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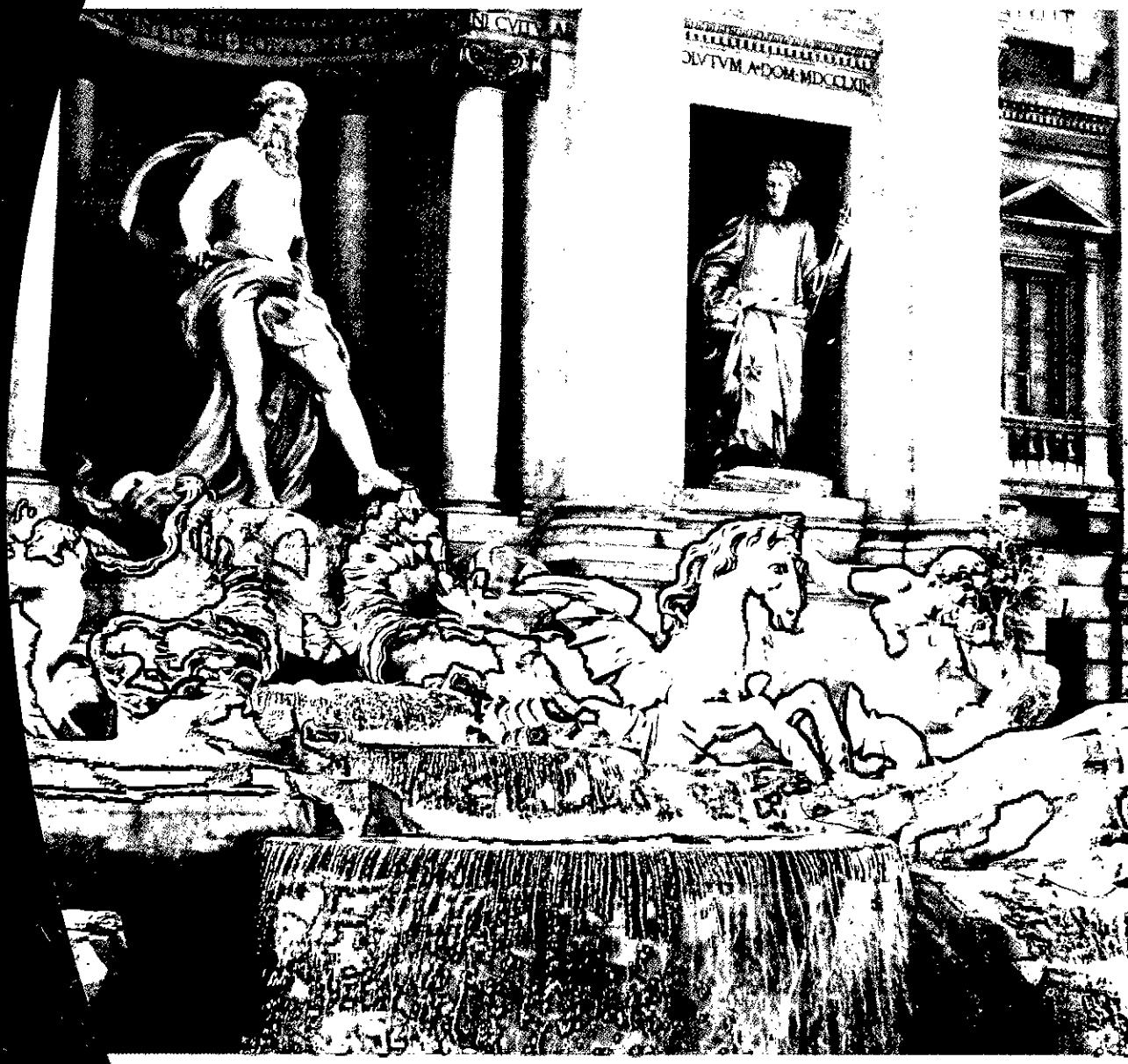
ACOUSTICS BULLETIN



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Institute of Acoustics

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Front cover photograph: The recent Spring Conference included several papers - and the Tyndall Medal lecture - on the subject of soundscapes. One interesting snippet that arose was that whilst British and German city-dwellers regarded the sound of a fountain positively, Italians were not so keen! Luckily, Nicola Salvi did not feel the same way: the cover picture shows a detail of his recently-restored Fontana di Trevi, Rome. *[photo: Ian Bennett]*

