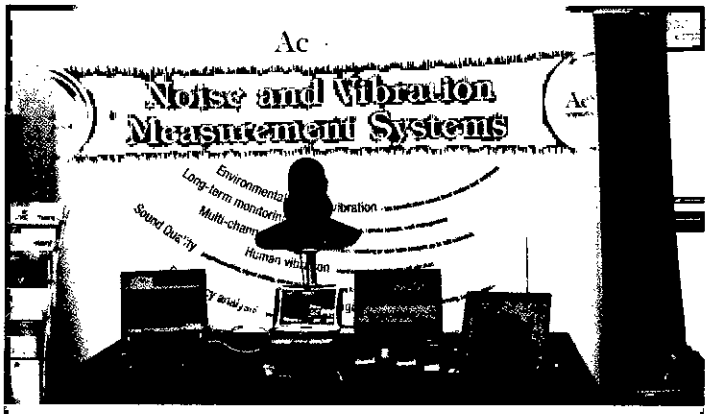
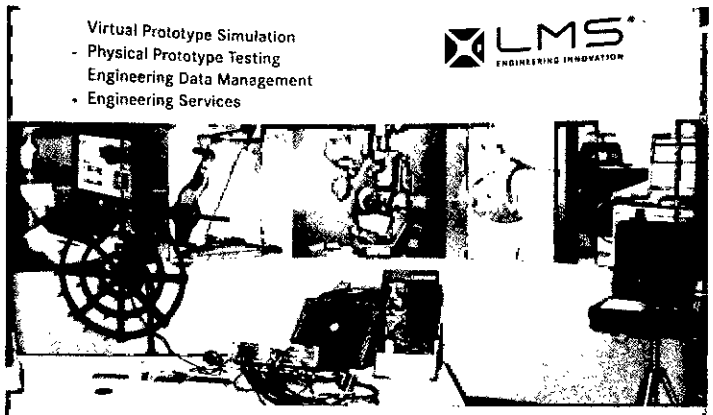
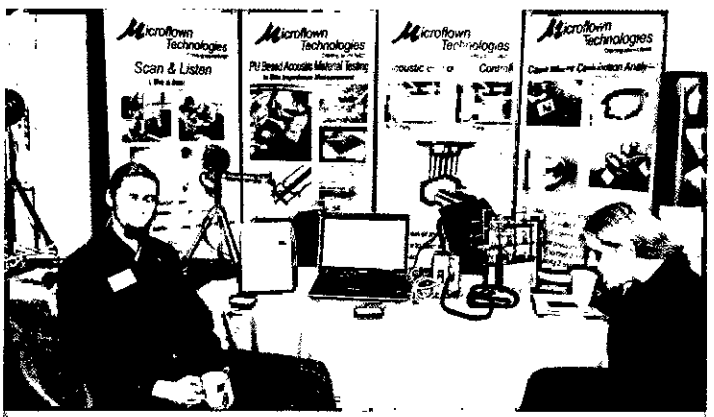


AcSoft

Castle Associates



LMS Technologies



Microflown Technologies

Autumn Conference 2008 - *continued from page 12*

of the same size; ignoring windshield effects at the calibration frequency. The demonstration clearly revealed the wild inaccuracies that could result if his advice were to be ignored.

An alternative to reverberation time measurement for sound insulation testing was then presented by **Beth Duarte** (University of Salford) who worked with **Andy Moorhouse** as well as having carried out research at the Federal University of Santa Catarina, Brazil. Studies investigating low frequency noise in the home were well justified by the poor sound insulation performance at such frequencies of many modern lightweight building constructions. Unfortunately, sound insulation measurements at low frequencies were associated with relatively high uncertainty and wide variance, which was an obstacle to efficient rating and control. A particular issue arose with reverberation time measurements, which were problematic in small rooms because of the modal characteristics of the enclosed space. An alternative was investigated by the project she presented, where a calculated volume velocity source was used instead. In theory, the power input to a room could be obtained from measurements of two parameters at two points in the room: the cross spectrum of sound pressure, and the peak value of impedance between these two points. A numerical simulation was carried out for a typically sized domestic room, and this was in the process of being experimentally validated in the University of Salford reverberation room. It was proposed to use sound intensity methods to measure the power transmitted through the wall into the receiving room, but a delicate balance would have to be drawn between this and the peak envelope method, as each was most accurate under the conditions where the other was least accurate. As a potential practical application, the microphone positions currently used for the ISO tests could also be used for the peak envelope tests, but the data would be processed differently according to whether the third-octave band of interest was in the diffuse or the modal region. The results so far, although short of verification, were very promising.

The final 'practical demonstration included' was on *The art of noise data acquisition*, by **Mike Swanwick** (Rolls Royce plc). Mike has many years of experience in practical noise data-gathering at various inhospitable sites all over the world, under circumstances where aircraft operational costs meant that he had to obtain as much data as possible under great pressure of time. He went through the steps required to ensure first-time success, which ranged from the sensible and obvious through the detail based on experience, even extending to carrying pencils as well as ball-point pens (in case of rain!). The prospect of finding himself hundreds (or even thousands) of miles from base with a vital piece of equipment missing filled him with horror, and he provided a valuable object lesson both to experienced and less experienced practitioners in the audience.

The final presented paper of the conference was given by **Paul Shields** and **Chris Skinner** (both Scott Wilson Ltd) and on behalf of their co-author, A Ralph (Westminster City Council), on the subject of *Analysis techniques for large data sets*. They had learned many lessons from the Westminster Noise Measurement Survey, carried out during 2008, about how to undertake large-scale noise surveys over an extended period of time. They discussed the use, calibration and maintenance of instrumentation over large surveys, and the downloading, saving and backup of the measured data. Having gathered data, it was then necessary to consider how they would initially be processed and formatted, and then full analysis could be embarked upon including the comparison of their results between sections of the survey, and with other, similarly-sized datasets. The previous surveys relevant to the work included the Nation Noise Incidence Studies of 1990 and 2001, the Westminster Noise Survey 2003, and the London Noise Survey 2004. The 2008 work fell into two phases, which involved a series of 20 measurements at random addresses in Westminster, each for a 24 hour continuous weekday period, followed by similar measurements at 15 additional sites selected by WCC at locations within, or close to, the designated Central Activities Zone. The data analysis included average daytime and night-time noise levels; a comparison of these figures with guidelines (eg from the WHO); 24-hour time histories, and cumulative distributions showing the proportion of the sample and of the population who were exposed to noise levels above a given value. A summary was presented of some of the more interesting findings of the survey.

A final discussion session then brought the conference to a close.

Engineering Medal

Professor R G White

Bob White has exemplified excellence in acoustical engineering for more than 50 years, from his early days as a scientific assistant at the Royal Aircraft Establishment, Farnborough, through his long service at the Institute of Sound and Vibration Research, Southampton, to his more recent work for the Royal Academy of Engineering and his many extramural activities worldwide. He was awarded the Tyndall Medal in 1984 and was made an Honorary Fellow in 2004.

At ISVR, his research interests in vibration focused on experimental techniques in the vibration and shock response of structures; the dynamic properties and structural application of carbon fibre reinforced plastics; and theoretical and experimental use of power transmission techniques in the analysis and design of machinery installations. Bob has supervised over fifty postgraduate students and published more than 150 papers in refereed journals. He is the only Professor we know who brought the kitchen sink with him to his inaugural lecture!

In addition to his research work, Bob undertook major administrative duties. He was Director of the ISVR from 1982 to 1989, where he started a new research group in signal processing and developed underwater acoustics research by building an underwater acoustics tank and associated laboratory. Subsequently he became Director of the University of Southampton Institute of Transducer Technology of which he was a founder member. He also served the University as Head of the Department of Aeronautics and Astronautics for a number of years.

But it is Bob White's unique contribution to the development of so many young engineers and so many engineering development projects, worldwide, that sets him apart from his peers.

He has served the Institute's Engineering Division since its establishment in 1989, working alongside Peter Lord as an interviewer for CEng candidates. Bob later became Chairman of the Engineering Division and a Vice-president of the Institute. He has continued to serve as a committee member and interviewer, while remaining active in the Royal Academy of Engineering.

In so many different ways, he is a unique role model of an acoustical engineer and he is most worthy of the award of the Institute's Engineering Medal.

Bob White receives the Engineering Medal from John Hinton

Award for Promoting Acoustics to the Public

Richard Collman

Having already been taken out on site visits from the age of thirteen and employed with his brother on the extra pocket-money-earning activity of assembling anti-vibration mounts, Richard graduated from Salford University with a degree in acoustics and computing sciences in 1984. Following graduation, Richard joined the family business, Acoustical Control Engineers Ltd, having achieved the first class honours apparently set as a criterion by his father.

In around 1996, Richard began presenting talks and leading relevant activities in schools at a rate of about two visits a year. He proactively prepared all the relevant material to deliver to age ranges from reception to secondary school level.

In 2006 Richard was amongst the first group of IOA members to become Acoustics Ambassadors through the Science and Engineering Ambassadors scheme run by Setpoint, Hertfordshire as part of a national programme. However, Richard went far beyond this. He developed an acoustics activity to take into schools, based on challenging pupils to hold a band practice without disturbing the neighbours. This activity is not just a pen and paper exercise. Using his own time and money, Richard designed and built some seven rigs, steel boxes with six open sides into which various materials can be slotted, including some panels with ventilation slots, and both resilient and sound absorptive materials. A simulated drum kit and bass guitar sources are put inside the rigs and the students learn, by a process of discovery, about the effectiveness of different noise control approaches. The solutions are costed by the teams and the noise level measured.

Since the initial pilot in May 2007, the activity has been taken up by Tring School, Knights Templar School and Chauncy School. Richard took charge on each occasion. This encouraged Tring School to nominate Richard for an award in the Best Activity category for the national awards run by STEMNET (Science, Technology, Engineering and Maths) which he duly won, receiving the award from the science journalist and broadcaster, Vivienne Parry, at the House of Lords in March 2008.

For Richard's inspiring work promoting acoustics to young people through an exciting and innovative school activity, the Institute of Acoustics is delighted to present the Award for Promoting Acoustics to the Public for 2008 to Richard Collman.

Richard Collman earned an Award for Promotion of Acoustics to the Public

Distinguished Service Award 2008

Keith Broughton

Keith Austin Broughton joined the Institute in 1986 as an Associate Member, having completed the Institute's Diploma in acoustics and noise control at Derby. For many years, Keith worked for Mines Research and Development in Bretby, where he was involved in a wide variety of technical challenges for the coal industry, ranging from engineering developments in noise control for mining technology through the management of environmental noise to the establishment of employee noise exposure policies and practices.

He subsequently joined the Health and Safety Executive at its headquarters in Bootle, playing a leading role in the development and implementation of workplace noise management legislation, supervising research contracts and promulgating good practice based on his extensive experience of such work in arduous and hazardous environments. Keith has also brought his knowledge and experience to good use in the development of British, European and International Standards in the fields of noise control and hearing protection.

Keith was elected MIOA in 1989 and became a member of the newly-formed Engineering Division, acting as a reviewer and interviewer for CEng and IEng applicants. He continues to serve the Institute in this role, having helped more than 150 members gain Engineering Council registration.

Keith became Treasurer in 1998, when the Institute was relocating to its current site in St Peters Street, St Albans. Working alongside Roy Bratby, who had just been appointed to the post of Chief Executive, Keith played a major role in the acquisition and implementation of the Institute's first comprehensive IT system, notably its new accounting system.

In recognition of his work for the Institute and his contribution to the field of occupational noise management and control, the Institute of Acoustics is delighted to make this Distinguished Service Award to Keith Broughton.

Keith Broughton is delighted with his Award for Distinguished Service to the Institute

Award for Distinguished Services to the Institute

Richard Tyler

Today we held the thirteenth Annual General Meeting of the Measurement & Instrumentation group. Those doing a quick subtraction will realise the Measurement & Instrumentation group was formed in 1995. This may surprise some as the measurement Diploma had been going for some years by this time. The first official meeting was at the 1995 Autumn Conference where the theme was 'Standards, Criteria, Measurements, Design in Acoustics'. My notes remind me that the AGM was held before dinner, and the fireworks, and that the chairman and secretary were formally elected.

Going back a little earlier to that June an ad hoc meeting was held forming the embryo committee where the Chairman and Secretary had volunteered.

We now need to go back to an earlier June in the late 1940s, to Ilford, where a son was born to a master carpenter. After attending Gearies Junior School he passed the 11+ and attended Ilford County High School for Boys, the local grammar school. Here he enjoyed the sciences but could not get on with history, indeed, he will now not touch a Joseph Conrad book. In an art class his picture of a bus station did not fit the teacher's expectation of 'your best memory of your summer holiday' ... but the bus station was the start of the holiday.

Most will by now have realised who I am talking about - especially Richard Tyler.

Sound, or more specifically music, became a large part of Richard's life following on from being awarded a scholarship - a Junior Exhibition - to the Royal College of Music at age 11, and he attended the RCM each Saturday. It was here he studied 'O' and 'A' level music, getting higher grades than in science at school. He was offered a place to study music full-time at the senior Royal College of Music, but chose instead to read engineering at university.

Richard graduated in electrical and electronic engineering from City University, London in 1971 and added an MSc in applied acoustics from Chelsea College, London in 1974.

From 1971 to 1974 Richard worked as a Scientific Officer at GCHQ in the Joint Speech Research Unit, researching new techniques for secure speech communications in real-time over HF radio links. Speech intelligibility and music ambience were central to the next change of job when Richard joined AERO. This was in the design and installation of assisted resonance systems, especially at the Royal Festival Hall. A step away from acoustics in 1977 brought Richard back to engineering, in designing high speed office photocopiers at Roneo Vickers Ltd. In 1982 there was a new direction with Rank Pullin Controls Ltd in the design of night thermal imaging cameras to military standards: also in 1982, Richard became a member of the IOA.

A return to the field of acoustics in 1983 was as Chief Engineer, later Manager, in the design of advanced sound measuring instruments at Lucas CEL Instruments in Hitchin. Richard was responsible for the world's first microprocessor-based precision meters with built-in memory and later the CEL 593 series meters with real-time parallel octave and third-octave band analysis. During his time at CEL Richard joined BSI committee EEL/24 and IEC TC29 on sound level meters (WG4), calibrators (WG17), EMC as chair (WG18) and filters (WG19). On human vibration Richard joined GME 21/6 and 21/2 as well as ISO TC108.

The new millennium brought a change of direction with the setting up of Acoustic and Vibration Instruments Ltd (AVI) to provide design and consultancy for noise and vibration measuring instruments. Within two years AV Calibration was set up to provide UKAS-accredited sound level meter, calibrator and vibration transducer calibrations.

As I said, Richard chose to study engineering but music has not been far away. A church organist for most of his adult life, he has commissioned, managed and worked on organ restoration. He plays the violin in the Bedford Symphony Orchestra and the Bedford Sinfonia.

Richard has been active within the Institute since joining and has always supported and promoted links with undergraduates. At CEL he promoted the understanding of instrumentation for the next generation of engineers. In 1994 he became a Fellow of the Institute and was central to the formation of the Measurement and Instrumentation group. No other group covered this area and the aim was to promote good practice, standards, traceability and new techniques. It is not surprising that he was elected chairman at the inaugural meeting on 19 June 1995.

Richard Tyler has continued as chairman, leading the M&I group with enthusiasm in fulfilling the aims set out in 1995. He has advanced the standing of the IOA not only in acoustics but in vibration.

For all of his work and dedication to the Institute, it is fitting that Richard Tyler is to receive the Award for Distinguished Services to the Institute.

(citation by Martin Armstrong)

Richard Tyler gets his surprise Distinguished Service Award from the President

Distinguished Service Award 2008

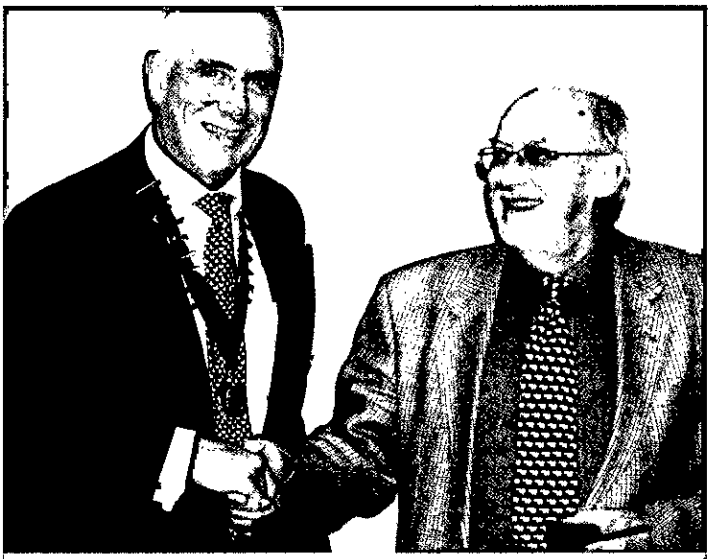
Andrew Watson

Andrew Ewing Watson (Andy, to everyone in the Institute) started his illustrious career with a Diploma in dairy technology at Agricultural College in Auchincruive, Ayrshire. This was followed by what turned out to be a rather 'cushy number' working for the RAF Central Recruiting Office in London as part of his National Service. Once completed, he managed a creamery in Johnstone, before a complete career change into selling for Proctor & Gamble.

In the early 1970s he joined British American Optical as their European Marketing Manager. This also coincided with his first encounter with noise and, also coincidentally, with Ian Campbell, then of Computer Engineering Ltd, when Ian came to demonstrate their new dosemeter. In 1978 Andy left BAO to return to Scotland where he ended up managing to win the Scottish agency for Computer Engineering Ltd (now Casella CEL). As his career progressed Andy added to his portfolio an MSc in acoustics, vibration and noise control from Heriot-Watt University.

Andy has managed to combine his love of cars and motor sport with his day job and has been the UK specialist on the measurement of noise from motor vehicles, a member of British Standard Committee on Transportation Noise, noise consultant to the Royal Automobile Club Motor Sports Association, and chairman of the Environmental Advisory Group of the MSAUK. His present position as senior partner in Acoustic Consultancy Services concentrates on workplace noise, motor sport and road traffic noise studies, as well as environmental impact studies.

Andy joined the IOA in 1980 and has been deeply involved in the work of the Institute, having served as a member of the advisory committee for the Workplace Noise Risk Assessment Certificate of Competence, and the main education committee. He is a long-standing member of the Noise and Vibration Engineering group and is currently a member of that committee. He has also been an active - and somewhat vociferous - member of the Scottish Branch!



Andy Watson, Distiguished Service Award, and John Hinton

In recognition of his work for the Institute and his contribution in the field of environmental and industrial noise management and control, the Institute of Acoustics is delighted to make this Distinguished Service Award to Andy Watson.