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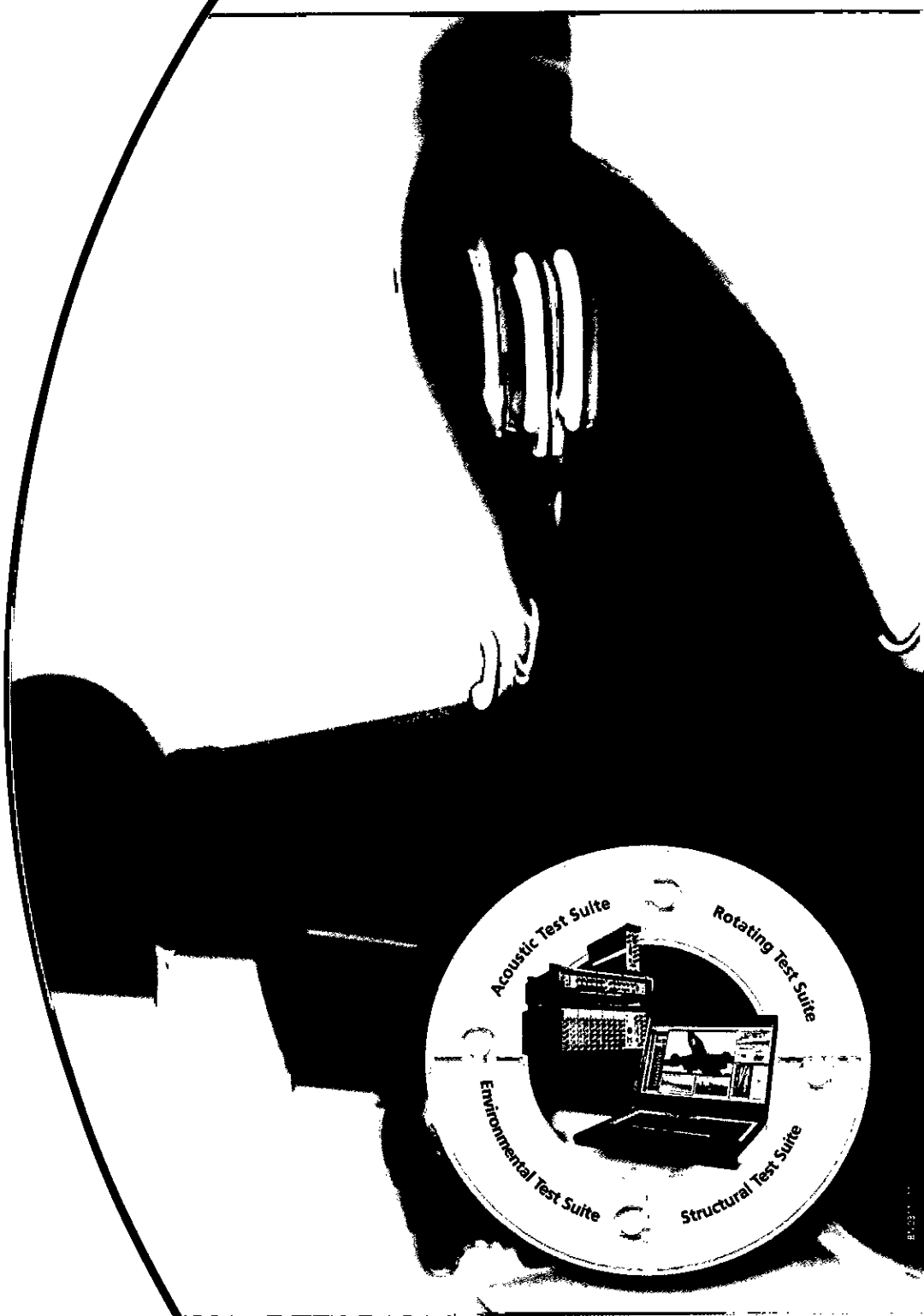

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Dear Members

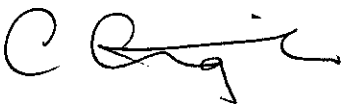
About five years ago Council became increasingly concerned that there were insufficient numbers of students taking acoustics degrees and then entering our profession. As part of the strategic review that we carried out, we resolved to take steps to engage with schools and make schoolchildren aware of the varied careers available in acoustics. A pilot scheme was developed, known as Acoustic Ambassadors, and I am delighted that Richard Collman, who championed the project, won the Best Activity Award in the Science and Engineering Awards scheme. We now have to build on this and roll out the scheme to a wider area.

I have just returned from the Spring Conference where there was a strong theme of communicating with the public. Two sessions were devoted to this subject and I was also able to present the Award for Promoting Acoustics to the Public to Wendy Sadler (for 2006) and David Sharp (for 2007). The dinner was concluded with a demonstration by the inimitable Trevor Cox. This included many of the acoustical principles he uses for talks to schoolchildren and included his world record holding whoopee cushion that required four volunteers to sit on it to deflate it. Fortunately for me, he did not appear to notice that he could have chalked up another first by the getting the four past and present presidents who were at the dinner to take part in the demonstration.

The past presidents were at the dinner for the award presentations. I presented Mike Ankers and Bernard Berry with their Honorary Fellowships, and Peter Wheeler read the citation for Bob Peters before I presented him with his Award for Services to the Institute.

The Spring Conference was an ambitious event, with four parallel sessions drawing delegates from a wide range of research topics. Both days began with a plenary session in which Christopher Harrison received the Rayleigh Medal, and Jian Kang received the Tyndall Medal. I am very grateful to Keith Attenborough and his research coordination committee for attracting so many good papers from people at research institutes which seldom attend our mainstream conferences. Several of these new faces have taken the opportunity to join the IOA and this will further strengthen our membership and widen the range of topics we can tackle at meetings.

As I write this letter I am acutely aware that my time as President is drawing to a close. It has been a privilege and a great pleasure to serve the Institute and its members over the last two years. It has allowed me to meet a far wider cross-section of our membership than I had previously, and to make many friends along the way. I am deeply grateful to all of those at Head Office and the many Council and committee members who have worked with me and helped make my term in office so rewarding. I know that the Institute will be in good hands under our incoming president, John Hinton, and I am very much looking forward to working closely with him.



Colin English

PRESIDENT

Citation: Bernard Berry

Honorary Fellowship of the Institute of Acoustics

Bernard Berry studied Electronic and Electrical Engineering before moving to the Institute of Sound and Vibration Research, Southampton where he gained an MSc in Human factors in Engineering. He then won a NATO science fellowship and spent a year at the National Research Council of Canada investigating the effects of impulse noise on sleep, using EEG techniques.

In 1970 Bernard joined the National Physical Laboratory and dedicated 30 years there to an extensive portfolio of activities in research, standardisation, consultancy and policy advice in the field of environmental noise and its effects on people. He excelled at his work which ranged from compiling the first ever 'Leq Guide' for the Government's Noise Advisory Council in the 1970s, to more recent EU-funded team projects on the effects of noise on health.

In 2001 he left NPL and embarked on a consultancy career, establishing BEL Environmental, continuing his notable work in acoustics. His work has included an EC project on the effects of road traffic noise and aircraft noise on children's health, and consultancy to the World Health Organisation's European Centre for Environment and Health in Rome.

Through his keen participation in many acoustical events and groups in the UK and abroad Bernard has become very well-regarded in the acoustics community at large. He is Chairman of the British Standards Institution technical committee on residential and industrial noise and is a member of many other British and international standards committees and working groups. Internationally, Bernard is an executive board director of the International Institute of Noise Control Engineering, and acts as european editor of its Noise News International. He advises many international bodies including the European Union and the World Health Organisation.

Bernard has been actively involved in the Institute of Acoustics for many years. He was president of the Institute from 1996-1998 and then served as vice-president for international relations from 2000 to 2007. He has been on the international advisory committees of a number of major conferences, including Internoise 2005 in Rio de Janeiro, as well as chairing Internoise 1996 for the IOA in Liverpool. He is now chairing the committee organising EuroNoise 2009.

Colin English presents an Honorary Fellowship to Bernard Berry

Finally Bernard has consolidated his huge contribution to the acoustics field through publishing over 100 papers in academic journals and conference proceedings, reports and book chapters. He has given more than a hundred presentations at many conferences, where he is often known for his wit and use of well-researched historical references.

For these reasons the Institute of Acoustics is very proud to award Bernard Berry an Honorary Fellowship.

Citation: Jian Kang

Tyndall Medal 2008

Jian Kang was born in China and received his higher education at the prestigious University of Tsinghua where he was awarded a bachelor's degree in architecture and a master's degree in acoustics.

He came to Europe in 1992, sponsored by the German Ministry of Research and Technology, to become a scholar at the Fraunhofer-Institut für Bauphysik in Stuttgart. Here he worked on non-fibrous absorbers and low frequency sound insulation in buildings.

In 1993 Jian came to the UK where he undertook a PhD at the School of Architecture at the University of Cambridge. His thesis was sound propagation in long enclosures and this formed the foundation for his future researches in urban soundscapes. In 1996, Jian was awarded the Robert Newman Medal of the Acoustical Society of America 'For excellence in the study of acoustics and its application in architecture'.

On completing his PhD, Jian took up a lectureship at the School of Architecture at the University of Sheffield and was rapidly promoted to a professorship. He has formed a strong multi-disciplinary research group which has worked extensively in environmental acoustics and led to the publication in 2007 of a book entitled Urban Sound Environment. At micro-scale, Jian has developed theoretical and computer models for simulating sound propagation in street canyons and urban squares, and examined the effectiveness of built environment morphologies. At macro-scale, he has studied the accuracy and efficiency of computer-based noise-mapping and applied the techniques in practice. He has also studied subjective aspects of environmental acoustics, including soundscapes in urban open spaces, based on 10,000 interviews across the EU and in China. His work is reflected in over 250 publications including three books.

In education, as well as lecturing in acoustics to architectural students and others, Jian has supervised numerous PhD and MSc students in his acoustics group.