Honorary Fellowship

David George Bull

David Bull started his career as an engineer with the RAF but whilst completing degrees in mechanical engineering and engineering acoustics joined the teaching profession in 1966 at North-east London Polytechnic. In 1968 David moved to Colchester Institute as a lecturer in the engineering faculty, and remained at the college until he retired from his post as Principal Lecturer in 1997, apart from a two-year stint in Denmark writing technical publications for Bruel and Kjaer. He continued as a part time lecturer at Colchester until 2001. David saw the need for a specialist acoustics course at Colchester Institute, as there were at that time a significant number of companies in the Colchester area involved in the acoustics and noise control industries. This led to David developing an in-house acoustics course that followed on to accreditation to deliver the IOA Diploma course in 1980. From 1980 to 1997 David was the principal tutor for the Diploma at Colchester, with well in excess of 300 students taking the examinations during that period, including many prepared to travel great distances for the day release course to benefit from David's unparalleled teaching reputation.

In 1989 David was instrumental in the development of the Certificate of Competence in Workplace Noise Assessment, was Chief Examiner for 12 years and chairman of the certificate committee for four years. He was also involved in the development of Certificate of Competence in Environmental Noise Assessment, running a pilot course at Colchester in 1993. In addition to these educational responsibilities David has also been a very active participant in the Institute of Acoustics including forming the Eastern Branch in 1988 (in conjunction with Peter Hunniball), being secretary of the Industrial Noise group from 1983 to 1998, and Vice-president of Groups and Branches from 1998 to 2002. From 1984 David also operated his own independent acoustics consultancy, dBAcoustics.

However, it is for his work in the field of education that David will always be remembered and held in the highest regard. He has had published over 20 papers in various journals and over a period of some 25 years has developed a unique range of practical demonstrations illustrating the principles of acoustics, vibration and noise control engineering that will never be forgotten by those who have seen them. His enthusiasm for acoustics and his innovative approach to education has left an ineluctable mark on countless students and has made a major contribution to the furtherance of acoustics as a professional discipline.

David Bull HonFIOA

His distinguished career encompasses consultancy, teaching and practice. In recognition of his exceptionally important services to education in acoustics and for services to the Institute, the Institute of Acoustics is delighted to award an Honorary Fellowship to David Bull.

Honorary Fellowship

Ian James Campbell

Ian Campbell can look back over 45 years of work within the acoustics industry and over 25 years championing the Institute of Acoustics.

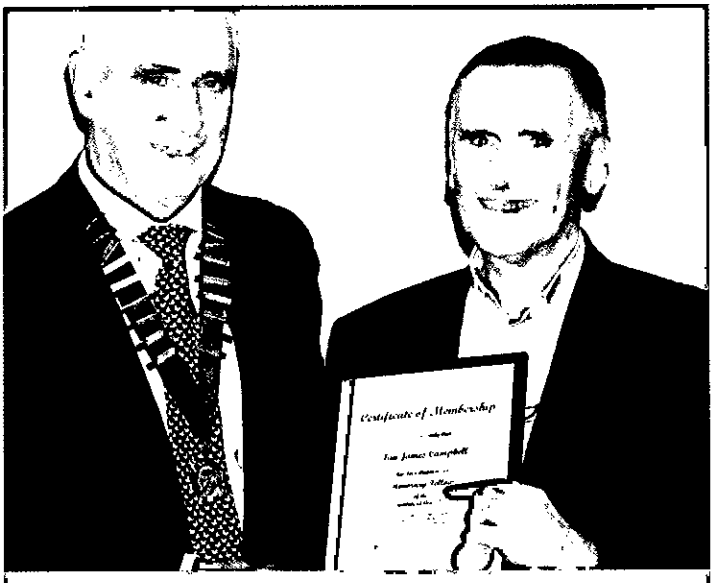
He studied at the Northern Polytechnic and Tottenham Technical College in London as well as the Heriot Watt University in Edinburgh, where he obtained his MSc.

Ian gained initial experience as an electronics design engineer working on audio equipment: this led to involvement in psycho-acoustic projects and developed into an interest in electro-acoustics.

Following the publication of the Wilson Report this knowledge was used to enable the first low-cost sound level meters to be put into production, a device which was within the resources of most local government and commercial organisations. Ian became a co-founder of CEL Instruments and was closely involved with the design and manufacture of the world's first Leq meter, the first integrating sound level meter, and the first environmental noise analyser. As managing director of the company it was grown from a small 'instrument-maker' to a producer of advanced acoustics instrumentation.

After the disposal of the CEL business to American interests Ian was engaged on locum executive projects for Lucas Industries plc, Cirrus Research plc and Gracey Associates.

From 1998 to the present day Ian has been Technical Director of Campbell Associates with a team that has expanded to 18 people and still supplies sound and vibration monitoring equipment. Recent achievements include obtaining UKAS accreditation for the Campbell Associates calibration laboratory, and his return to work after a third retirement!



Ian Campbell FIOA

In 1998 Ian became President of the Institute of Acoustics having been a member from some 15 years. In 1994 he was appointed to the Council of the Institute and in 1996 chaired the business review committee that undertook a strategic and operational review of the activities with a view to preparing the Institute for the millennium and beyond.

Ian is currently a member of the Measurement and Instrumentation committee, the organisers of this year's Autumn Conference. In recognition of his contribution to the field of instrumentation and for services to the Institute, the Institute of Acoustics is delighted to award an Honorary Fellowship to Ian Campbell.

Honorary Fellowship

Tony J Jones

Anthony Jones graduated from the University of Salford with a first class honours degree in Physics in 1969. He then undertook research into the subject of human sensitivity to whole body vibration, leading to the award of his doctorate in 1973.

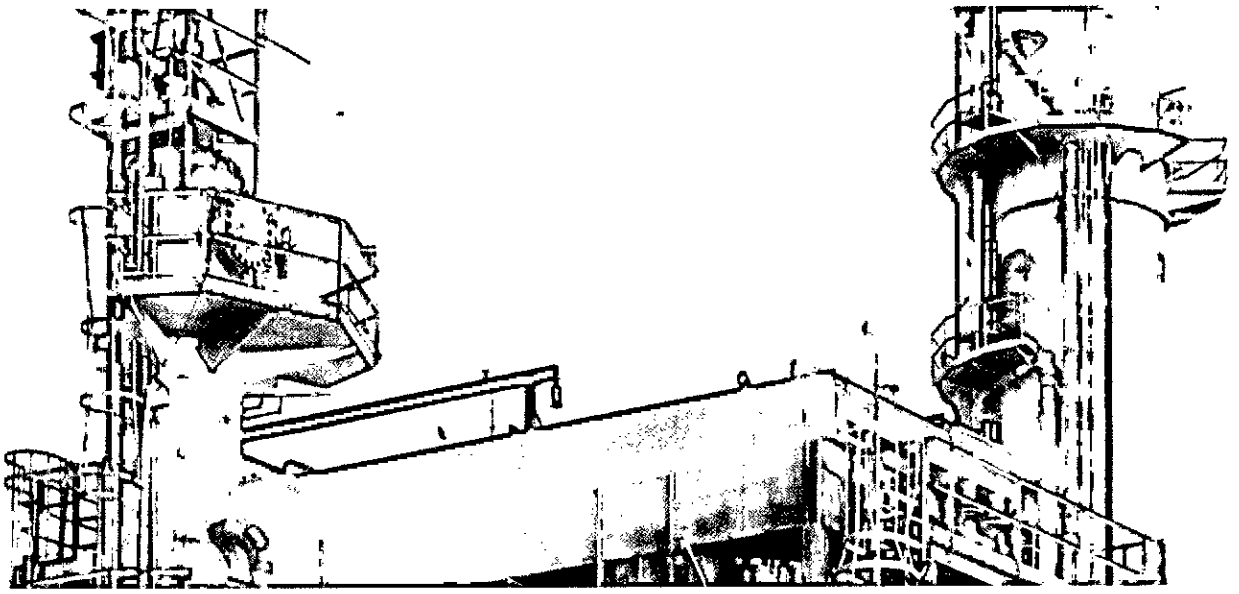
He joined AIRO in 1972 as a consulting engineer and, after accumulating considerable experience in all aspects of the company's activities, was appointed chief consulting engineer in 1974 and managing director in 1978. During his employment with AIRO, Dr Jones has been engaged on a wide variety of work in the fields of sound insulation, transport noise, acoustic design and noise control in buildings, measurement and assessment of vibration, industrial noise control and environmental noise appraisals.

From 1986 to 1992 he held the post of honorary secretary of the Association of Noise Consultants, and was elected chairman of the association over the period 1992 to 1995. At the same time he was invited to attend the meetings of Council of the Institute of Acoustics. This led to him becoming the honorary secretary of the Institute from 1995 to 2001, and in 2002 he was made the Institute's President-elect. He duly became President in 2004 and finally left Council this spring after attending Council meetings for 15 years (of which 12 years were as an officer). He has served on Executive and the medals and awards committee for a similar period. On Council he acquired a reputation for an attention to detail and accuracy, and displayed an incredible memory for previous decisions!

Tony has been keen to encourage the involvement of younger members in the Institute's activities and promoted the setting up of a network of young members' representatives. He has also helped to steer the Institute through a period of significant change that has resulted in its having a much more secure financial position and a more professional outlook in all of its activities.

For all of his work and dedication, the Institute is pleased to award Tony Jones an Honorary Fellowship.

Tony Jones FIOA



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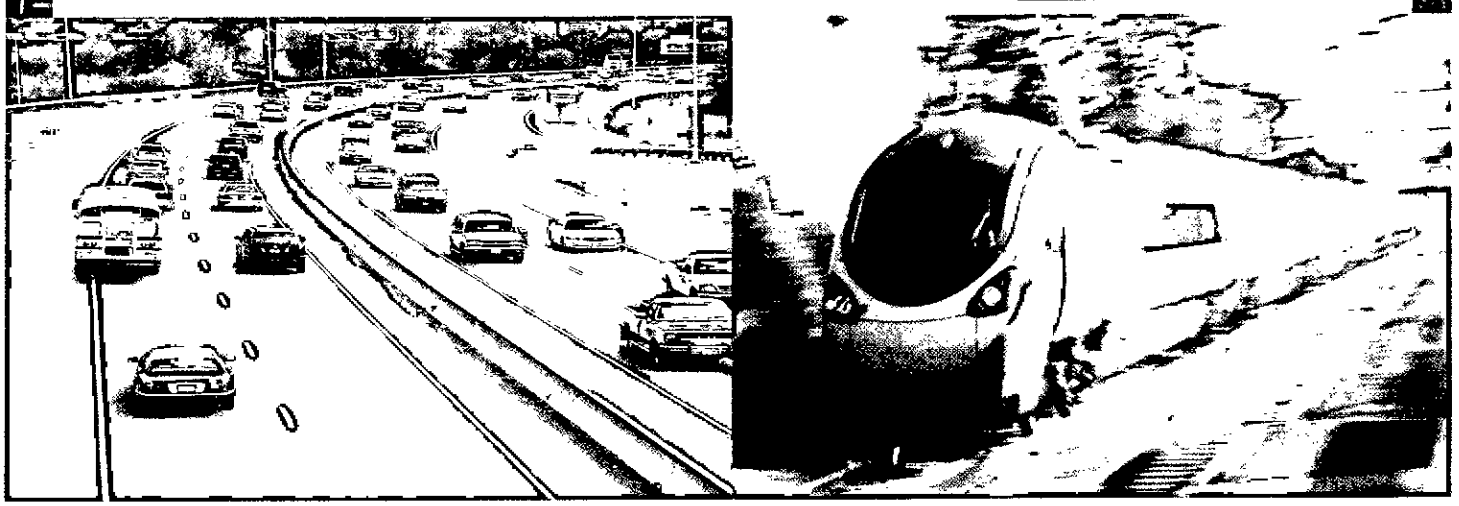


Honorary Fellowship

Geoff Kerry

Geoff Kerry joined the Institute at its foundation in 1974 and has served in many roles, culminating in election to President in 2002.

He gained a BSc in Applied Physics at Salford University in 1967, while working at Hawker Siddeley Aviation at Woodford, where he often took to the air, armed with a sound level meter, having successfully completed the flight test observer course at RAF Boscombe Down.

In 1969, he joined Peter Lord and colleagues at Salford University as scientific officer for the Department of Applied Acoustics. Geoff was a founder member of the Institute's North-west Branch and of the Industrial Noise group (now Noise and Vibration Engineering group), and was elected Fellow of the Institute in 1981. Through the early years of the Institute's development, Geoff played a major role regionally and nationally.

At Salford, working with Peter Lord and, latterly, Peter Wheeler, Geoff oversaw the design, construction and commissioning of three successive generations of acoustic test facilities, taking responsibility for UKAS accreditation and the numerous commercial and governmental research and development projects awarded to the department, and helping to build its international reputation for teaching, research and consultancy. He has always been active in British and International standards development, and, since his retirement from the University, he continues to act for UKAS as a specialist assessor.

In 1994, Geoff gained Chartered Engineer status through the Institute and was also awarded CPhys through the Institute of Physics.

Geoff has served the Institute tirelessly for many years as a member of the membership committee, and as treasurer until 1998. He was elected President for 2002 - 2004, serving on Council through a key period in the development of the Institute.

In recognition of his long and distinguished service to the Institute and his unique contribution to the development of acoustics as a profession, the Institute of Acoustics is delighted to award an Honorary Fellowship to Geoff Kerry.

Geoff Kerry Hon FIoA

Westminster Noise Strategy

Consultation Response from the Institute of Acoustics London branch - November 2008

This representation on the Strategic Environmental Assessment (SEA) Scoping Report and the Noise Issues and Options Report, which form part of the Westminster Noise Strategy, has been prepared on behalf of the Institute of Acoustics (IOA) by members of its London branch. This representation was requested by Cllr Daniel P Astaire in his letter dated 1 October 2008 to Mr Kevin Macan-Lind of the IOA and has been authorised by the President of the Institute.

The IOA is the leading professional body in the United Kingdom concerned with acoustics, noise and vibration and is active in research, education, environmental and industrial organisations. The Institute is a nominated body of the Engineering Council, a member of the International Institute of Noise Control Engineering and the International Commission on Acoustics and a founding member of the European Acoustics Association. Members of the IOA are active in the development of UK, European and International Standards.

Comments on SEA Scoping Report

No comments

Comments on Noise Issues and Options Report

Noise Issue 6

Relating to railway and tube noise, we would request that the effect of sound pressure levels being generated within tube trains on passengers is considered. On certain sections of some tube lines within Westminster, noise levels can be uncomfortably high. On other sections, noise levels seem to be sufficiently high to encourage the many people listening to personal music players to turn the volume up to levels which could potentially damage their hearing in the longer term, just to overcome the background noise.

It is also noted that some public address announcements and warning tones (such as those prior to the doors closing) on tube trains and buses can be uncomfortably loud, especially for those forced to stand close to the sounder during busy times. It is recommended that consideration be given to introducing limits on such warning tones. Furthermore there is a case for automatic volume controls on tube train public address systems to avoid instances when the driver accidentally turns the volume up too high. It is recognised, though, that a balance is needed as at times, higher levels are needed to compensate for the background noise levels generated when the train is moving at speed.

Options and ideas 1A and 1B

These comments are based on experience of Westminster's approach to new and replacement plant and the practical difficulties that this can cause.

The options and ideas for the noise strategy include strengthening the control of noise from plant and equipment. There appears to be no consideration to reviewing critically the planning policies and practices and considering relaxation where they might be found to be unduly onerous.

Although we appreciate the rationale behind policy Env 7 and agree with the general aims of this, the way in which it is structured may lead to planning conditions that are invalid because they are unreasonable or unenforceable. Westminster's response to this seems to be that if the applicant feels this to be the case they are welcome to challenge the condition(s), relying on the fact that most applicants are then forced to take a pragmatic view that any such challenge will significantly delay their project by an unacceptable amount of time. There appears to be scope for a more balanced approach in this area.

The relationship between values of L_{Aeq} and L_{A90} at a particular location depends upon the acoustic characteristics of that location. The values may be

similar or differ by more than 20dB depending upon the degree to which noise levels fluctuate in that particular noise environment over the period of measurement. This means that in areas where the residual sound level is relatively steady and the L_{Aeq} exceeds 55dB, the permitted rating level will be slightly less than 45dB. However, where the residual level fluctuates significantly but yields the same L_{Aeq}, the corresponding permitted rating level may be around 25dB. Aside from the potential unreasonableness of such different criteria for the same baseline condition (L_{Aeq} slightly exceeding 55dB) this is actually contrary to the aims of Env 7 because in the steady noise environment, which is arguably more sensitive to the contribution from new noise sources, a higher level is permissible than in a fluctuating noise environment, which is potentially less sensitive to the contribution from new noise sources.

Item 2 of Env 7 states that 'where the external *background* noise level does not exceed the above WHO Guideline levels [55dB, 50dB and 45dB L_{Aeq} for day, evening and night respectively]...'. The above reference to background noise level (L_{A90}) should therefore be to the residual level (L_{Aeq}) instead, to reflect the metric in which the criteria are presented..

Even where the WHO Guideline levels are not exceeded, the above comment regarding the potential disparity between L_{A90} and L_{Aeq} values still applies. Particularly in this case it may be totally inappropriate to relate the source noise level to the quietest external background noise level. For example in a relatively sheltered location it may be more appropriate to ensure suitable noise levels within living accommodation or bedrooms (presumably assuming open windows), using guidance such as BS.8233 or WHO and taking account of potential creeping background noise as appropriate (which may not be a significant concern in some locations), rather than simply stipulating a level relative to the external background noise level, which may result in the need for more noise abatement than appropriate with the aim of achieving arguably unnecessarily low internal noise levels.

Although Env 7 implies it, the wording is unclear regarding the fact that the rating penalty should only be applied if the source noise contains acoustically distinguishing characteristics at the noise-sensitive properties. In most cases, if the source noise level is 10dB below the background noise level, the penalty will not be invoked.

The above points show that under some circumstances implementation of this policy will result in an unreasonable condition being imposed.

In many situations it will not be possible to measure accurately the noise level produced by a source that complies with Env 7, or fails to comply by several dB. This means that in these circumstances the condition is unenforceable and therefore invalid.

It seems somewhat unsatisfactory to have a policy that can be readily demonstrated to result in invalid planning conditions under such (not uncommon) circumstances.

There is some mention of energy consumption in the document. However, it does not appear to have been appreciated that over-attenuating plant can significantly increase the energy consumption of that plant. With the very stringent limits on noise from plant it is often necessary to attenuate plant with bespoke solutions, as 'off-the-shelf' equipment that can provide adequate attenuation is not often available. Space is often a limiting factor in the design of a plant attenuation scheme. Additional fans are often required to provide airflow through an attenuation system. Where space is limited it is often necessary to impose greater aerodynamic resistance in order to achieve the required level of attenuation than would be the case for a lower level of attenuation. These factors mean that additional energy is required to continue to operate the plant. This is in addition to the increased carbon footprint of the components of a substantially more extensive attenuation scheme than may otherwise be required, or even for a complete attenuation scheme that may be required to achieve an unnecessarily low noise level, when off-the-shelf equipment would be suitable if a slightly higher noise level were permitted. Thus there appears to be an inconsistency between the noise policy and the energy policy. Arguably, noise reduction is being given too much weight.

In order to achieve very low plant noise levels the physical size of the plant and its attenuation measures may be larger than if higher plant noise levels were

continued on page 24

Westminster Noise Strategy - *continued from page 23*

permitted. Where the plant footprint is restricted (fairly common in Westminster) the height of the attenuation may have to increase causing problems with visual impact.

Although we appreciate Westminster's objective is to protect residents from the harmful effects of noise, we consider that Westminster's policy Env 7 (Appendix 2) is too stringent.

Options and ideas 3B and 3C

We support the development of voluntary codes of practice for licensed premises, and propose that incentives be offered to licence holders who publicly sign up to the code. Incentives could include priority processing of future planning and licensing applications.

Additionally, during the licence application or extension process, a bespoke code could be developed for the individual premises, drawing applicable clauses from an agreed list. Focusing a specific set of applicable objectives may be easier for the licence holder to assimilate and therefore encourage action on their part.

Options and ideas 4C

We understand that the Notting Hill Carnival is an event of cultural and historical importance, which brings pleasure to millions of people every year. Having the opportunity to enjoy music reproduced at very high sound pressure levels is a key factor of the carnival. Any move to reduce music levels must take account of the fact that many residents of Notting Hill will have moved into the area knowing of the existence of the event, and will enjoy, tolerate, or avoid the event, in the latter case by taking a holiday.

Consideration could be given, however, to controlling noise from carnival goers as they leave the carnival or congregate outside pubs and bars beyond the official carnival area.

Options and ideas 6C

Traffic calming measures and traffic flow schemes which promote driving at steady low speeds should be considered. Discrete devices such as speed bumps encourage braking and accelerating which are usually noisy activities, tending to increase fuel consumption and the release of carbon compounds and air pollutants. The bump-type devices may also reduce the average lifespan of road vehicles which may increase the problems of waste management and energy consumption in the production of new cars.

Meeting report: London branch

Ed Weston. Noise mapping in Scotland - the highs and lows

In August 2006 Bernadette McKell, then at Hamilton McGregor, began work on the Scottish Noise Mapping project for the Scottish Government. The mapping was completed in July 2007, following a year of highs, lows, innovation and hard graft. On Wednesday 17 September 2008, Bernadette gave a talk to around 40 members of the IOA London branch at their impressive new venue, Capita Symonds' offices at 1 Proctor Street near Holborn. She presented an overview of the work during this period, and also discussed the 'action planning' phase which followed and is still in progress.

The presentation was structured around the high and low points the team experienced throughout the project. The team consisted of colleagues at Hamilton McGregor; MVA transport planners who provided much of the data; AECON, the consulting arm of Cadna who handled much of the bulk data processing; and a firm who supplied the permit-to-work software which facilitated auditing and commenting procedures.

The first 'low' was concerned with submitting the tender documentation, shortly followed by the first 'high' when they won the tender. The bid specifically involved mapping Scotland's two agglomerations with populations greater than 250,000, *ie* Edinburgh and Glasgow, plus some outliers. The NEXTmap Digital Terrain Model (DTM) for Britain was chosen to model the study areas. Giving heights on a 5m grid, this format provides better accuracy than contours, and improves compatibility with noise modelling software, but has numerous data points. With a total study area of over 8000km^2, plus around 2000km of roads and 1000km of railway lines, the datasets were unmanageably large because they required prohibitively long processing times. Furthermore, the team were struggling to obtain any rail traffic data at all. This was considered a 'low'.

The IT specialists in Bernadette's team came to the rescue, however, and succeeded in significantly reducing the number of data points. The techniques used are soon to be released in a GIS (Geographic Information Systems) publication.

But there was still no rail traffic data. Unfortunately the Corporate Network Model (CNM) which will bring traditional reference material into a GIS format is not due to become available until 2011 at the earliest, which was far too late for the team. Instead, Network Rail eventually provided Engineering Network Model (ENM) and National Gauging Database (NGD) data in shape-file formats. The number and types of trains on track sections were determined using data from ACTRAF, but there were a few lingering problems relating to train speeds. This information could not be extracted from the Railsys system, and the GEOGIS system gave only track speeds, not train speeds. The National Rail Timetable database was eventually used to provide average speeds between stations calculated from timing point locations (TiPLocs).

So, against the odds and after many sleepless nights, Bernadette and her team completed the mapping on time. She described how the launch of the mapping was delayed by the Scottish Nationals entering parliament, and the night of chaos on Victoria Quay on the eve of the launch, which necessitated tracking down a reliable internet connection to finish the presentation (incidentally, this went down well). This phase of the project ended on a high note.

Following preparation of the noise maps, an action plan was to be drawn up. This work was led by the Scottish Environmental Protection Agency who acted as the project manager. A steering group consisted of the Scottish Government, the lead consultant and chairs of the four working groups: Edinburgh, Glasgow, Transportation and Airports.

The work involved developing a procedure between Environmental Health and Planning to enforce mitigation measures such as glazing specifications and the construction of noise barriers. Bernadette stated that the Environmental Noise Directive sets out to avoid, prevent or reduce the harmful effects of noise on a *prioritised basis*, and explained what process of prioritisation was adopted. This involved the use of 'blobs' and 'slugs' (see the web site for a complete explanation), but in essence the top 1% of cases become candidate noise management areas for which noise mitigation strategies are developed. These strategies require alignment of mitigation measures with current processes, eg when a road becomes eligible for resurfacing, it is suggested that a low-noise surface is used. Following implementation of these strategies, a virtuous cycle is envisaged whereby improvements are reflected in the noise maps as and when they are updated, followed by further noise-mitigating action.

At the time of the meeting, draft action plans for Edinburgh and Glasgow had come back from consultation with mostly favourable comments. Further information is available at **www.scottishnoisemapping.org** and the London branch would like to thank Bernadette for her informative and entertaining presentation. Following the meeting, members were pleased to note that the new meeting venue is in easy walking distance (be it in the opposite direction) of the Citte of Yorke pub, which was where the evening ended, as usual.

Meeting report: North-west branch

Peter N Greenhalgh. 'Are my dBs too loud, or not loud enough?'

Peter Mapp is clearly a popular speaker, as it quickly became apparent that additional seating was required. And then some more, and some more ...

Our illustrious chairman, Peter Sacre, introduced the proceedings on Thursday 13 November 2008 in fine style by pointing out that the speaker had 'been around for many years', a point which Peter Mapp took with true aplomb.

We were then treated to an interesting journey through the problems of balancing the needs of PA systems - intelligibility, high signal-to-noise ratio (SNR), high direct to reverberant ratio (DR) - against the sensitive receivers or neighbours (low SNR, PA remaining below ambient levels). It was clear that not all public address system installers were taking account of this need for balance, and complaints of noise nuisance against PA users were on the increase.

User problems that compounded the issues were highlighted, including speaker annunciation, rate of delivery, microphone technique, language, age, and listener acuity, all of which contributed to the efficiency of getting the information across, not forgetting echoes and reflections. For example, if an announcer was not using his or her first language, there appeared to be a quantifiable 4dB disadvantage.

Loudspeaker radiation patterns were not all that they should be, and installers seemed to take little regard for orientation, placement or appropriate power ratings.

Target intelligibility levels were given as >0.5 STI (RaSTI) as the minimum required for evacuation systems, with SNR >10dB (for the overall A-weighted level), which was not easy to achieve in a stadium). Emergency standards required a level of 90dB(A), although there appeared to be no rational explanation for that value. Peter guided us briefly through relevant standards, including BS.5839 (fire alarms) BS EN 60849 (EU-wide emergency sound systems) and IEC268-16 (intelligibility measurement).

Some interesting case histories were covered, although many of the major issues seemed to land firmly on the doormat of the rail industry, where it was apparently perfectly acceptable to test external loudspeakers adjacent to residential premises at 05.30h daily! Some of the issues were, at the time of writing, the subject of litigation.

Solutions were offered which, by and large, were remarkably simple (which leaves us wondering why the installers did not follow industry good practice in the first place, such as zoning or partial screening). Improved criteria to avoid nuisance were suggested.

Peter then moved on to show evidence of the varying levels of hearing loss in different sections of the community, noting that the elderly invariably suffered from presbycusis, a point that had to be explained loudly to Geoff Kerry later. Exposure through life also contributed to later hearing deficiencies. Again, solutions such as AFILS, infra-red and FM hearing support systems were outlined, along with modern programmable digital hearing aids.

Peter outlined ongoing research, into human hearing responses to different sound fields, and tailoç a number of thought-provoking issues arising from these topics, leaving as many questions unanswered as answered. We now need a follow-up talk on sensoneural-audio processing. Are there any takers out there?

This was an interesting and informative talk, well received by all, albeit huddled together after the man with the key to the air-conditioning had gone home! Our grateful thanks, as ever, go to Arups for hosting the event and providing the catering.

Meeting report: Central branch

Gary Timmins. Investigations of poor sound insulation : NHBC's perspective

As head of NHBC's Acoustic Services, the talk given on 8 September 2008 by Paul Goring focused primarily on the experiences that Paul has gained since joining NHBC, and provided an enlightening and entertaining look at sound transmission issues experienced by the NHBC Claims department.

A general overview of the role that NHBC plays with respect to new houses in Building Control, the sound transmission issues covered by their warranty, and the claim resolution process was given. It came as a surprise to many that sound transmission issues were covered only for the first two years of a property's life. The explanation for this was that issues in respect of sound transmission would usually surface within this time or not at all.

A rogues' gallery of photos was included providing an insight into a number of issues ranging from accumulation of debris within separating wall cavities, through missing blocks in party walls that had been rendered, to examples of poor design for curtain walling. Examples of issues picked up by NHBC's Building Control department were also presented showing a wall with mortar joints barely filled and a variety of missing fire collars where soil vent pipes penetrated separating structures. By far the most entertaining was the exhibit of the 'mad plumber' who had probably lost a spanner or vital tool under a timber floor, and proceeded to attempt to locate it by hammering holes through the floor!

Paul talked through an interesting case study in which an improvement in $D_{nT,w}$ $+C_{tr}$ *of up to 8dB* was observed after the removal of debris from the cavity of a masonry separating wall and the addition of a scratch coat of render.

Paul went on to show a number of extracts from sound insulation test reports (with names obliterated to protect the originators) submitted for review to him by the NHBC Claims and Building Control departments. The audience showed genuine shock and surprise at the poor quality of some of the content submitted.

Before a well-attended meal at the Jaipur Restaurant, the talk finished with a lively question and answer session covering pertinent issues such as whether impact tests should generally be carried out on decorative floor finishes (Paul indicated that they should not!) and if it was acceptable to undertake tests within occupied dwellings (Paul indicated this was not ideal, though it was often the only practical option in some instances).

Meeting report: South-west branch

Wind turbine visit

As an introduction to the forthcoming one-day meeting on wind farms in Bristol on 16 January 2009, organised by the IOA, the South West branch organised an afternoon visit to the wind turbines at Bristol Port, followed by some related presentations in the evening. The events took place on 22 October 2008.

On an ideal day for the visit (dry but windy), 15 SW branch members met up at Avonmouth Docks for the chance to get up close and personal with a wind turbine.

The group was met by Julian Werret of the Bristol Port Company (BPC), who kindly escorted the group around the site, and gave an excellent talk on how the turbines were selected, and how they were working for them after a year of operation.

The three 2MW Enercon E82s turbines are ideally situated next to the River Severn and the existing BPC activities, so noise from the turbines is inaudible above the ambient noise level (from the M5 motorway) at the nearest residential properties.

The group was very appreciative of the chance to hear the various noise components that a wind turbine has, and weather conditions on the day were conducive to distinguishing the noise from the downward passage of the blades as opposed to the noise from the power generation equipment. Overall it was an excellent visit, and it was great to see wind energy providing a large percentage of the power consumption for an industrial process!

Afterwards the group headed to UWE, where other members who could not attend during the afternoon joined the meeting. Two presentations were given, covering large and small turbines.

Gavin Irvine of Ion Acoustics began by describing work he had done whilst at Hayes Mackenzie on the noise assessment undertaken for the very turbines visited earlier. He summarised the ETSU-97 assessment process, which is the standard adopted for such assessments in the UK, and identified the key requirements of each step in the process, and outlined the different approaches available to limit any noise impacts.

Richard Perkins of PB followed by describing the current position on the assessment of micro turbines, and their potential inclusion as a permitted development for home owners. Richard outlined the concept of permitted developments, and the difficulties in setting a 'one size fits all' noise criterion which would be required. He outlined the optimum wind conditions for micro-turbines, observing that these were not generally found in suburbia.

The SW branch members pose under a wind turbine at Bristol Port

Important notice

Misuse of the Institute's logo

Institute of Acoustics

The IOA has become aware of a number of breaches of copyright in the use of its logo by organisations that erroneously misuse this image on their websites.

Only the IOA's sponsoring organisations are permitted to use the appropriate logo, which has been supplied to them for this purpose. No other companies, firms or organisations may legitimately use the logo.

Please immediately report any potential cases of this malpractice to the IOA so that appropriate action may be taken to rectify the error.

Stolen Equipment

Larson Davis kit missing

This is a list of the serial numbers of Larson Davis type 824 meters stolen from Hann Tucker Associates in the past 18 months.

Serial no. 1340 - stolen August 2008

Serial no. 1350 - stolen August 2008

Serial no. 3057 - stolen March 2007

Serial no. 3533 - stolen March 2007

Serial no. 1340 - stolen November 2008

If a member or organisation should be offered any of these items of equipment, please inform Gareth Evans of Hann Tucker Associates Ltd on **01483 770595**, or the Editor on **0161 487 2225**. No uncomfortable questions will be asked.

New members

The following were admitted to the membership grades shown as a result of the Membership Committee meeting on 6 November 2008, and Council on 4 December 2008

Members (MIOA)

Folzan, M J M
Gladden, R A
Hammer, P
Irish, M A
Kennedy, P J
Milligan, T E
Swainston, N J
Yahathugoda, I

Associate Members (AMIOA)

Adamson, N P
Aitken, S R
Albrecht, S A
Baker, A D
Banks, C J
Bearman, L A
Billin, H L
Boot, M J
Braham, J J
Brierley, J
Bull, F
Butler, M J
Chilvers, J D
Ciotkowski, A
Croft, S
D'Avillez, J V A
Denham, D J
Derbyshire, C L
Dodds, N
Durn, C J
Egan, C A
Emery, K J
Eynon, R L
Garritt, E L
Gill, C S
Griffiths, D T
Harrison, M
Herwin, P N
Hopwood, P D
Jones, D
Jones, F A
Kells, A
Khan, I
Kourik, A
Leggate, G J
Lothian, S J
Macdonald, R C
March, N R
McEvilly, F
McNally, M
Medley, A P
Millar, K A
Millard, N J
Miller, N P
Moule, M W
Nicholson, L J
Nicholson, S L
Oldridge, A J
Paterson-Stephens, I
Shepherd, C V
Sissons, D L
Taylor, L V
Ward, R
Warren, M H R B
Watkins, R J
Wright, K
Wrigley, D J

Affiliates

Donnelly, M
Nichols, A L
Porter, R W

Technician members

Flitton, J
Lawless, R E
Scott-Baird, C J

Student members

Butterworth, I
Deeks, J
Leask, J T M
Serrao, K M
Stone, J T
Woo Young, J

Sponsors

ISOMASS Ltd
ANV Measurement Systems Ltd

Upgraded memberships and reinstatements.

Fellows (FIOA)

Chiles, S G
Greer, R J
Webb, L J

Members (MIOA)

Coleman, B
Davies, P A
Driscoll, P G
Gibson, A C
Girvan, N
Healey, J F
Jindu, Z P
Makin, T J
Peakall, S J
Pratley, D S
Turner, R J
Wright, P

Associate members (AMIOA)

Barnard, R S
Brett, V A
Draper, R
Frisby, A P
Knowles, P J
Liviani, L
Puente, J
Sims, G N
Tebbs, R

Sponsor

Arup Acoustics

IOA certificate pass list

Certificate Name: Certificate of Competence in Environmental Noise Assessment
Exam Date: 3 October 2008

Bel Educational Noise Courses

Waldron K J

University of Birmingham

Cross I
Dolman V L
Freeman-Evans J
Hall S
Higham C J
Karslake K W
Portass G
Rahman A E
Wiatr A G

University of the West of England, Bristol

Broad M
Cloke M
Dalton H M
Fox R B
Goodfield W S
Griffiths T C
Griffiths T J
Leakey A W
Mitchell C E
Tofts J
Williams G B

Colchester Institute

Burrell K
Clarke T J
Cox L W
James S
Little L
Ninham S
Watson N
Wotton M D

University of Derby

Bennette S C W R
Brittan A J
Buck A
Dolman L A
Grainger F M
Hudson B M
Lathbury E
Ozimek J
Park G J
Puri V
Woodfine C L

Leeds Metropolitan University

Millard D

Liverpool University

Blaine T
Bryan C
Cockerton P A
Foster W L
Garvie C M
Gibbs G M
Goward N P
Hancock C
Herbert P
Kemp B R
Logie A
Meehan L
O'Brien P

NESCOT

Bhopalsingh M J
Brown R
Forbes N C
Mohammed N
Patel K P
Powell H
Robinson A W
Veerasamy R R

EEF Sheffield

Barker M
Burke C A
Burnet K
Crampton S
Darwent C
Giles J M
Waddell S D P

Instrumentation corner

Martin Armstrong, Alcor S&V

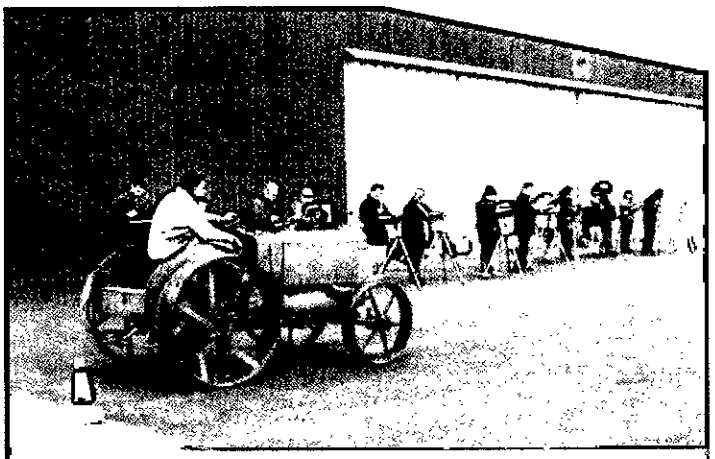
This is the start of something new, and for want of a better title, the Measurement and Instrumentation group has named it Instrumentation Corner. It will be the first in a series of a regular column from the Measurement and Instrumentation group. Each member of the committee will select a topic for the column to give hints and tips about anything relevant to practical measurement work in sound and vibration.