Jian Kang receives the 2008 Tyndall Medal

Jian is a Fellow of the Institute of Acoustics, a member of Council and a member of the building acoustics committee. He is also a Fellow of the Acoustical Society of America and a member of the technical committee on architectural acoustics. He is an editor in environmental noise for Acustica (united with Acta Acustica) and is on the editorial board of the Journal of Architecture and Planning.

For his prodigious contributions to environmental acoustics and, in particular, the behaviour of sound in the built environment, the Institute of Acoustics is delighted to award the Tyndall Medal to Professor Jian Kang.

Citation: Michael S Ankers

Honorary Fellowship of the Institute of Acoustics

Born in Leeds in the last years of the war, his father's job in the RAF meant that Mike moved around the UK and Germany as a child, his last school being the Royal Grammar School, High Wycombe.

Mike joined Manchester City Council in 1962 and during the next four years completed a sandwich course at the Royal College of Advanced Technology. He took an increasing interest in pollution regulation and control and on qualifying as a Public Health Inspector served only a short time on general duties before being offered a post in the Air Pollution Group. This dealt primarily with industrial air pollution: he took part in the massive national domestic clean air programme which led to Manchester becoming the first fully smoke-controlled city in the UK.

Noise control duties were passed to the group in 1970 and then in 1971 the city purchased its first precision sound level meter (a Brüel & Kjær type 2204); Mike took the instruction book home and read it cover-to-cover several times - the making of an instant expert! He took the lead within the group on sound level instrumentation and its application to environmental health work, and even designed and fitted out a mobile laboratory for extended field measurements.

The introduction of major legislation in the early 1970s demanded a shift to objective and scientific measurements of sound pressure levels. Mike Ankers took a leading role in the North-west to share expertise and knowledge amongst those involved in noise measurement and assessment. He served for over twelve years on the Manchester Area Council for Clean Air and Noise Control, first as secretary then as chairman of its noise working group.

During this period he also became a member of the British Acoustical Society, which in 1974 became the Institute of Acoustics, making him a founder member and also the first Environmental Health Officer to join. His contacts with the Acoustics group of the University of Salford led to him joining the Institute's meetings committee with a view to expanding the Institute's programme in environmental noise. He also served for several years on the membership committee.

Colin English presents an Honorary Fellowship to Mike Ankers

Mike was a founding member of the North-west branch of the Institute, and served as chairman for several years. Together with his wife Hilary, he also assisted for a decade or more in the running of the IoA's Reproduced Sound series of conferences at Windermere. He was elected Fellow of the Institute in 1989 in recognition of his work on its committees.

Mike became an assistant director of environmental health in 1985, and then in time, via various promotions the head of service. In 1991 the Chartered Institute of Environmental Health elected him as a Fellow in recognition of his long contribution to environmental noise policy, regulation and control. He was elected IOA president for the years 1990-1992, and served as immediate past president until 1994. Then, after thirteen years on Council, he reluctantly decided to devote all his time to his full-time job in Manchester, although he continued to maintain a keen interest in acoustics and particularly in promoting the Diploma course amongst his junior colleagues.

For all of his work and dedication to the Institute, we have great pleasure in awarding Michael Ankers an Honorary Fellowship.

Citation: Bob Peters

Award for distinguished service to the Institute of Acoustics

Robert Julian Peters ('Bob' to everyone in the Institute) read physics with ancillary mathematics at Imperial College, graduating in 1965. He stayed on, studying under Professor RWB Stephens in underwater acoustics, gaining his MSc and PhD. He joined Lucas CAV in 1970, working on diesel engine noise and vibration control. He moved to Twickenham College of Technology in 1973 and subsequently transferred to NESCOT in 1975.

When he joined the recently-established Institute of Acoustics in 1977, his proposers were RWB Stephens, Geoff Leventhall and Brian Smith.

At NESCOT, Bob developed short courses in acoustics and noise control for practitioners and environmental regulators, and many of our members owe their success to the foundations provided by him. He started delivering the Institute's Diploma course in 1978, building student numbers rapidly from 13 to 45 over the first few years. After a series of promotions, he was appointed Head of School in 1989. Bob also became a part-time tutor for the Open University and South Bank Polytechnic.

When Bob was elected FIOA in 1980, his supporters again read like the 'Who's who' of twentieth-century acoustics in England – Raymond Stephens, Edgar Brown and Brian Smith.

Bob retired from NESCOT in the late 1990's and became principal acoustic consultant with Applied Acoustic Design, engaging in a very wide range of consultancy projects. He still works for AAD part-time.

He has been deeply involved in the development of the Institute's Diploma, initially working closely with Roy Lawrence. He was a member of Education

Bob Peters with his Award for Distinguished Service

Committee for many years, serving latterly as chairman, and also became chairman of the Workplace Noise Certificate committee. Bob also acted as a diploma and workplace noise certificate examiner. He has acted as project examiner for the Diploma and senior tutor for the distance-learning students since the mid-1990s.

Bob has served on Council as vice-president (groups and branches) and he has played an active part in the development of London branch activities.

In short, Bob has served the Institute tirelessly for the past thirty years and has played a leading role in the education of hundreds of acoustics professionals over his lifetime in the profession. He is most worthy of this Distinguished Service Award.

Citation: Christopher H Harrison

Rayleigh Medal 2008

Dr Harrison is an innovative and internationally-recognised scientist currently working as a principal scientist at the NATO Undersea Research Centre (NURC) in Italy. His original work in underwater acoustics spans four decades, during which time he has published widely in journals, as well as through numerous conference articles and NURC reports.

Chris started his research by undertaking a PhD at the Scott Polar Research Institute in Cambridge on radar propagation effects in glaciers. He then changed field (and medium) to research underwater acoustics, initially working at the Admiralty Research Establishment in Teddington and then at the Naval Research Laboratory in Washington DC, USA. On his return to the UK he spent two decades working in consultancy firms specialising on underwater acoustics, before moving to NURC in 1999.

The concept of a diagnostic tool - a simple analytical formula that gives insight, or can be used to check the results of complex numerical calculations - is a recurring theme throughout his career. When developing such tools the ability to make the right approximations requires deep physical insight, a quality he possesses in abundance.

His work has included significant contributions to the improvement of sonar performance models. He has developed closed-form formulae that can be used as benchmarks, or used in fast codes to predict sonar performance. His work led to the propagation loss benchmarks for the Sonar Modelling Handbook, the INSIGHT sonar performance model used by navies and research laboratories worldwide, and the bistatic sonar performance model SUPREMO developed while at NURC.

His seminal work on three-dimensional (3D) propagation in situations where the seabed is not flat, for which he received the Institute's A B Wood Medal in 1992, was carried out long before such problems became soluble through fast numerical computation. The ideas he introduced are still used today to aid the interpretation of acoustic propagation in complex ocean environments.

Chris Harrison receives the 2008 Rayleigh Medal from the President

Some of his most innovative work has been performed since he moved to NURC, where he has investigated the passive measurement of seabed parameters using ambient noise - the sound produced by wind and waves. He has shown how a vertical array can be simply used to determine the reflection properties of the seabed and estimate its layering. These concepts have been successfully implemented experimentally and give the community new, powerful tools for estimating some of the most difficult ocean parameters.

A hallmark of Chris's papers and presentations has been the reduction of complex physics to deceptively simple terms, often leaving the reader wondering 'Why didn't I think of that?' He is a theoretical acoustician with deep physical insight, and an ability to put his ideas to practical use. His pioneering work has resulted in genuine innovations that have challenged how we look at existing concepts in underwater acoustics.

For these reasons the Institute of Acoustics is very proud to award the 2008 Rayleigh Medal to Dr Christopher Harrison.

Award: Wendy Sadler

for Promoting Acoustics to the Public

It was possible (at long last) to conclude some outstanding business of the Institute at the Spring Conference: the Awards for Promoting Acoustics to the Public for 2006. Wendy took full advantage of the captive audience at the Conference Dinner to compare a group of acousticians with her experience of young people, and asked for an intuitive response to the question of whether a 'singing' wineglass sounded higher or lower when emptied. It is slightly embarrassing to report that of those who voted, 90% got the answer wrong. This was a slightly worse performance overall than that of school pupils, although they might have been guessing... Those acousticians who chose not to vote at all receive a definite demerit, however!

Wendy's passion for promoting acoustics to school students and the general public alike using music as a theme arises out of her mission in life to excite people about science in general. Her work in this area began in 1995 when she started working with the Techniquest Science Centre in Cardiff Bay where she was responsible for the development of music shows for the theatre and workshops for visiting families on the topic of musical instruments. She was awarded a BA/Royal Society Millennium Award to develop and deliver music technology presentations and workshops in South Wales. These presentations are aimed at using music as the hook to engage an interested, but non-specialist, adult audience in music technology and acoustics.

In 2002, Wendy established her own business called Science made Simple. Wendy has also written popular articles on the science of sound, has presented on local radio about how sound works and has also written books on the theme. She has developed her own science of music show and has travelled widely with the show. An accomplished musician, she uses various musical demonstrations to bring the shows to life. Performing the 'Last Post' on a corrugated tube, and making strange, vaguely musical, sounds from a dustbin and a bucket make for an entertaining and memorable performance.

Wendy Sadler with her Award for Promoting Acoustics to the Public

Wendy has also engaged many young students through lectures and in particular an Institute of Physics National Schools and Colleges Lecture Tour featuring her show "Music to your Ears" with which she has travelled the world. The presentation covers the basics of sound production, frequency and pitch, amplitude and volume, the dangers of listening to loud music, tinnitus, resonance, harmonics, how an acoustic amplifier works, how analogue music is turned into digital signals, how electronics can be used to change the sounds of a voice and how voice synthesis works.