It should prove to be an interesting series as the M&I group committee members, between them, cover a wide range of expertise, not only in the fields of acoustics and vibration, but also in instrumentation and measurement in general, although we do not stray too far from the core aspects of the Institute.

So where to start? At the beginning is often the best, so here goes. The Institute of Acoustics was formed in 1974 by the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society. Full information about the IOA can be found on the Institute web site. It was a further 21 years before the Measurement and Instrumentation group was inaugurated. This gap seems a little surprising given the importance of instrumentation and good measurement practice within the other specialist groups. Right from the start the new group set a goal (which has remained) of education for users in making accurate measurements, using precision instrumentation, calibration and traceability to standards with best measurement practice always at the forefront. The mission statement for the group can be found on the M&I web page.

Over the past 13 years the group has organised one-day and two-day meetings on subjects including noise mapping and long term monitoring, sound power and intensity, human response to vibration, legislation, and speech intelligibility. These meetings have been held at a range of venues such as a Space Centre, amongst motorcycles and cars, and at a palace, as well as the more usual hotels and universities. The picture shows a number of delegates measuring the noise outdoors at the Shuttleworth Collection, from a range of sources such as this tractor from about 1940.

Looking forward to 2009, the year will see the publication of two quite interesting but completely different documents from Europe. One is the new Machinery Directive, which includes noise levels and vibration values covering safety. The other deals with ride comfort for railway passengers. Understanding and implementing standards, and the legislations that require compliance, are important to health and safety as well as the quality of life.



Agricultural machinery noise was not limited in the 1940s

The Machinery Directive has been recast from the earlier Directive and will come into force on 29 December 2009. It is a wide ranging Directive covering all aspects of risk assessment to ensure the health and safety of persons, in particular workers and consumers, by inherently safe design and construction of machinery. The adaptation of nearly 600 harmonised standards has been necessary.

Noise and vibration are but a small part of this comprehensive Directive but they are of great importance to the members of the IOA. The changes to the reporting of the noise and vibration emissions are that the uncertainty of measurement must now be given by the manufacturer. The changes in this Machinery Directive reflect the link to the Physical Agents (Vibration) Directive and have necessitated the ongoing revision of standards for testing hand-held, hand-guided and mobile machinery.

Sometime in spring (or summer) 2009, a long awaited revision of standard EN 12299 *Railway applications - Ride comfort for passengers* will be published. This standard should help in assessing the quality of travel for many passengers using guided transport. The comfort index NMV, from very comfortable to very uncomfortable, extends from below 1.5ms^{-2} to above 4.5ms^{-2}. It requires a complex calculation but should help guided transport systems improve their ride.

Look out for more hints and tips from the Measurement and Instrumentation group in future issues of *Acoustics Bulletin*.

IOA certificate pass list

Certificate Name: Certificate of Competence in the Assessment of Hand-arm Vibration
Exam Date: 17 October 2008

Institute of Naval Medicine

Shawcross K R

EEF Northern

Armstrong M A
Kimmins J
Robinson J T
Stoker G M

IOA certificate pass list

Certificate Name: Certificate of competence in Workplace Noise Risk Assessment
Exam Date: 7 November 2008

University of Derby

Ackerley T J
Cave S F
Davies S R
Dolphin C F
Fildes D
Ince C A
McGill J
Murray H A
Parkes T J
Tinsley R

Rapid Results College

Nesbit J E
Probert N D H

Shorcontrol Safety Ltd

Burke J
Conway T
Dixon S
Donovan M
Lynch J
Lynch P M
O'Hanlon M
Thomas C

EEF East Midlands & Mid Anglia

Breach N C
Culled H E
Ford J
Marshall L M
Scott C A
Varley N
Wilkinson G J

EEF Sheffield

Clyne C S
Coombes N
Huntsman S
Robinson J T

Conference report

Alan Mornington-West. Reproduced Sound 24

So you missed the Reproduced Sound Conference number 24? Well, you had better make sure you come to the jubilee event that will be RS25 at the end of November 2009. Here is what you missed at this year's event.

The Institute's Electroacoustics Group committee organises the Reproduced Sound (RS) conferences. This year they were blessed with more suitable papers on the overall theme of Immersive Sound than there was space in the time table. We had some excellent poster presentations as well, which we hope will mature into full papers at RS25. Overall some 128 delegates registered, including 24 students - an encouraging number - perhaps resulting from the very special conference price offered to students.

As is usual for RS, the proceedings started on the evening before the main conference with a tutorial question-and-answer session on the general topics of rooms, loudspeakers, intelligibility and practice. This was very well attended by over 60 eager participants, keen to test the expert minds of Trevor Cox, Keith Holland, Paul Malpas and Mark Bailey.

On Thursday 20 November, the formal conference was officially opened by Sam Wise, chairman of the committee, who then called on the President of the IOA, John Hinton OBE, to present the Peter Barnett Memorial Award to Dr David Griesinger. This done, Mark Bailey, the session chairman, invited David to present the Peter Barnett memorial paper - the first of the conference's 24 papers. David, who has had an impressive career within the industry, talked through the conflicts which arise when balancing reverberation ratio and its role in the perception of localisation, clarity and the sense of audience envelopment of the sound. Some elegant demonstrations using a JBL 5.1 system were used to highlight the issues he brought to the fore. Following on, Phil Newell talked about the effect that visual stimulus, such as the monitoring in video editing suites, has on the perception of loudness and equalisation, and Jamie Angus discussed the effects which diffusers have on low frequency room modes.

In the intervening coffee break delegates could quiz the presenters on various aspects of the papers, or talk to any of the seven companies who had taken up exhibition space at the conference. Paul Malpas introduced the next session and its speakers, Roger Schwenke, Michael Whitcroft and Ambrose Thompson to talk respectively about aspects of electroacoustic architecture, a modelling method for optimising the placement of room surfaces, and some results of work carried out on optimising the use of high power loudspeaker line array systems.

Following lunch Julian Wright chaired the session on loudspeaker and microphone technologies and introduced papers from Tom Black, David Carugo and Lara Harris. Tom Black works with Alcons who specialise in high-power ribbon transducers. David Carugo took us through a wide range of options in which standard microphones could be used in a variety of combinations with a view to optimising the ease of obtaining a stereo mix as well as a surround sound mix with minimal extra processing. Lara Harris talked about the work being carried out to evaluate loudspeaker reproduction at low frequencies using a modulation transfer function technique.

Up next was the topic of modelling, a session chaired by Bob Walker, in which Patrick Macey, Kelvin Griffiths and Mark Dodd presented excellent papers on modelling, accuracy and the insights which techniques such as finite element analysis reveal. For those keen on the mathematics these were the papers to concentrate on and, on a lighter note, the conference went on to enjoy the after-dinner presentation. Matt Trevor talked through the use of Nintendo game remote controls for controlling sound and video composition and effects in real time. This included manipulating the virtual position of the sound within a multi-speaker environment - the essence of immersive sound.

The RS conferences provide one of the best opportunities for

The cellar at the Old Ship Hotel hosts the pre-conference tutorial session

EA Group Chairman Sam Wise introduces the conference

David Griesinger receives the Peter Barnett award for his lifetime contribution to the science of reproduced sound

Recent graduate Matt Trevor delivers the workshop "Wii are the music makers", entrancing delegates with his demonstration of interactive sound and vision control using Nintendo games controllers

networking and chewing over audio technicalities in the industry, and RS24 was no exception. The bar was still active, despite the attempt by the orchestrations of the conference's own musicians to distract them at well past one in the morning. It is with great pleasure that I can report that the first presentation of Friday's first session (chaired by Sam Wise) was fully attended. Professor Phil Nelson talked through the topic of multi-channel sound reproduction and projects at ISVR. This was a presentation whose detail and content truly warranted careful study in a peaceful environment. Bruce Wiggins continued the thread of mathematical analysis with an insightful discussion as to whether ambisonics had come of age. Auralisation carries with it the need to calibrate the levels used, as Alistair Meachin discussed.

Helen Goddard was not able to come to the conference and our regular Australian attendee, Glenn Leembruggen, stepped in to chair the session on intelligibility with papers from Peter Mapp, Evert Start and Thomas Steinbrecher. Peter Mapp described some of the shortfalls and conflicts involved in establishing the potential intelligibility of hearing aid loop systems. Evert Start discussed the speech intelligibility in multi-source environments and demonstrated a unique delay optimisation technique based on psychoacoustic principles. Thomas Steinbrecher then presented an excellent paper challenging the use of the speech intelligibility index in applications where time delays and frequency response errors play a part.

Allen Mornington-West chaired the afternoon session on time and frequency measurement, and introduced Bob Walker to talk about some of the problems found with very early reflections and stereo localisation in mobile sound control rooms. Julian Romero discussed three-dimensional room impulse response measurements in the context of critical listening spaces. John Shelton took the conference through a comparison of popular transforms and their mathematical representations which are encountered in the analysis of time and frequency.

The final session, chaired by Simon Jackson, started with Russell Mason's paper on the impact of head movements in measuring spatial attributes. This was followed by a quite different style of paper, which looked at the topic of creating sound using waveholes and microsounds - you need to read the paper and to have listened to the audio clips, so yes, you should have been there. Steve Jones questioned some prevailing views about the amount of electrical power really needed to achieve sound pressure levels in practical situations and suggested that considerable savings could be achieved, giving a 'green bonus'.

So, finally off to dinner, and a talk afterwards on the issues of making real time measurements both in theory and practice with Wolfgang Ahnert, Peter Mapp and Mark Bailey. Then there was a final opportunity for serious networking at the bar, and some more music, and this was again a late night for many at the end of a very successful and much appreciated conference.

Many words of thanks are due but they must first go to Kevin Macan-Lind's guiding hand, together with hard work from Linda Canty who superbly managed the event and the registrations, and Judy Edrich for her promotion and publicity that resulted in a successful level of attendance.

The Merits of Acoustic Particle Velocity as a Measurable Quantity

Alex Koers.

Introduction

Whilst sound pressure transducers have been widely applied for many years and are well understood, the benefits of measuring the acoustic particle velocity directly increase year on year. Ten years after its inception, Microflown Technologies from the Netherlands has begun trading in the UK.

In the summer of 2008, Ricardo UK's power-train noise, vibration and harshness (NVH) department decided to procure a large array of PU mini sound intensity probes to improve their acoustical testing methods for engine run-ups.

The Arnhem based company will be presenting papers and exhibiting at three international congresses in the UK in the next twelve months, allowing British acousticians to see some state-of-the art measurement technology from their neighbours across the North Sea.

This overview of the history of the Microflown acoustic particle velocity sensor and its applications is intended to help the reader to familiarise himself with current technology. Apart from novel testing methods for the automotive and aerospace industries, applications for building acoustics, environmental acoustics and the defence and security industries will be discussed.

Microflown's working principle

The Microflown sensor is a good example of what microelectromechanical systems (MEMS) technology can contribute to today's world. Two extremely thin platinum wires are placed on a silicon substrate and heated up to about 300°C. If airflow occurs around these wires, heat transfer will take place, cooling the upstream wire. As the air picks up some heat, the downstream wire will be cooled just a little less. The temperature difference in the cross-section of the two wires causes a change in the electrical resistance of the system. The voltage output signal turns out to be a direct measure for the acoustic particle velocity signal. The frequency response is linear and has three corner frequencies in the audio range that can be compensated either by software settings or electronically. Thus, finally, acoustic particle velocity has become a directly measurable quantity.

Remarkably enough, whereas volts and amperes have been measurable quantities in the electrical domain for hundreds of years, the absence of a means to measure acoustic particle velocity as the acoustic equivalent of amperes was overcome by computing the particle velocity from the pressure gradient. It is only in hindsight that the number of assumptions previously made and their practical validity have become clear.

Anyway, the ability to measure both of the physical quantities that describe a three-dimensional sound field allows novel approaches in acoustic testing to be explored.

Product lines

Essentially, there are only three product lines that come in various configurations and numbers of probes. The scanning probe holds just a Microflown sensor element which can be customised in its orientation to the longitudinal axis of the probe. Its frequency range is from 0.1Hz to 150kHz, with the signal noise levels varying throughout the range, being the subject of further research and development work.

The so-called PU probe measures both sound pressure and acoustic particle velocity at one single point. The smallest version has the size of a match, and both 'half-inch' versions (regular and mini) have a protective cap that becomes obtrusive at around 10kHz, while causing a packaging gain of around 10dB as compared with the 'match' version.

The so-called USP probe comes in three versions, all of which consist of three orthogonally-placed Microflown sensors and a sound pressure transducer, allowing the measurement of the entire 3-D sound field in one single spot. It should be noted that this is a fully-assembled probe.

A completely monolithic 3-D sound chip was introduced as recently as October 2008 as a less intrusive alternative to assembled USP versions. The sound pressure transducer has been replaced by a device based on a Microflown sensor element that is made sound pressure sensitive by its packaging.

Figure 0

'Scan and listen' device makes acoustic particle velocity audible

Human beings are equipped with two sound pressure transducers in their heads, with their brains being programmed to use the signals captured to interpret sound fields: this makes the use of sound pressure transducers an intuitive matter. However, the number of applications based on the 'unheard' acoustic particle velocity signals is increasing rapidly. A number of these advances in the world of sound and vibration are described below.

Non contact measurement of vibration

Although accelerometers have been around for several decades, it was only recently that scanning laser vibrometers were introduced as a non-contact method of measuring structural vibration. Obviously, unlike accelerometers, scanning lasers do not cause a mass load. They can scan a surface quickly but sequentially. A line of sight is required and, moreover, not every vibration is necessarily causing sound in the far field.

Microflown based probes offer a third alternative. Close to a vibrating surface, in the normal direction, the acoustic particle velocity equals the structural velocity owing to the 'glue' condition. This allows the vibrations to be measured in another non-contact manner. If the sound pressure signal is picked up simultaneously, both the vibration levels and sound radiation levels can be measured at the same time in one single spot. A larger number of probes allow stationary test cases to be evaluated.

End-of-line acoustic testing in the presence of background noise

An industry trend is increasingly towards testing of 100% of parts and products, preferably carried out in the manufacturing line itself. As far as sound and vibration is concerned, the range of relevant transducers includes accelerometers, scanning lasers and sound pressure microphones. For vibration measurement, the Microflown sensor offers a more compact alternative to a non-contact scanning laser. Whereas sound pressure transducers are susceptible to background noise from the factory environment, acoustic particle velocity sensors are not. As a result, acoustic end-of-line testing without an anechoic room becomes feasible.

Three factors contribute to the competitive advantage of particle velocity compared with sound pressure under these specific conditions. Firstly, if background noise hits the surface of the test object, the corresponding sound pressure doubles, and the corresponding particle velocity level goes to zero. Secondly, the vibrations of the test object itself create particle velocity signals that only gradually turn into sound pressure, as the sound waves propagate away from the surface. Therefore it seems logical to pick up the particle velocity signal. Thirdly, whereas particle velocity is a directional quantity, sound pressure is omnidirectional, and thus includes much background noise. All three effects taken together can lead to a difference of up 40dB.

'Scan and listen', making acoustic particle velocity audible

For quick troubleshooting, the acoustic particle velocity signal can be made

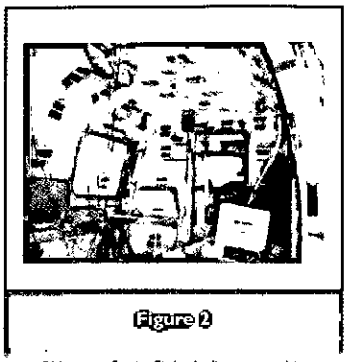


Figure 2

PU array for in-flight helicopter cabin interior transfer path analysis

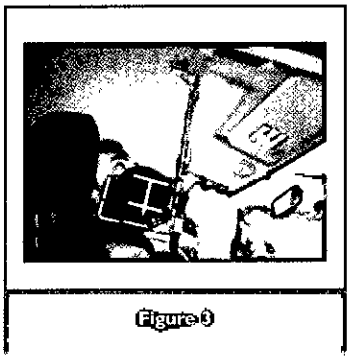


Figure 3

In-situ impedance measurement on car interior top liner

audible using some electronics. It allows engineers to 'listen to' noise sources. Obviously, vibrating modes can also be made audible, just as the well-known sand test would make them visible (although on a horizontal plane only). This quick troubleshooting tool is useful for the analysis of transients such as squeak and rattle.

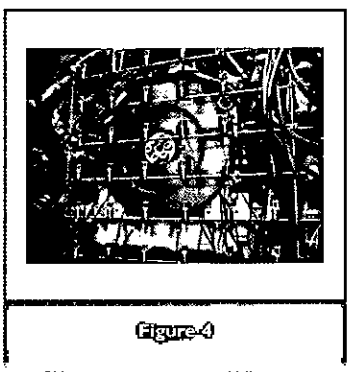


Figure 4

PU mini array measuring Volkswagen Touareg engine run-up

In-situ determination of acoustic impedance

Compared with the widely used Kundt's tube method, the PU surface impedance method is not only non-destructive, but also permits the analysis of sound waves reaching the subject surface at oblique angles. Moreover, a high spatial resolution can be achieved, down to a few square millimetres. By measuring both acoustic particle velocity and sound pressure at the surface, using a loudspeaker as a well-defined sound source, a free field testing method becomes available that is novel and easy to use. The method was developed and proven by Lauriks (University of Leuven, Belgium) and others, and published in the Journal of the Acoustical Society of America in 2005.

The method allows the characterisation of the acoustical properties of materials not only as manufactured, but also as installed, eg in a car, or in a church or theatre. As the method is non destructive, each individual sheet of acoustic damping material can be tested straight after manufacturing or immediately before use. For some categories of materials, the PU surface impedance method might also be more reliable than the Kundt's tube method. It is not widely realised, for example, that the clamping of samples as required in Kundt's tube measurements might influence the measured absorption properties.

As the PU surface impedance method can also be applied with a relative movement between sensor head and testing object, quality control applications emerge for continuous types of measurements on the production line. With a fixed position of the sensor head, acoustical materials manufactured in a continuous process can be tested whilst they are still in motion. Similarly, the mechanical properties of road surfaces can be evaluated from the acoustic properties measured with a sensor head mounted on a moving vehicle.

Topics of current research and further development include the low-frequency behaviour of the method, ie below about 300Hz, and the measurement in the presence of a grazing flow, such as would occur around jet engine liners.

Sound intensity and sound power measurements

Traditionally, sound intensity measurements are based on the use of a pair of phase-matched sound pressure transducers in a so-called PP probe. The practical upper frequency limit is about 6.3 kHz. Different spacers need to be used for measurements in different frequency ranges.

With the PU probes, sound intensity can be measured using two different acoustic signals. As the PU probes are much smaller, sound intensity measurements on small objects or in cavities also become feasible. No spacers are required, and the bandwidth exceeds 20 kHz. A comparison between the two methods of sound intensity measurement was published in a JASA paper by Jacobson (DTU, Denmark) in 2006. It confirmed the methods to be comparable in many cases, but the difference between the two methods under certain conditions was very obvious.

PP probes are susceptible to the pressure/ residual intensity index. This problem can be countered by measuring under anechoic conditions. Conversely, PU probes are susceptible to highly reactive fields. This can be overcome by moving the probe a little further away from the test object, which is a less costly way of solving the problem.

The JASA paper also confirmed that the proper calibration of the PU probe was of importance. Since it was written, a sphere calibrator has been developed which uses a loudspeaker to create a well-defined sound field.

As free field conditions are no longer required for sound power measurements using a method based on sound intensity, a revision of the ISO sound power standards using sound intensity measurements is in progress. These standards refer to IEC 61043, which prescribes a sound intensity measuring device based on a pair of sound pressure transducers.

Fast vehicle cabin interior transfer path analysis

The intrinsic features of PU probes have provided a boost to the optimisation of the acoustic treatments applied to reduce cabin interior noise levels in cars and other vehicles. PU probes offer a single-transducer solution for the entire transfer path analysis setup in three ways:

- for low-frequency problems, the acoustic particle velocity signal is measured, rather than being approximated by structural velocity measurements as in the past;
- for mid-frequency and high-frequency applications, sound intensity is measured in a way that is not susceptible to the pressure/residual intensity index that hampers measurements based upon a pair of phase-matched sound pressure transducers;
- in order to determine the transfer paths in a reciprocal way, the pressure signal of a PU probe measures the impact of volume velocity sources

Where volume velocity sources were dependant on a sound pressure transducer in the past, acoustic particle velocity controlled sound sources have become available as well.

A complete car can now be tested in a few days. Measuring cabin interior noise while driving has also become a practical option, and this technique can provide valuable information on wind, engine and tyre noise that complements the test results from wind tunnels, semi-anechoic rooms and chassis dynamometers. The first few customers using such techniques were Head Acoustics and BMW (both Germany) and Faurecia/Peugeot Citroen (France). In the summer of 2008, in-flight tests were carried out for the first time in a helicopter, when PZL Swidnik (Poland) tested 15 flying conditions.

Current development is based on the use of larger channel count arrays for testing business jets, commercial passenger aircraft, and submarines, using digital and wireless technologies.

continued on page 34

The Merits of Acoustic Particle... - *continued from page 33*

Breakdown analysis of overall sound pressure level

The reciprocal transfer path analysis method used with PU probes has been used to develop a means of helping engineers break down the overall sound pressure level of products into their various causes. The method was developed for Visteon, a manufacturer of HVAC systems to the automotive industry, in Kerpen near Cologne (Germany).

In industry, it often occurs that the only prescribed product acceptance limit is an overall sound pressure level. If this target is not met, engineers require insight into the various sources contributing to the overall sound pressure noise level. For that purpose, the velocity radiation levels can be measured at a large number of points and multiplied with their relevant transfer paths to the position of the measurement microphone.

Direct acoustic near field camera

Until recently, shear sound pressure-based holographic methods were used to compute both the sound pressure and acoustic particle velocity levels at certain positions at the surface of a test object. Such computations are no longer required. An array of PU probes allows the real-time visualisation of the measured values of sound pressure and acoustic particle velocity. Sound intensity and acoustic impedance values are simply obtained from these. By varying the density of the measurement nodes in a reconfigurable grid constructed from metal wires, the resolution of the array can be customised to a particular measurement setup. A fixed grid such as that found with a hand-held camera version can be used as a quick troubleshooting tool for finding acoustical 'hot spots'. The camera also allows the analysis of incoherent sources and transients such as door slams.

Even under ideal conditions (such as an anechoic room, a semi-infinite flat surface) the reconstruction of acoustic particle velocity (a vector value with a high dynamic range) from sound pressure (a scalar value with a low dynamic range) led to errors of up to 30dB as reported by Jacobson (DTU Denmark) in a JASA paper in 2005.

As PU probes are not susceptible to the pressure/residual intensity index, engine run-ups can be carried out in non-anechoic environments, confirming the first tests made in 2005 at the Otto von Guericke University, Magdeburg (Germany) on a VW Touareg engine.

Acoustic far field measurements using 3-D vector sensors

Acoustic far field measurements are based on sound pressure transducers only. Positioned in an array at a certain distance, time delay measurements are used to compute sound sources at an object in the acoustic far field. This beam forming method, as it is called, is widely used, but there are some limitations. The system is not sensitive to the lower frequencies, as it would require huge (and thus impractical) distances between individual sound pressure transducers. The dynamic range is limited, and all sources are projected on the surface of the object itself. This is not always a true representation, especially for flow-induced noise sources. Beam forming has line or plane symmetry, and in order to obtain correct data, all measurement points have to be collected and processed first.

Vector sensors are already used for beam forming in other parts of the frequency range, eg for radar or cellular applications. In the acoustical frequency range, the first tests were carried out in the summer of 2006. Now, two years later, there is ample evidence that acoustic vector sensors have significant merits. Depending on the classification of the acoustical problem, several acoustic vector sensor strategies can be implemented.

The origin of a transient gunshot can be localised using a pair of 3-D sound intensity probes to triangulate the sound source. Early measurements have proved that the range of the method exceeds 1000 metres in an open field, using a 9mm handgun as the source.

The geometric position of a single flying helicopter, considered as a single sound source with a strong tonal component, can also be triangulated with a pair of 3-D sound intensity probes. Alternatively, the helicopter's location can be determined using a single 3-D acoustic vector sensor, from the vector information, the Doppler effect and the r-2 law. Effectively, the 3-D sound probes or sound chips act like passive radars that can not be detected by the opponent.

Figure 5

Two 3-D sound probes triangulating helicopter trajectory at Oosterbeek

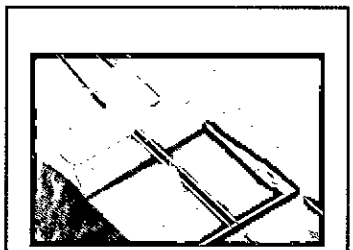


Figure 6

SEM picture Microflown sensor with two heated platinum wires

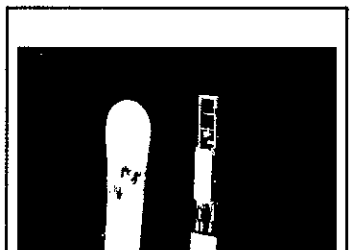


Figure 7

Completely integrated 3-D sound chip

Further research is under way on how to separate more sound sources in a three-dimensional space, applying the well-known MUSIC beam forming algorithm to vector sensors. The robustness of the system and its accuracy are being investigated.

Acoustic energy as a control parameter for active noise control

Research on active noise control seems to suggest that acoustic energy is a better overall control parameter in active strategies than sound pressure, which happens to be a local quantity. Thus, sound pressure measurements might be prone to placement errors. As the USP sound probe or sound chip picks up both the sound pressure scalar value and the velocity vector value, the acoustic energy can easily be computed. Some initial work has been completed by Brigham Young University, Provo, Utah (USA). Further development work is required to assess the full implications of changing the error sensor quantity, eg for adaptive liners.

Congresses in the UK

In December 2008, Microflown Technologies attended SAPEM 2008 in Bradford, and in April 2009, the NOVEM congress in Oxford is scheduled. The company will be represented at Euronoise 2009 in Edinburgh (www.euronoise2009.org.uk), and at the second CEAS European Air and Space Conference, Manchester (www.ceas2009.org), both in October 2009.

The inventor

The Microflown sensor was invented by Hans-Elias de Bree at the MESA+ Institute of the University of Twente, Enschede (Netherlands) in 1994. After completing his PhD on his own invention in 1997, Hans-Elias de Bree co-founded Microflown Technologies in 1998, and currently holds the position of director of research and development. In 2006 he was appointed professor at the School of Automotive Engineering at HAN University, Arnhem, where he teaches vehicle acoustics.

Alex Koers is a director of Microflown Technologies, Arnhem, Netherlands, tel: **+31 316 581490**, E mail: **koers@microflown.com**

Artists and Scientists Working Together

Marianne Greated and Clive Greated.

Introduction

This article describes the experiences of a visual artist and acoustician working together in the field of public engagement. Public engagement is playing an increasingly important role in the work of both artists and scientists, especially those engaged in research, and indeed many grant awarding bodies now see this as an essential element of any research programme. Our experiences mainly relate to two public engagement exhibitions, *Sound* and *Coast*, funded by EPSRC as part of their public engagement programme and on which we have both had a major involvement.

The title of this article may in itself be contradictory as it is only in relatively recent years that the more traditional field of scholarship has been separated into discrete art and science compartments, into which scholars have now been segregated. University departments such as Natural Philosophy have been changed into Physics departments (Edinburgh University did this at late as the early 1970s) and the breadth of disciplines covered has been narrowed. Similarly, schools of art have been subdivided into fine art, design and architecture. Scholars in early times usually took a wider perspective. The ancient Greek scholar Pythagoras (560-480 BCE), for example, related the 'golden section' (the ratio of the slant height to the distance from the centre to the edge in a pyramid) to the proportions of the human figure. More directly in the field of acoustics he studied which notes sounded pleasantly together, using what we now call a monochord, and worked out the frequency ratios of the string lengths, thus discovering the principles of harmonics: much later this led on to Fourier analysis. Leonardo da Vinci (1452 - 1519) is probably the most notable example or a rounded scholar. In modern terms we would probably have to classify him as a combination of artist, scientist and engineer.

Although universities have gone down the route of separating academics and students into narrow compartments, in fact this is not really embedded into their charters. At Edinburgh University, for example, the stated mission is to 'provide an outstanding education environment, supporting study across a broad range of academic disciplines and serving the major professions' and to 'enhance the scientific and cultural vision of society as well as its economic wellbeing'. In educating science students it is becoming increasingly accepted that the creative element is important, in addition to problem solving. As an example, group projects have recently been introduced into the fourth year physics course at The University of Edinburgh. In one of these, the students opted to perform Michael Frayn's play *Copenhagen* which represents a fictional account of a mysterious meeting which took place in 1941 between two of the greatest physicists of the twentieth century: the German, Werner Heisenberg and the Dane, Niels Bohr. In the current academic year a group is studying noise in the environment and its impact on the community.

Similarities Between Sonic and Visual Imagery

Flicking through the pages of *The Musician's Guide to Acoustics* [1] and other books on acoustics one can not help but notice the similarities between sound and vision, and these are frequently used as a vehicle for integrating projects which have an artistic element. There are also fundamental differences, of course, which are equally important.

The most obvious similarity is that both sound and light can be represented as waves with a given spectral distribution of frequencies and wavelengths. The term 'rainbow of sound' conjures up a visual picture of how sound frequencies are

continued on page 36

Artists and Scientists Working Together - *continued from page 35*

distributed over the spectrum. Also the spectrogram is often used to give a moving picture of a changing sound spectrum. This has been used on a number of occasions in the SOUND exhibition as an interactive exhibit. Audible sound waves have a very broad range of frequencies from about 20Hz to 20kHz - almost 10 octaves - whereas visible light waves only cover a range of approximately 4×10^{-14} to 7×10^{-14} Hz, a ratio of less than two (an octave) between the lowest and the highest. One of the audience at our recent *cafe scientifique* presentation in Stockport asked what would happen if the visible spectrum were as wide as the sound spectrum: would we then generate visible harmonics?

Another interesting analogy is in the way in which we construct images in three dimensions. Human beings have two eyes and two ears separated by not-too-different distances in the horizontal plane. Slight differences in the images formed by the two eyes give us stereoscopic vision and allow us to estimate the distance of different objects in our visual landscape. In a similar way, if we close our eyes we hear the direction from which different sounds are coming, *eg* whether someone speaking to us is to our left or right side. We cannot take the analogy too far, or course, because our ears use quite different mechanisms from our eyes when estimating distance. This was discovered by Lord Rayleigh (1842 - 1919) who produced his 'duplex' theory to show how the brain used both time difference and sound level difference to obtain directional clues. More recent studies, using for example head-related transfer functions, have extended Rayleigh's early ideas to give us a very full understanding of how the brain interprets the sonic landscape. Auditory spatial awareness has been the subject of many recent texts, *eg Space speaks, are you listening.*[2]

If we look further into the question we find that there are many more analogies between sound and vision. For example the question of how sounds are masked by others of different frequency is quite closely related to the visual counterpart of different colours being in close proximity. Even the quantum nature of light has an analogy in very low pressure acoustics.

Sound Exhibition

Increased levels of sound in the environment seem to be one of the inevitable consequences of technological advances, and change our milieu in diverse ways. The problem is particularly pertinent in large industrial cities and is seen as a major problem for the emerging economies of the east which are undergoing such rapid industrial development. *Sound* is an exhibition of two-dimensional art works and installations inspired by some of the often conflicting issues that arise, and the research that is going on to try to combat them. To give but one example, renewable energy sources are seen as a way of reducing carbon emissions into the atmosphere but opponents to wind turbines cite the noise they produce as being a problem and often oppose the construction of wind farms on these grounds. More generally, though, the exhibition seeks to question the barriers sometimes set up to delineate art from science.

The first thing to say about the contents of the exhibition is that it is continually evolving but in essence it is made up of a number of paintings set in a soundscape. It opened in a fairly small way in the Scottish Parliament in 2006 and was expanded to show at the larger Dynamic Earth venue in Edinburgh. From there it went the Glasgow Science Centre, the London Metropolitan University, the Centre for Contemporary Arts in Glasgow and the Waterfront Gallery in Belfast (under the name *Louder Now*). The wide range of venues reflects the fact that we want to display in public spaces where the material will be seen by a broad cross section of the general public.

The soundscapes for the exhibition are in the form of what might be termed *musique concrète*, which is a type of sound collage made up of sound files recorded from the real world and sometimes manipulated acoustically. Examples of recorded sounds are traffic noise, aeroplanes, underground trains, motorcycles and factories. Generally speaking we have recorded these monophonically and used either the Protools or Cubase editing program to generate surround sound in something resembling 5.1 configuration. In a few cases the constraints of the venue have meant that we have had to work in stereo, and on one occasions the visitors listened to the sound through earphones.

Coast Exhibition

The Coast exhibition has been running for longer that *Sound* and relates to the problems of pollution and erosion around the Scottish coastline. For the last year it has been showing in Denmark, at the Natural History Museum in

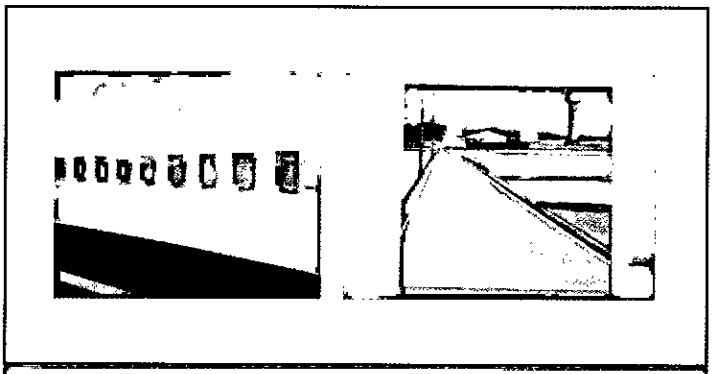


Figure 1

Paintings from the Waterfront exhibition in Belfast.

Figure 2

Left: the underground gallery
Right: a sequence of rising bubbles in water used in the soundscape

Figure 3

Left: the reverberation room
Right: the Floating Gallery at the Falkirk Wheel.

Aarhus, the North Sea Centre in Hirtshals and Denmark's Aquarium in Copenhagen. Before that it showed at a number of venues in the UK and also at the National Bank Cultural Centre Thessaloniki and the Goulandris Centre in Athens. Like the *Sound* exhibition it has attracted very large numbers of visitors.

The introduction of a soundscape into the Coast exhibition is a relatively recent innovation. On the grounds that the coastal environment is important for wildlife in the sea as well as well as humans, a number of the component sounds were recorded underwater with a hydrophone. An example is the sound from a rising bubble under water, shown in Figure 2. Small bubbles in water have a natural frequency of vibration which give rise to pitched sounds with frequency dependent on bubble size. Fish sounds were obtained by courtesy of the Marine Laboratories in Aberdeen.

The first venue where a soundscape was tried was the North Sea Centre in

Hirtshals in northern Denmark. Here the gallery is in the basement and the walls on one side are actually the glass walls at the bottom of their large aquarium, one of the largest in Europe. The paintings were displayed on the other walls and illuminated so that they showed prominently in the rather dim light. Entering into the gallery down a staircase gave a very atmospheric effect and highlighted the relationship between the environments above and below the waves. Some idea of this is given by the pictures in Figure 2.

Synergy

Working as an artist and scientist together has been an opportunity to create exhibitions that are distinctive and engaging for the general public. From the point of view of the artist, scientific and technological innovations offer new possibilities for artistic expression whilst for the scientist the artistic element opens up a whole new arena for exploration. A feature of the two exhibitions discussed here is that they are both concerned with the environment where there are conflicting views relating to health, preservation, economics and visual beauty. Some of these are more relevant to the scientist and others to the artist but working in combination the two can create synergy.

Future Ideas and Venues

The fact that the exhibitions are continually evolving is crucial to their continued existence. At each showing of an exhibition it is important for the artist to come up with new ideas in order to maintain the interest of the visitors and the press as well as the creators.

The next showing of *Sound* will be at the national Physical Laboratory in Teddington where paintings will be displayed in their anechoic and reverberation rooms together with soundscapes. In order to try out the idea a pilot exhibition was set up in the School of Physics at Edinburgh University and shown to an invited audience. Visitors to the exhibition first entered the reverberation room, shown in Figure 3. Here the soundscape was made up of a more-or-less continuous sequence of sounds which came at the listener from all directions. A single painting surrounded the whole room so the visitor was entirely surrounded by sounds and visual images. From the reverberation room you went directly into the anechoic room where the sound level was contrastingly low. The soundscape here was made up from discrete and widely separated sounds which appeared to come from prescribed directions, in between the sections of complete silence. Here small paintings were spaced at intervals round the room. Visitors found the experience quite dramatic and in some cases disturbing

One other venue where the exhibition has shown recently was in the Floating Gallery at the Falkirk Wheel. The Falkirk Wheel is a major feat of modern engineering and attracts huge numbers of visitors. The Floating Gallery is in effect a barge moored near the entrance to the wheel. This gave the opportunity to further explore the use of a single surround image, as shown in Figure 3.