She says that acoustics is a fascinating area of study and one that has a fundamental impact on many aspects of our everyday lives. She is delighted to be able, by means of music, to encourage young people in particular to think more about the science of sound, and, we hope, generate an interest later in life to consider acoustics as a possible career.

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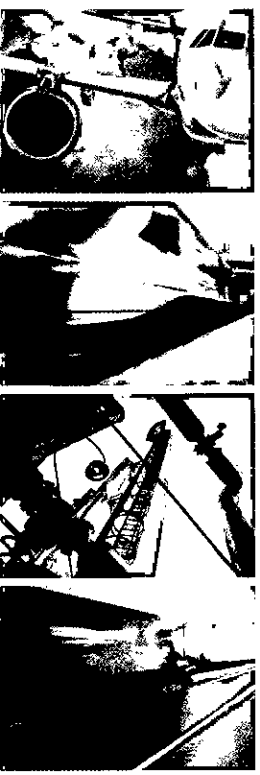

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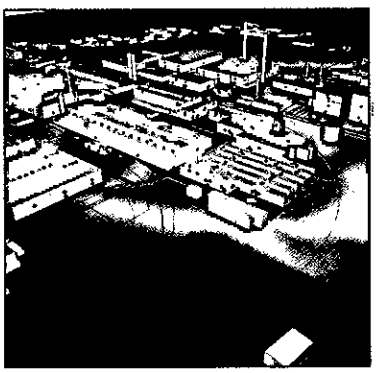
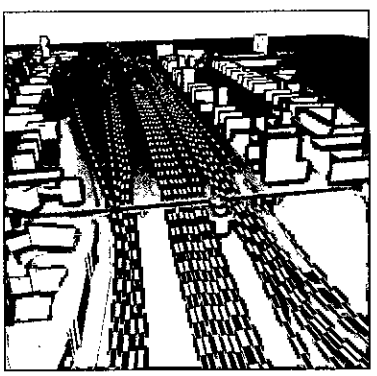
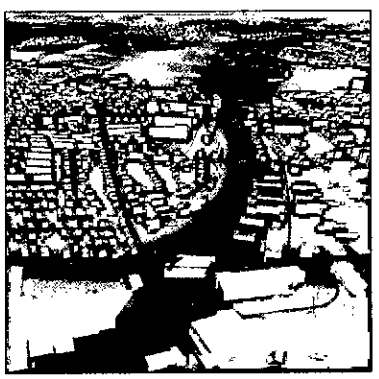


Prediction and detailed analysis of noise at industrial facilities



Optimization of building layout near roads and railway lines



Calculation of noise maps for cities of any size

Spring Conference 2008

University of Reading

The theme of the 2008 Spring Conference, organised by the Building Acoustics Group and held on 10 and 11 April 2008, was 'Widening Horizons in Acoustics'. The world of acoustics research is changing fast. There are many acoustically-related research projects that are not related to noise and vibration control, and indeed, many people carrying out acoustically-related research do not regard acoustics as their primary calling. The IOA's Spring Conference aimed to survey current acoustically-related research and to encourage interaction between IOA members on the one hand, and researchers working predominantly in acoustics on the other. As well as sessions on research related to the IOA interest groups, the conference included presentations describing current EPSRC-funded projects that have some acoustical content or relevance.

Special sessions were included on building acoustics, acoustics in medicine, musical acoustics, soundscapes, underwater acoustics, inverse problems in acoustics, environmental acoustics, communicating acoustics, engineering acoustics, measurement and instrumentation, and speech and hearing.

The Conference attracted 187 delegates - the great majority of which attended on both days - and more than 110 papers, starting with the Rayleigh Medal Lecture by Chris Harrison. There followed four parallel technical sessions, with each of the sessions chaired by a different specialist, conforming with the IOA's usual practice at large conferences. The second day's proceedings again began with a medal lecture, this time by Jian Kang, 2008 Tyndall medallist.