Marianne Greated works through the Glasgow School of Arts and Scottish Arts Council, **info@mariannegreated.com**
Clive Greated is in the School of Physics, University of Edinburgh, **c.a.greated@)ed.ac.uk**

This article is based on a presentation by the same authors at the IOA Spring Conference 2008, at the University of Reading.

References

1 Murray Campbell and Clive Greated *The Musician's Guide to Acoustics* Dent 1987

2 Barry Blesser and Lida-Ruth Salter *Space speaks, are you listening* MIT Press 2007

iPod listening levels on London Underground for music and speech

Phil Wash and Stephen Dance.

Introduction

The risk of recreational noise exposure such as amplified music played at concerts or in nightclubs has been well documented for over the last 40 years: however, noise exposure from other recreational sources such as that from personal stereos has been less documented. The advent of mp3 players such as Apple's iPod, with its long battery life and huge memory, has made 'music on the move' very popular with millions of people in the UK alone. Owing to the meteoric rise of the mp3 player, many recent stories in the press have discussed the increasing use of personal stereos, mainly focusing on the levels at which some people (particularly teenagers) listen to music and the possible health implications. It has been argued that the levels at which people listen to music is a personal choice and that in most cases the majority of people are responsible enough to know what is 'too loud'. However, what if the levels set by the user are strongly influenced by another variable such as background noise? The sight of commuters listening to music is a familiar scene on the London Underground, where background levels can sometimes be as high as inside a busy bar playing amplified music. If a commuter listens to an mp3 player whilst exposed to these levels of background noise, how high will the volume be set to overcome the background noise? More importantly, are these levels a cause for concern with regard to personal health? Bearing in mind that current (2005) UK Noise at Work Regulations set a maximum exposure limit of 87dB(A) averaged over an eight-hour working day, it seems plausible that these levels could be exceeded. If this is the case, it could be argued that a commuter listening to an mp3 player during the commute to and from work could be more at risk to hearing damage than a road worker using a pneumatic jack-hammer who, under law, uses appropriate hearing protection.

This investigation aimed to measure the output levels of an mp3 player used by 33 test subjects when exposed to a typical continuous background noise under controlled conditions. The output level was measured with and without a background noise present to enable a comparison to be made with regard to the effect background noise has on the user-defined output level.

Development of the mp3 player

Ever since the arrival of the Sony 'Walkman', articles have been written in audiology journals speculating about the possible damage caused by over-exposure to music which is being emitted in such close proximity to the ear. However, hearing damage is generally caused by exposure over time rather than a single event (unless the event is an extremely high level). Two of the main factors affecting the use of personal cassette and compact disc players were the lack of media available at any one time and the battery life, both controlling factors for the listening time. Mp3 players, however, are low-power devices which can store up to 40,000 songs and have a typical battery life of 40 hours. It could be argued, therefore, that because of the massive selection of songs (meaning short attention spans can be catered for) and long battery life, the noise exposure for the average user of a modern mp3 player could be much longer than that for a user of a personal cassette player. As of February 2006, Apple had reportedly sold 42 million iPods, this being the model often regarded as the industry standard mp3 player.

Review of noise levels from mp3

In February 2006 a lawsuit was filed against Apple Inc by John Kiel Patterson of Louisiana USA. Although it was not medically proven that the accuser suffered from hearing loss, the prosecution lawyer based the case on the claim that the mp3 player was 'not safe to use as currently sold' as it did not carry adequate warnings regarding the likelihood of hearing loss. The case will still sub judice at the time of writing. Many independent sources claim that devices such as the iPod are capable of producing levels of 115dB, but whether this is at a particular frequency or an overall L_{Aeq} is unknown. At present, France has legislation for all portable in-ear music devices to be limited to 100 dB(A).

Of course, not everybody will listen at the maximum volume, but there is a risk of the volume being increased by accident. To address this problem the latest iPod models contain a user-defined noise limiter built into the software, allowing the user to preset the maximum volume.

Listening factors from portable music players have been extensively researched: for a review of the literature see Wash[1]. To highlight two recent results: First, Fligor and Cox[2] found that setting a player to 70% of maximum gain resulted in an excessive noise dose within one hour. Secondly, a telephone survey undertaken by Deafness Research UK/BMRB, in which there were 1001 responses, found that 81% of young people aged between 16 and 34 listened to an iPod for at least 1 hour per day[3].

Experiment

People who listen to mp3 players during their commute to work are generally exposed to background noise from trains (underground and surface), buses, and road traffic (whilst walking). It was decided to measure and record the noise on an underground train during a typical commute. Noise levels were measured as 84dB $L_{Aeq,2min}$, with a highest single event of 96dB L_{AFmax}. The wave file of the underground train journey was used as the background noise in the following experiment.

Three sound 'tracks' were chosen for the experiment. These were two genres of music and one news podcast which consisted of speech only. The genres of music chosen were 'rock' and 'pop' as these were considered to have varying spectral content. Figure 1 shows the one-minute spectra as analysed for an iPod set to 85dB(A), measured through standard Apple in-ear earphones, using a Brüel & Kjær dummy head and torso connected to a Norsonics 121 analyser. Figure 2 shows the configuration.

Only 'pop' and 'speech' results are presented. Each 'track' was played through the in-ear earphones and the volume adjusted by the test subject until he or she was happy with the level. Then the Norsonic 121 noise analyser was activated to measure concurrently the noise levels via the dummy head. This was achieved using a signal splitter at the output jack of the mp3 player, meaning the stereo signal was being played through two sets of in-ear headphones. The noise levels were measured over a period of 20 seconds for each of the tracks. The process was then repeated with the calibrated background recording of the underground train played through the loudspeaker at 84dB(A) in the anechoic chamber. Of the 33 subjects, 66% were less than 40 years old, 21% were aged between 40 and 60, and 13% were over 60.

Measurement Results

Presented in Figures 3 and 4 are the measured listening levels for 33 subjects (left and right ear, logarithmic average) with and without background noise present. Also shown are the differences between the two measured levels for each test subject.

For pop music, the results show that **without** simulated background noise the lowest measured level was 60.3dB(A) and the highest was 90.2dB(A). The mean level was calculated as 76.9dB(A). For speech, without simulated background noise the lowest measured level was 46.1dB(A) and the highest 84.2dB(A). The mean level was 66.3dB(A).

For pop music, the results show that **with** simulated background

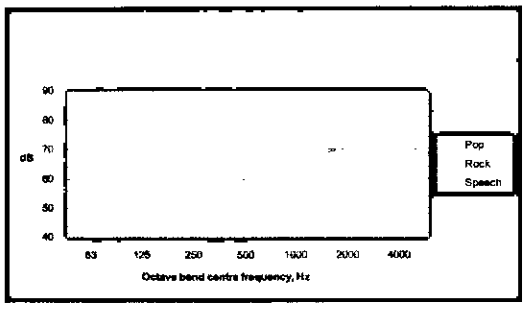


Figure 1

Comparison of measured octave band spectra for each output form iPod.

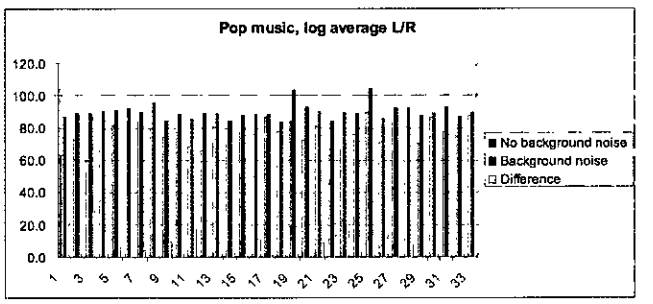


Figure 3

Measured $L_{Aeq,20sec}$ for each subject listening to pop music with and without background noise present.

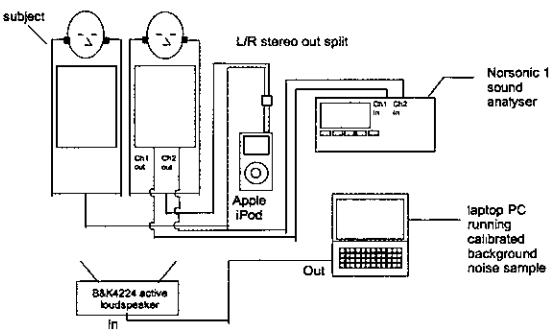


Figure 2

Block diagram of the apparatus setup.

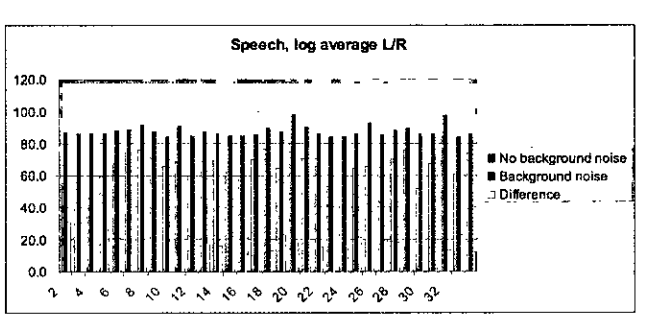


Figure 4

Measured $L_{Aeq,20sec}$ for each subject listening to the speech podcast with and without background noise present.

noise the lowest measured level was 84.3dB(A) and the highest was 104.5dB(A). The mean level was 90.2dB(A). For speech, with simulated background noise the lowest measured level was 84.6dB(A) and the highest 98.3dB(A). The mean level was 88dB(A).

For pop music, the lowest measured increase in level was 2dB and the highest was 29.1dB. The mean increase in level was calculated to be 13.3dB. For speech, the lowest measured increase in level was 11.8dB and the highest was 40.6dB. The mean increase in level was calculated as 21.6dB.

The results from the standard deviation calculation, shown in Table 1, show that the measured data vary more when there was no background noise present, compared with the cases where background noise was present. This could suggest that the advent of background noise forces the listener to adjust the volume setting to a level which is above the noise floor but also below the threshold of pain.

Noise Exposure

The Control of Noise at Work Regulations 2005 set action values for daily noise exposure and peak noise, both with and without hearing protection. The values are given in terms of $L_{EP,d}$, which describes the exposure over a typical working day (8 hours).

Output from iPod	Standard deviation		Standard deviation of difference
	Simulated background noise off	Simulated background noise on	
Pop	7.59	4.48	6.70
Speech	8.87	3.41	7.10

Table 1

Calculated standard deviations for the measure noise levels of 33 subjects

Specifically, this gives rise to the following:

Lower exposure action value $L_{EP,d}$ ie a daily personal noise exposure of 80dB(A)

Upper exposure action value $L_{EP,d}$ ie a daily personal noise exposure of 85dB(A)

In summary, an exposure level of 80dB $L_{EP,d}$ or over is considered to be detrimental to a person's hearing to the extent that the Health and Safety Executive recommends hearing protection. The results

continued on page 40

iPod listening levels... - *continued from page 39*

for each test subject are shown in Table 2. It should be noted that these exposures were calculated for just one hour of iPod use, as this was found through questionnaires to be typical for 21 to 30 year old subjects. As expected, the older age groups admitted to less exposure from their personal mp3 player eg 33 minutes for the group of 31 to 40 year olds.

Conclusions

Listening levels using in-ear earphones for one hour a day were acceptable when used in a quiet environment: only two subjects had dangerous levels of calculated noise exposure, and it occurred only when listening to rock music. Pop music was found to pose a limited risk, and speech posed no risk from noise exposure. However, when the environment changed to include underground train noise, 13 subjects (39%) had dangerous levels of noise exposure when listening to rock music. In addition, there was a considerable increase in the number of subjects with some risk from noise exposure for pop music (70%) and from the speech podcast (33%).

Further work will include audiometric tests of all those subjects with particularly high listening levels, to determine whether the level is merely a personal preference, or results from a higher level of hearing loss than other subjects. A follow-up survey using Bose active noise-canceling headphones is currently under way.

This article is based on a presentation at the 2008 Spring Conference. The paper was taken from a dissertation written as partial requirement of the Environmental and Architectural Acoustics course at London South Bank University.

Phil Wash is with Bickerdike Allen Partners, London.
Stephen Dance is with the Acoustics Group, FESBE, London South Bank University

Test subject	$L_{EP,d}$ dB for 1 hour of iPod exposure, simulated background noise off			$L_{EP,d}$ for 1 hour of iPod exposure, simulated background noise on		
	Pop	Rock	Speech	Pop	Rock	Speech
1	54	63	47	78	81	78
2	64	58	47	81	85	78
3	51	59	37	80	83	78
4	65	63	51	82	80	78
5	73	67	59	82	84	80
6	74	72	68	83	82	80
7	76	79	67	81	86	83
8	71	68	62	84	81	78
9	66	71	57	76	81	76
10	69	67	60	80	83	82
11	60	54	51	77	79	76
12	57	66	61	80	82	79
13	72	67	61	80	80	77
14	71	64	53	76	78	76
15	68	68	51	79	81	76
16	68	65	61	80	79	77
17	78	71	68	80	84	81
18	69	72	56	75	84	79
19	76	81	71	95	97	89
20	64	72	62	84	87	82
21	72	79	62	81	88	77
22	55	52	44	76	77	76
23	58	71	42	81	88	76
24	67	73	56	81	83	78
25	81	74	57	95	96	84
26	62	65	56	77	79	76
27	74	73	61	83	88	80
28	73	75	67	84	88	81
29	62	61	43	79	81	77
30	78	79	59	81	86	77
31	69	76	75	81	93	89
32	66	85	52	78	86	76
33	79	85	65	81	89	78

Table 2

Noise exposure level calculated based on 1 hour of iPod use and 7 hours of quiet. Figures in grey boxes exceed the Lower Exposure Action Value. Figures in red boxes exceed the Upper Exposure Action Value.

References

1. Wash P *Investigation into noise levels produced by personal mp3 players*, MSc thesis, London South Bank University, 2007
2. Cox C, Fligor G Output *levels of commercially available portable compact disk and the potential risk of hearing* (Lippincott Williams and Wilkins, USA)
3. Deafness Research UK/BMRB Telephone omnibus survey: iPod generation (Beattie Media).

Nationwide Louvre Company

Environmental protection for bell tower

NLC is a family-run company based in Great Barr, Birmingham, which for the last twenty-three years has specialised in the installation of aluminium louvres, acoustic louvres and louvred screens. A couple of years ago the company was asked by architect Henk Strik of Caroe Partnership to come up with a way of preventing water ingress into the bell tower of Christ Church in Swindon. NLC designed, supplied and installed weather louvres with high-performance motorised shut-off dampers to the rear. While the bells are not in use, the dampers remain shut but are switched open when the bells are to be rung. This prevents water-borne moisture such as fog, snow and even driving rain from entering the building. The dampers are fitted with fail-safe motors that automatically close in the [illegible] pressing a button and disengaging the actuator gearing).

Following the installation the company was informed that the church was extremely pleased with the works carried out. Soon afterwards, NLC was contacted by John Beauchamp of Benjamin and Beauchamp, conservation architects for St Patrick's Cathedral in Dublin.

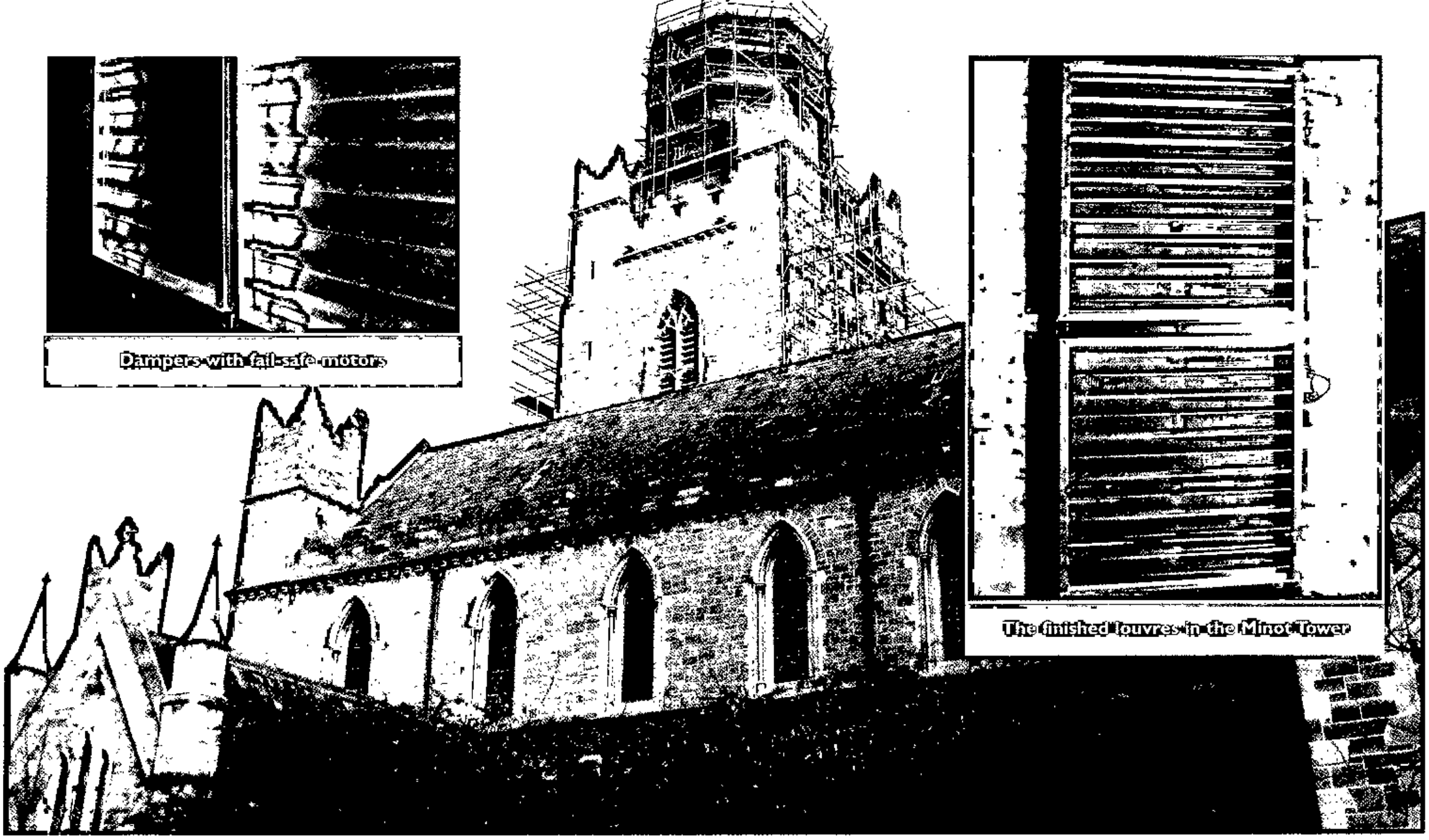
Because of the very exposed position of the cathedral, double bank weather louvres with motorised shut off dampers to the rear were requested. The units were approximately 2800mm wide × 4600mm high (louvred area) and were fitted to all four sides of the Minot's Tower, making 32 motorised shut-off dampers altogether.

More images can be found at **www.nlcontracts.co.uk/case-studies/**

As stone restoration work was being carried out to the Minot Tower the structure was accessible from the scaffolding so the modular sections of louvres and damper could be taken into the tower through one of the external openings.

The architect was working in anticipation of a new EU law which is expected to state that the ringing of bells may now be covered by broader noise pollution requirements: the principle of the cathedral was here first no longer applies. It is hoped that the installation of the shut-off dampers will be an additional benefit. Should it be necessary, one or possibly two elevations of the tower can be closed off whilst the bells are being rung, to reduce noise levels in the direction of [illegible]

For more information:
Lee Levy tel: **0121 360 6140**
or email **lee@nlcontracts.co.uk**



Dampers with fail-safe motors

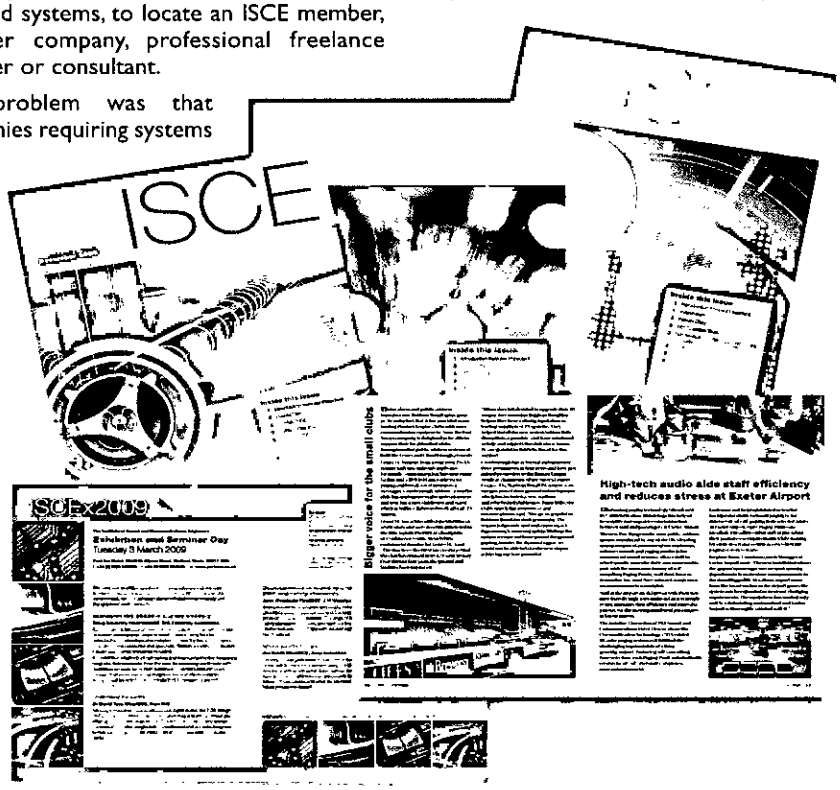
The finished louvres in the Minot Tower

Institute of Sound and Communications Engineers

ISCE launches online buyers' guide

The ISCE has produced an online buyers' guide that will help potential buyers of sound systems, including induction loop and infra-red systems, to locate an ISCE member, whether company, professional freelance engineer or consultant.

The problem was that companies requiring systems to be installed to the highest standards did not know who, or where, to contact. The Buyers Guide will be a valuable professional resource for any company, or local authority requiring installations designed and fitted by competent companies and engineers.



The Institute of Sound and Communication Engineers recently celebrated 60 years of professional help and support. The ISCE has most probably been one of the world's best kept secrets, only known to those who are aware of the Institute's high professional and ethical standards demanded from all of their members.

Membership of the Institute is based on proven technical and practical competency and only individuals reaching the required standards are accepted as members.

Following the successful launch of the Institute of Sound and Communications Engineers magazine, advertising space and a limited capacity for inserted 'flyers' is now available.

Contact Ros Wigmore at ISCE on **0118 9542175**, or email **ros@isce.org.uk** for further information.

Defra commissions research

Effectiveness of environmental impact assessment in dealing with noise

Defra has recently appointed a team headed by acoustic consultants Rupert Taylor to review the effects of the planning process on the noise environment with regard to human health, flora, fauna and the built environment. The other team members are Bernard Berry, Director of Berry Environmental Ltd, who has conducted research for both Defra and the World Health Organisation, and Dr Graham Wood, who is Reader in Environmental Assessment and Management at Oxford Brookes University and co-director of their Impact Assessment Unit.

The study will investigate the effectiveness of the environmental impact assessment (EIA) process in dealing with noise impacts. The study is solely concerned with airborne noise and does not cover vibration-induced effects. It will consider both the environmental statement (ES) itself and the outcome of the process ie after the development has been implemented. For the ES stage the project will assess both the technical quality of the noise section and whether the impacts are described sufficiently clearly for the benefit of those who might be affected.

Where developments have been completed the study will review how well the noise impacts were predicted, whether any mitigation offered or imposed has achieved its objective, and whether there are any unexpected noise issues such as those leading to complaints.

EIA procedures in other EU member states will also be compared with the UK process and any possible transferable benefits identified. Finally, consideration will be given to any effects that noise action planning under the terms of the European Noise Directive might have on the current planning process as regards noise.

Since the study encompasses the outcome (in noise terms) of completed developments, the team would be interested to hear of specific examples where the operating phase has proved to be either successful or problematic in respect of the noise impact.

Please contact Stuart Dryden at Rupert Taylor (**smd@ruperttaylor.com** tel: **01993 852 347**).

Campbell Associates

Award winners

Campbell Associates is a well-established family company providing sales, support, calibration and hire of sound and vibration instrumentation. The firm is delighted to announce that is has received recognition for its sales and service dedication to its customers within the UK and Eire from Norsonic AS. Norsonic has over 40 years of technical expertise in the development of high precision and quality sound instrumentation. John Campbell was given the award in Norway in November 2008.

info@campbell-associates.co.uk


John Campbell (L) receiving an award from Norsonic AS

Now hear this

Arup's SoundLab opened

Architects and building developers in London can now 'listen' to a proposed building before it even gets off the drawing board at the acoustical consultants' recently rebuilt SoundLab. Any space can be auralised, from train stations, sports stadia and airport terminals to concert halls, museums and office buildings. Recent SoundLab projects have included Oslo's Opera House, London's Kings Place, Heathrow Terminal 5 and the British Museum extension.

Until ten years ago, architects could use only educated guesswork to establish whether buildings would sound just as they expected. Then, following 15 years of measuring buildings and acquiring data, Arup made it possible to 'hear' a building before the foundations had been laid and compare it with existing buildings.

Today, the rebuilt laboratory enables the listener to experience the sound of a space or potential space as never before. Someone developing a concert hall, for example, might want it to have the acoustics of an existing hall, but with some subtle differences in texture or depth. A recording of an orchestra can be used, playing the same piece of music in the existing hall and then in the new building, thus providing an accurate comparison of the acoustics.

Neill Woodger, who developed the original SoundLab in New York, says that Arups took the opportunity to redevelop London's SoundLab completely while rebuilding the offices at 8 Fitzroy Street. Like many of the theatres the firm helped to design, this was a 'box in a box' construction, and so was completely isolated from its surroundings, with super quiet ventilation. The data projector has even been housed in a soundproofed box, and the heavy doors to the facility are like those usually seen in recording studios.

The SoundLab can be used to highlight potential problems so that they may be addressed before building starts. By auralising the differences that would be made by applying different cladding or glazing, for example, decisions can be taken on different aspects of the design: indeed, it may even be reveal that less sound isolation is needed than originally thought, thereby saving money.

Auralisation can also be used on external environments. For example, in a recent city park project, the client was concerned that nobody would use it, because it would be too noisy with traffic. So techniques were developed to listen to the sound of the park, including road noise and masking by trees and birds. The same soundscaping technique was used when advising on the design for the Dongtan eco-city in China, where private cars were restricted and people would expect to be able to enjoy the sounds of nature. SoundLab has also been used for a number of prestigious art installation projects, including Bill Fontana's Harmonic Bridge at the Tate Modern.

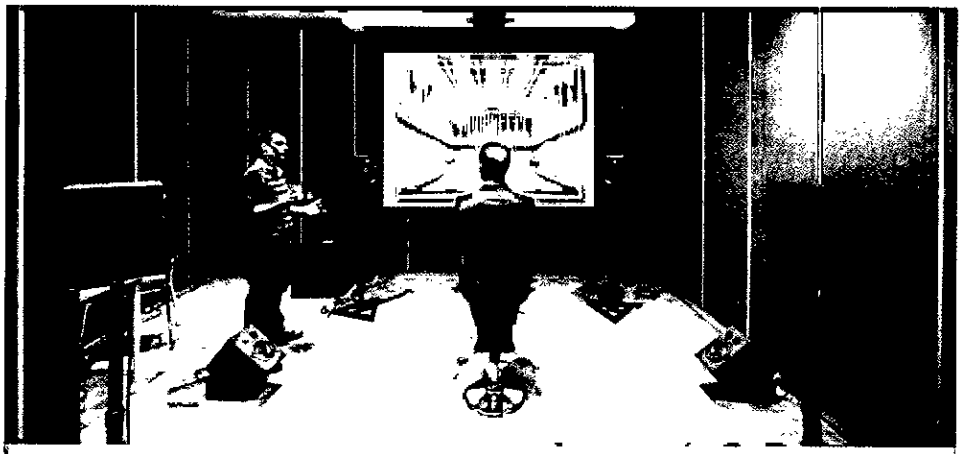
London's is one of five SoundLabs, with the others in New York, Melbourne, Hong Kong and Glasgow. They all have a giant screen so that visitors can actually see themselves in their new building, whether that be a concert hall, office block or railway station. This really helps visitors appreciate the sound of their new construction.

continued on page 44

Now hear this - *continued from page 43*

This was just one further stage in SoundLab's constant research and development. Already in development at the laboratory in Glasgow University's Digital Design Studio is a facility where visitors can wear '3D' glasses and experience a full visualisation experience. The virtual reality programming would enable them to manipulate objects and see how movement of items in the room affected the distribution of sound.

For more information: Beth Hurran at Arup on **+44 (0)20 7755 5403**, email **beth.hurran@arup.com**



The Arup SoundLab allows a listener to hear what the building will sound like when it is completed

Tinnitus charity appoints new chairman

News of an old friend

Members will be interested to learn that the British Tinnitus Association (BTA) has appointed our former Chief Executive, Roy Bratby, as the new chairman of the registered charity. The BTA was set up in 1991 and now supports thousands of tinnitus sufferers and advises medical professionals from across the world.

The experienced team at the BTA understands the impact that tinnitus can have on the lives of sufferers and those who live with them, so provides the most appropriate and expert advice and information free of charge, via a free helpline on 0800 018 0527 and on-line at www.tinnitus.org.uk. The Association also offers printed information and audio support via post.

Jack Shapiro, Vice-president of the BTA, who co-founded the charity approached Bratby to step into the role of chairman when the position became vacant in September 2008. He commented that Roy had a vast amount of experience and had held senior positions at various charities. He offered a solid understanding of what they wished to achieve and he was delighted that Roy had accepted the position of chairman.

Roy was a member of the council management of the BTA from 2002 until 2005. Now retired, he is looking forward to continuing his voluntary work within the Association. He said that he was pleased that he could contribute his knowledge and experience to the charity and was looking forward to his new role as chairman. He felt he could provide valuable input that would lead to the further development of the Association and its objective of promoting the relief and alleviation of tinnitus.

Roy Bratby takes over from Ewart Davies who retired from his position of chairman but continues his commitment to the charity by maintaining his role as a trustee.

Previously Roy held the position of Chief Executive of the Country Houses Association, and before his retirement in 2006 he spent nine years as Chief Executive of the Institute of Acoustics.

He is a member of the National Trust and English Heritage, serves on the Council of the St Albans and Hertfordshire Architectural and Archaeological Society, being chairman of the programme development committee, and is a member of the St Albans Probus Club - Verulamium.

Hot on the heels of this announcement came the news that the British Tinnitus Association (BTA) was donating a record £230,000 funding grant for a three-year tinnitus research post at University College London (UCL) Ear Institute in the search for a cure for the condition.

The donation will be used to support a Senior Research Associate post and a small team of researchers, working in a leading multi-disciplinary research facility.

The project aimed to lay the foundations of a proper understanding of tinnitus by exploring potential causes at multiple stages of the auditory pathway – with the goal of developing strategies for early diagnosis, identification of susceptible individuals and ultimately finding a way to abolish the causes of this debilitating condition.

At least ten per cent of the adult population in the UK had tinnitus and it could cause great distress to sufferers and their families. The British Tinnitus Association was committed to finding a cure for the condition and it was hoped that the research funding was the first step.

Roland Schaette, an experienced tinnitus researcher, would hold the Senior Research Associate post at UCL. Schaette had written a number of publications on tinnitus and hearing, had extensive experience in researching the auditory system and had presented at tinnitus conferences across the globe. He aimed to find a comprehensive theory for the development of tinnitus. He hoped to do this by developing an understanding of how hearing loss can lead to tinnitus and find out how to reverse the changes that initially cause the condition. Studies of animals, people currently suffering from tinnitus and computer models would be used to carry out the research. Schaette would be working in close collaboration with a number of experts at the UCL Ear Institute.

Roy Bratby

His goal was to understand how hearing loss through damage to the inner ear can lead to tinnitus. When the auditory system tries to compensate for hearing loss, tinnitus can arise as a side effect. Ultimately the objective is to reverse the changes to alleviate tinnitus and find new treatments for the condition.

David McAlpine, Professor of Auditory Neuroscience and Director, UCL Ear Institute said that the BTA's commitment to funding a research fellowship marked a significant step in the search for a cure for tinnitus. At the Ear Institute they believed that the most fruitful approach to finding a cure lay in understanding how the healthy auditory system worked and how it was perturbed by tinnitus. In partnership with the BTA, the Ear Institute would be able to develop a programme of research that brought a wide range of scientific disciplines to bear on the investigation of tinnitus.

New faces at WSP Acoustics

Five new starters in 2008

Despite the recent economic downturn, WSP Acoustics is maintaining growth with five new starters in 2008 and a number of UK and overseas projects being awarded by signature clients.

WSP Acoustics has over 85 staff in five countries including four offices in the UK, three offices in Sweden and staff in Finland, Dubai, New York and South Africa. This year Laurence Evans, Emma Greenland and Louise Beamish started in the London office, Mark Scaife joined the Dubai team and Marty Schiff joined the New York office. In addition, WSP has a significant share in Muticonsult, a Norwegian engineering consultancy employing an additional 30 acousticians.

A number of international projects are currently being managed by UK staff including the Shard at London Bridge, Reem Island in Abu Dhabi, and the public inquiry for Everton Football Club's stadium relocation to Kirby town centre.

During 2008, WSP Acoustics worked with, amongst others, Foster and Partners, Renzo Piano Building Workshop, Zaha Hadid Architects, Berkeley Homes, Rapleys, Sainsbury, Tesco and Taylor Woodrow.

This year is also looking promising with major projects (including funding!) in the Middle East, USA and Mauritius.

New starter Emma Greenland says that working on projects as part of an integrated engineering design team with WSP Structures, M&E, Energy and Fire Engineers enables a strong joined up design approach.

The WSP Team

Emma Greenland

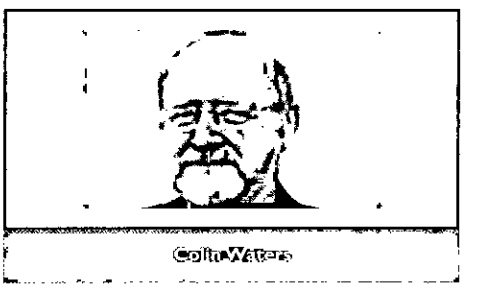
Louise Beamish

Colin Waters

Colin Waters Acoustics active again

Colin Waters CEng FIOA MRAeS has now left Arup where he was a Director with the responsibility for environmental noise matters in the Acoustics group. Having spent eight years at Arup he will now resume his consultancy practice as Colin Waters Acoustics.

He will also join the Dalton Research Institute of Manchester Metropolitan University as a visiting professor in the Centre for Air Transport and the Environment. Professor Waters will continue his research interests at the Centre in the field of airport noise assessment, measurement and control.



Colin Waters

Keith Green

Obituary

It is with regret that we record the death of Keith Green CEng MIOA. Keith was an experienced and respected engineer in the transport sector: his chartered status, earned without the benefit of a university degree, reflected the dedication he gave to his profession.

His expertise in anti noise and vibration technology for railways, most recently with Pandrol where he had been a Senior Engineer for the past 10 years, made our underground trains run more smoothly — the quietness of the Jubilee Line can be substantially attributed to his work.

He had a personality and enthusiasm that was hard to match. He liked to be noticed and regularly expressed his individuality through loud and colourful ties, which very much became his personal trademark. At Christmas parties he would always be the one still wearing the funny hat to the end. He was also a founder member of the Pandrol London to Brighton bike ride team – though, with steep hills, he occasionally adopted the 'get off and walk' strategy, but he still completed the 58 mile route.

When Keith joined Pandrol in 1997 he brought with him noise and vibration experience that he applied to rail fastenings that would help make railways around the world using Pandrol fastenings quieter to both passengers and the surrounding environment. In particular he was extensively involved with the new St Pancras station for the Channel Tunnel Railway Line, and the noise and vibration test site on Hungerford Bridge.

Keith travelled extensively overseas, spending time in both North and South America, passing on his noise and vibration experience to customers and consultants within the railway industry. He also spent time in Romania which resulted in one of their particularly noise-sensitive bridges being made substantially quieter. Other projects, to mention just three, were in Japan, Sweden and Turkey. He was an experienced and respected engineer in the transport sector; his chartered status, earned without the benefit of a university degree, reflected the dedication he gave to his profession.

Keith will be remembered as a reliable and generous member of the technical team who was always willing to assist wherever possible. His leisure interests included caving, diving and gliding, and his memorial service, which took place on 27 October 2008 at St Lawrence's Church, Alton, was followed by an outstanding air display by Lasham Gliding Society and the Vintage Gliding Club. The congregation included members of Keith's family, friends, professional colleagues, divers, cavers and glider pilots and was a tremendous testament to an extraordinary life.

Bap Band goes into battle with horns blazing

Kings Cross, on the night of 20 November 2008, IOA members from Bickerdike Allen Partners prepare to do battle with eight rival bands drawn from companies involved in construction at the inaugural Battle of the Construction Industry Bands.