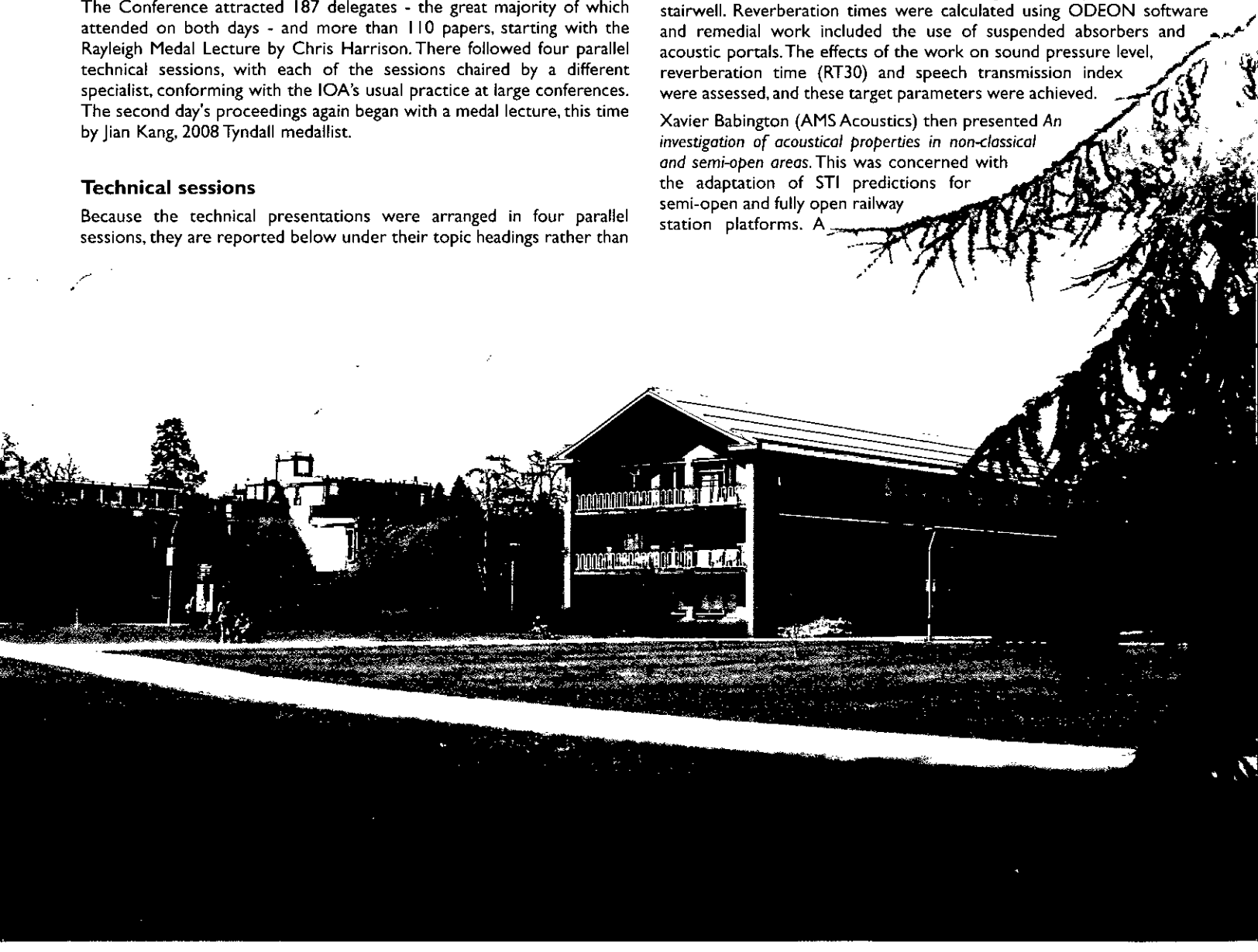
Technical sessions

Because the technical presentations were arranged in four parallel sessions, they are reported below under their topic headings rather than truly chronologically. The author certainly needed a while to 'get his head around' the printed abstracts (alphabetically by subject grouping), the conference programme (chronological, but in room order) and the delegates' list (alphabetical)! 'Building acoustics' sessions, for example, began the conference in Room A, but it was not until 24 hours later that the session was concluded with a further six papers, a different chairman, and in a different lecture room. It is therefore hoped that the treatment which follows is not too confusing.

Building Acoustics

The session opened under the chairmanship of Anne Carey. The first paper was *Wire-free work spaces: the Saltire Centre, Glasgow Caledonian University* was presented by Sarah Russon (BDP Acoustics). Sarah gave a 'tour' of the Centre and its unique adaptation of the acoustic design to incorporate both new interior and sustainable design ideas. The Learning Centre at the university consisted of five floors of study and resource areas, with a main circulation atrium linking the courtyard and central stairwell. Reverberation times were calculated using ODEON software and remedial work included the use of suspended absorbers and acoustic portals. The effects of the work on sound pressure level, reverberation time (RT30) and speech transmission index were assessed, and these target parameters were achieved.

Xavier Babington (AMS Acoustics) then presented *An investigation of acoustical properties in non-classical and semi-open areas*. This was concerned with the adaptation of STI predictions for semi-open and fully open railway station platforms. A



The attractive Reading University campus seen from near the Palmer Building

public address and voice alarm system in such an area needed attention to subtleties that could improve acoustical predictions of reverberation time and speech intelligibility. The effective volume and direct-to-reverberant-noise ratio of a space as yet unbuilt could only be estimated, and Xavier looked at the parameters in greater depth as the first stage in an extensive prediction and measurement programme.

Next, Ze Nunes (Mach Acoustics) gave *An overview of on-site test results of classroom corridor walls, including the effect of doors, glazing and ventilators.* The requirement for 40dB insulation performance (BB93) had made cross-ventilation unfashionable, but little information was available on the site tolerances applicable to these corridor partitions. The results of 85 site tests were presented on partitions with various ventilator types, door seal types, service penetrations and glazing, and the standard of workmanship was also assessed. Likely site tolerances could then be proposed, and comments were made on the outcomes in terms of the requirements of BB93.