Hailing from all over the UK, the bands took industry puns to another level. Competitors included AC/CB from Chapman Bathurst, Another Brick... from MDA, Canary Wolves from Canary Wharf Construction, the Instigators from HLM/Scott Browning, the Ova Tones from Arups, Public M&E and Wild Sex Party from WSP (who devised and hosted the event) as well as Bickerdike Allen's Bap Band.

Up for grabs were prizes for the best performance and the runner-up, best new band formed especially for the event, and lastly the considerably less rock'n'roll prize for most organised band. The judging panel consisted of session musician Neil Pyzer from Geno Washington's Ram Jam Band, Stuart Clark from Music Week, and talent spotters Pia Ashcroft and Lou Alchamaa from Sony BMG (disappointingly the latter had not brought along his X-Factor champion girlfriend).

Each band had a mere twelve minutes to impress the judges and get the audience screaming for more: points were deducted for over-runs and bribery.

The Bap Band is John Miller (bass), Peter Henson (piano), Ed Weston (drums), Arthur Lewis-Nunes (trumpet), Laura Jellicoe and Lesley Turner (saxophones), as well as ringers Roger Kelly from CDM on vocals and the legendary former-BAP guitarist Theo Niaounakis from Hoare Lea. They exploited their ample horn section by performing the Eddie Floyd classic *Knock on Wood*, followed by *If You'll Be My Baby* by blues man Gary Moore, in which Theo's four-chorus epic guitar solo would have had even Hendrix on his knees.

Even so, the acousticians could only muster runner-up to the best performance, with first place going to host band WSP for their renditions of songs by the Killers, the Strokes and Talking Heads.

The event took place at the German Gymnasium opposite St Pancras Station in central London, and was arranged to raise money for the Chinese Earthquake Appeal and a Kings Cross youth charity, the Copenhagen Project. It attracted so much interest that the venue had to be 're-fire-engineered' to increase its audience capacity to 350. Owing to its overwhelming success, a rematch in 2009 looks highly likely.

Bap Band backstage (photograph by Neil Fraser)

John, Theo, Roger and Ed (photograph by Neil Fraser)

Lesley, Laura and Arthur - The Horns (photograph by Neil Fraser)

Peter on Piano (photograph by Neil Fraser)

Sue Bird

Elected President of the INWES

Sue Bird FIOA has been elected President of the International Network of Women Engineers and Scientists (INWES). The election took place in July at the Fourteenth International Conference of Women Engineers and Scientists (ICWES14) in Lille, France.

Sue Bird is a Fellow of the Institute of Acoustics, and a Chartered Engineer. She has worked in industry, local government, and general consultancy. For 20 years she was a partner in Bird Acoustics, and after that was a principal consultant in Hepworth Bird Acoustics.

Sue is a former President of the Women's Engineering Society in the UK and has long been active in encouraging women and girls to go into science and engineering, and to stay there. She was one of the people who set up INWES, and has been a board member ever since.

ICWES Conferences have been held every three years since 1964, and based on this network which already existed, and helped by the encouragement of UNESCO, INWES was formed in 2002 at the ICWES12 conference in Canada. Now, the organisation, which is incorporated as a non-profit corporation in Canada, has members in over 40 countries throughout the world. The network instigates world-wide discussions on good practices on how to increase the participation of women in science, technology, engineering and mathematics (STEM) at all levels, and in all countries. Mentoring, networking, and sharing information at all levels are its central goals, and it runs projects and programmes to benefit women in STEM.

Sue Bird

Comments on Technical Contribution 'The study of complex industrial noise fields' Acoustics Bulletin, Vol33, No6.

I commend the aim of providing non-specialist readers with information that should assist them to understand the advantages and disadvantages of various types of instruments and techniques for identifying the location of the principal sources of noise in geometrically and acoustically complex environments. However, I am surprised and disappointed that paper of this standard should be authored by persons 'with NPL'. I was amazed to read that 'Until recently, the only type of acoustical measuring instrument for the investigation of noise emissions in industrial environments was the sound level meter'. Although sound intensity measurement is not an infallible means of identifying or quantifying principal sources, it has received widespread and effective use in scans close to vibrating structures as a rapid means of placing in rank order the various regions radiating broadband sound. In reverberant environments, the fact that intensity is a vector offers the great advantage over sound pressure because, in close scans near solid vibrating surfaces, the reverberant field incident on the surface passes the intensity probe, is reflected from the surface, travels past the intensity probe in opposite directions, and registers negligible net normal intensity. By contrast, the directly radiated component is fully registered. Sound intensity measurement is undoubtedly not well suited to the location of tonal sources in highly reverberant environments, but neither are single-plane circular microphone array acoustic cameras or even the human auditory system. This is a particular problem in cases of spatially extended structures that are excited into harmonic vibration, because the whole coherently vibrating surface constitutes the source. Spiral microphone arrays have superior spatial aliasing suppression, which is an advantage with tonal sources in reverberant spaces because the room reflections are fully coherent with the directly radiated field.

The application of Laser Doppler Vibrometry (LDV) to the rank ordering of sound radiation from various areas of a vibrating structure sources of sound is not straightforward because regions of strongest vibration are not necessarily the regions of strongest sound radiation, especially in the lower audio-frequency range. However, virtually all vibrational sources of sound encountered in industry are linear, so that the radiated sound power is proportional to the square of the velocity amplitude: the interference effects referred to are irrelevant to this condition. The reference to LDA techniques is puzzling. The authors are correct in identifying the existence of uncorrelated or partially correlated source regions as a problem in applying LDV scanning to source location. This can be overcome to some extent by the use of ancillary transducers and Nearfield Acoustic Holography (NAH) microphone array techniques, together with complex signal processing and analysis. But highly irregular and congested source geometry and strong reverberant fields make their application under the form of conditions described in the paper problematic.

The reported exercise was not really a test of the ability of the measurement systems to identify a 'new and unexpected source within a complex sound field' since the load on the pump was varied and, not unexpectedly, the pump was identified as the source that varied. Actually, the cheapest and simplest method of principal source identification in the case reported would be temporary wrapping of sections of the pipework together with sound level readings.

I was puzzled by the graphs that purported to reveal the variation of radiated sound with the setting of the valve. It is said in the text that 'a substantial increase in noise' occurred as notch 6 was engaged. But Figure 6, which plots the A-weighted sound level, which should correlate well with perceived loudness, does not seem to bear this out. Nor does Figure 12, in which the lowest vibration levels are measured in the case of notch 6. The paper does not explain how 'extraneous noise sources can be removed without switching off their sources' as claimed. Figure 8 is incomprehensible and the units of the axes are illegible. Why is it that level changes over time cannot be 'readily captured' by a sound level meter? What are the common acoustical parameters that the sound level meter can capture, and what have they to do with source location?

Regrettably, I have to express the view that the stated conclusions from the research are not securely supported by the evidence presented in this technical contribution.

Prof Frank Fahy HonFIOA

Cirrus Environmental

New construction site noise monitor

Cirrus Environmental, the UK company which specialises in noise monitoring tools for the environmental market, has introduced a new instrument that has been specially designed for use on construction sites and building projects. The EK:813C is a robust, reliable and cost effective way to measure noise levels. It is simple to operate, with only four buttons, and these can be preset so that the person tasked with making the measurement does not have to make any decisions about the configuration of the meter.

If noise measurements need to be taken overnight or over longer periods, the EK:813C can be used with a weatherproof kit which protects it from the elements, as well as providing a robust and secure case for the instrument. The unit is unique in this market, according to Richard Wright of Cirrus Environmental. The company knew that many of its customers were not noise experts, so they were looking for equipment that was simple to operate yet gave the information needed. The new meter had been designed with the construction market in mind and the result was a package that gave companies the confidence that making noise measurements would be simple and straightforward.

The new instrument is the ideal tool for construction companies both large and small, as it can be used for short-term and long-term noise measurements. It is supplied as a complete weatherproof measurement kit, with a windshield, acoustic calibrator, software and download cables in a robust carrying case. This makes it particularly well suited for unattended outdoor measurement, because the instrument and microphone are protected from the elements.

Cirrus Environmental provides a complete service for businesses wishing to monitor and manage their environmental noise impact, using products from Cirrus Research plc.

For more information:
Richard Wright - Cirrus Environmental,
01262 670245, sales@cirrus-env.com

Acoustic ventilators

CMS Acoustics provides a breath of fresh air

Responding to Part F of the 2000 Building Regulations and the rise in the development of brownfield land, CMS Acoustic Solutions has launched a comprehensive range of acoustic ventilators. Designed to allow fresh air to pass through while providing sound insulation, CMS acoustic ventilators are ideal for use near nuisance noise sources such as main roads, railways or airports.

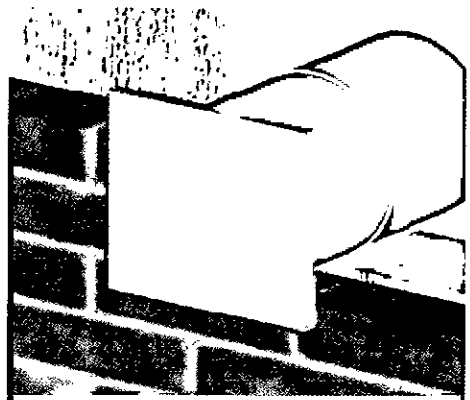
Providing compliance with Building Regulations Approved Document F, CMS Acoustics' latest product offering includes 'background', 'hit-and-miss', 'cowled' and 'acoustic core' ventilation sets. Manufactured from fully recyclable plastic, the range of through-wall acoustic ventilators offers effective ventilation for new-build or refurbishment projects in domestic and small commercial applications.

Offering the most energy efficient form of ventilation, non-mechanical background ventilators allow a controllable amount of fresh air to enter rooms at a continuous and low rate. In areas exposed to high winds, such as high-rise developments, CMS acoustic background ventilators can be specified with an acoustic cowl, preventing damage to the external grille. This can also increase the sound insulation achieved by up to 3dB over the standard background ventilator performance of 36dB, and reduces the amount of light and draughts which can pass through.

Where rooms contain a heat-producing appliance, CMS ventilators can be treated with a fixed open, flush fitting louvre vent, allowing an unrestricted airflow to reduce the risk of blockage and ensure the safety of the building occupants.

Offering a minimum airborne sound insulation of up to 35dB, hit-and-miss ventilators provide an ideal adjustable solution for areas where the amount of air entering a room needs to be manually controlled by the occupant.

David Holder, sales director, CMS Acoustics, commented that effective ventilation was key to



Through-wall acoustic ventilator

creating an acceptable living or working environment. The new range of ventilators enabled compliance with Part F of the Building Regulations, while providing high performance insulation from nuisance noise. As the vents were non-mechanical, the ventilators incurred no running costs and with basic maintenance they could last indefinitely.

CMS Acoustic Solutions Ltd, **01925 577711** or **enquiries@cmsacoustics.co.uk**

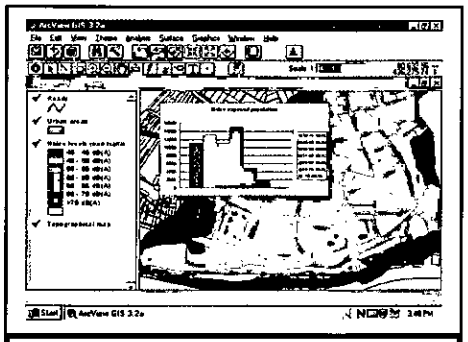
Sound and the City

Brüel & Kjær launches latest version of Predictor software

Environmental noise mapping is now much simpler with world leading sound and vibration expert, Brüel & Kjær's new Predictor 7810 software. Created specifically for use with the Type 2250 and Type 2270 sound level meters, Predictor 7810 v6.1 is the most efficient multi-purpose Windows software package available for noise mapping, management, action-planning and assessing the impact of urban noise. It can be used to calculate and analyse various noise sources for many different applications, ranging from small-scale impact assessments such as neighbour noise to mapping of large built up areas in towns or cities.

Environmental assessors must adhere to many regulations in their line of work, including fulfilment of European Commission Directives on computation methods (2003/613/EC) and the Harmonoise (road/rail) method. Predictor has been designed to produce results compliant with these and a range of other national and international calculation standards. Local authorities can prevent future problems from noise complaints by using the software to create building noise management systems for continued monitoring and control of noise within their geographical areas.

This latest version has an improved data handling system, making it much more user-friendly, which includes an intuitive Windows-based graphical user



Screen capture from Predictor

interface, plus an integrated project organisation options for scenario management and archiving.

For more information
email **heather.wilkins@bksv.com**
or phone **01438 739 000.**

The robust, reliable and cost effective EK:813C

Nor140VID

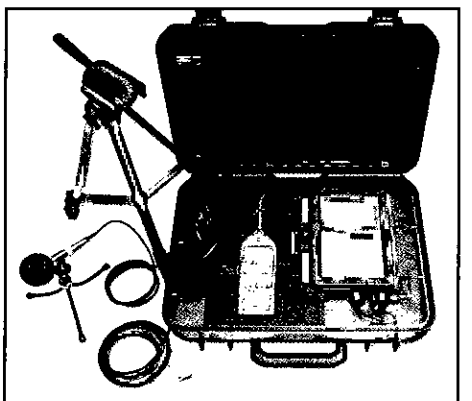
Integrated video with noise measurements

Unattended noise measurements can provide useful information, but often it is not possible to ascertain which establishment the noise is associated with, or indeed whether the noise is from its patrons or from the general public gathering in the street. Norsonic has worked closely with UK local authorities to develop a simple-to-use system that integrates video recording with sound level measurements and full fidelity audio.

The Nor140VID system logs sound levels constantly, but video and audio is only collected when a user hand-switch is activated. This saves considerable time when analysing measurements as video is limited to the period when the complainant sees that there is a problem, rather than the standard CCTV system which requires extensive officer time finding areas of interest and correlating sound level information. The video recordings also have a pre-trigger to store video and audio one minute before the hand-switch is activated, to assist in catching impulsive events.

The Nor140VID system will be valuable for establishing the extent of an alleged nuisance. If a noise nuisance complaint is verified then it provides professional evidence for all parties in licensing reviews, and in action against the licensee.

For more information please contact **info@campbell-associates.co.uk**



Nor140VID - Integrated video with noise measurements

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Committee meetings 2009

DAY	DATE	TIME	MEETING
Thursday	22 January	10.30	Diploma Tutors and Examiners
Thursday	22 January	1.30	Education
Thursday	29 January	10.30	Membership
Thursday	12 February	11.00	Publications
Thursday	26 February	11.00	Medals & Awards
Thursday	26 February	1.30	Executive
Thursday	5 March	10.30	Engineering Division
Tuesday	10 March	10.30	Diploma Examiners
Thursday	**12 March**	**11.30**	**Council**
Tuesday	7 April	11.00	Research Co-ordination
Thursday	16 April	10.00	Meetings
Tuesday	21 April	10.30	CCWPNA Examiners
Tuesday	21 April	1.30	CCWPNA Committee
Thursday	7 May	10.30	Membership
Thursday	21 May	11.00	Publications
Tuesday	2 June	10.30	CMOHAV Examiners
Tuesday	2 June	1.30	CMOHAV Committee
Thursday	18 June	9.00	Executive
Thursday	**18 June**	**1.30**	**Council**
Thursday	25 June	10.30	Distance Learning Tutors WG
Thursday	25 June	1.30	Education
Wednesday	1 July	10.30	CCENM Examiners
Wednesday	1 July	1.30	CCENM Committee
Thursday	2 July	10.30	Engineering Division
Tuesday	7 July	10.30	ASBA Examiners
Tuesday	7 July	1.30	ASBA Committee
Thursday	9 July	10.00	Meetings
Tuesday	4 August	10.30	Diploma Moderators Meeting
Thursday	3 September	10.30	Membership
Thursday	10 September	11.00	Medals & Awards
Thursday	10 September	1.30	Executive
Thursday	17 September	11.00	Publications
Thursday	**24 September**	**11.30**	**Council**
Thursday	1 October	10.30	Diploma Tutors and Examiners
Thursday	1 October	1.30	Education
Thursday	8 October	11.00	Research Co-ordination
Thursday	15 October	10.30	Engineering Division
Thursday	5 November	10.30	Membership
Tuesday	10 November	10.30	ASBA Examiners
Tuesday	10 November	1.30	ASBA Committee
Thursday	12 November	10.00	Meetings
Tuesday	17 November	10.30	CMOHAV Examiners
Tuesday	17 November	1.30	CMOHAV Committee
Wednesday	25 November	10.30	CCENM Examiners
Wednesday	25 November	1.30	CCENM Committee
Thursday	26 November	11.00	Publications
Thursday	3 December	9.00	Executive
Thursday	**3 December**	**1.30**	**Council**
Tuesday	8 December	10.30	CCWPNA Examiners
Tuesday	8 December	1.30	CCWPNA Committee

Refreshments will be served after or before all meetings. In order to facilitate the catering arrangements it would be appreciated if those members unable to attend meetings would send apologies at least 24 hours before the meeting.

Conferences and meetings:

Diary 2009

16 January
Wind farm noise
Bristol

5 March
Measurement & Instrumentation Group
Audible - Inaudible
London

31 Mar - 1 April
Underwater Acoustics Group
Bioacoustics 2009
Loughborough

28 - 29 April
Environmental Noise Group
Spring Conference 2009 - Environmental noise management in a sustainable society
Duncombe Park, Warwickshire

26-28 October
EURONOISE 2009
Edinburgh

Further details can be obtained from Linda Canty at the Institute of Acoustics
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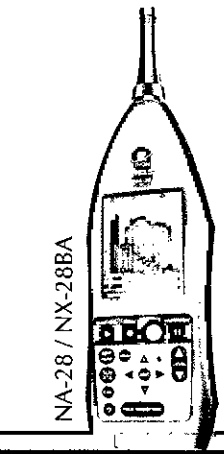
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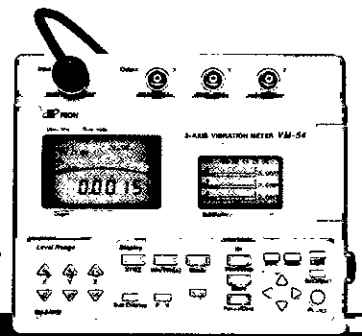
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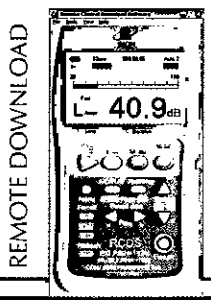

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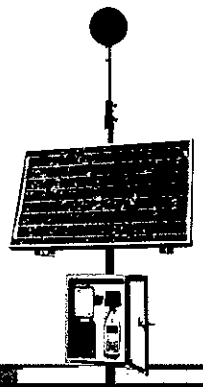
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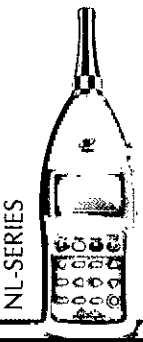
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