Yan Meng (University of Sheffield) presented *Numerical modelling of sound fields with mixed specular and diffuse boundaries using a combined ray tracing and radiosity method.* This was a prediction method for urban areas suitable for use in auralisation, based on a combination of ray tracing and radiosity.

The insertion loss of poroelastic plate silencers in the flow duct was explored by Haydar Aygun (University of Hull). The investigation included the insertion losses of perforated and non-perforated poroelastic plate silencers in a duct.

Controlled cold extrusion of recycled porous media for acoustic applications was the subject of the paper by Amir Khan (University of Bradford). This was concerned with the production of acoustic materials from waste products using a new low energy method. The materials could be designed for impact insulation and sound absorption, and the costs per square metre sheet was considerably lower than that of sending the same waste materials to landfill.

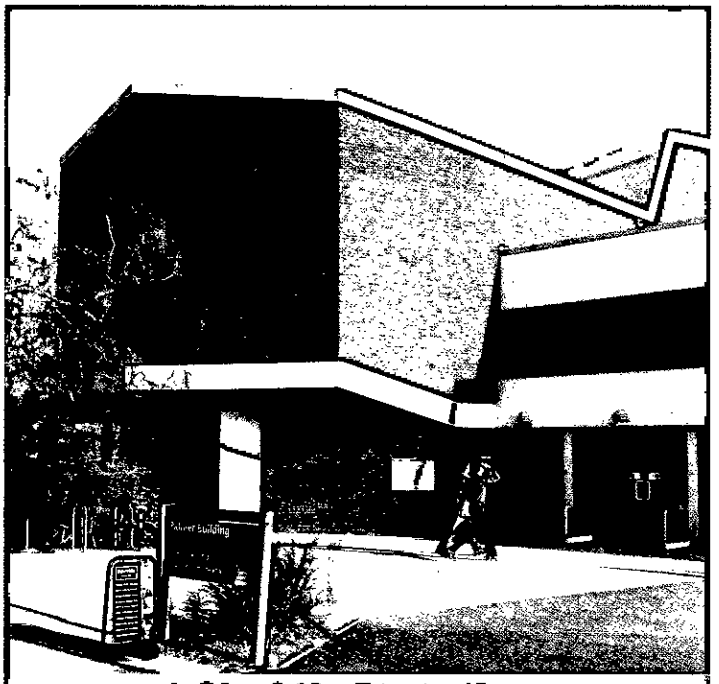
Thursday's Building Acoustics session concluded with an interesting - and at times heated - discussion on the future of building acoustics research, with contributions from Jian Kang (University of Sheffield), Trevor Cox (University of Salford) and Carl Hopkins (University of Liverpool). International perspectives were provided by John Bradley (Canadian National Research Centre) and Jin Jong Jeon (Hanyang University, Korea).

Nigel Cogger was chairman of the concluding Building Acoustics session.

The session opened with a paper *Computer model utilisation for speech intelligibility assessment in enclosed spaces using sound systems* by Christos Nestoras and Stephen Dance (both London South Bank University) which presented a computer modelling technique for the analysis of room acoustics in spaces, with particular reference to estimating the speech intelligibility. The model has been validated for three example room types and good agreement with both T_{30} and STI characteristics was found.

The following two papers examined practical issues with sound insulation testing that have emerged as a result of the implementation of the Approved Document E requirements for testing residential properties. *An examination of the guidance for field measurements of sound insulation in the ISO140 series of standards: Initial results* was presented by Robin Hall (BRE) on the interpretation of BS EN ISO 140-4 and 140-7 methodologies when undertaking field testing in typical domestic rooms. This paper reviewed the effects of level differences in the source signal between adjacent third-octave bands and source location on the reliability of measurements and found that neither gave rise to significant variation in the measured single number sound insulation, although further work with different separating partitions and source types needs to be undertaken.

Ian Critchley then presented *A joint research project by the Association of Noise Consultants (ANC), Robust Details Ltd (RDL) and the Building Research Establishment (BRE)* the results of an empirical study undertaken with co-author Philip Dunbavin on the presence of the tester in the room and fixed and moving microphone measurement techniques. The testing showed that the presence of occupant in the source room while recording source data, but not when recording receiver data, made little difference to the single figure sound insulation value, particularly for larger rooms, but could lead to an apparent reduction of up to 1dB in smaller rooms (~20m³). Use of a manual moving microphone could result in improved repeatability of measurements at low frequencies, compared with fixed microphone positions. These two papers were part of an ongoing study to improve the reliability and accuracy of field measurement of sound insulation.



the Palmer Building, University of Reading, home of the IOA Spring Conference for the first time

the layout of the Palmer Building made it easy to change sessions between papers

John Bradley (National Research Council, Canada) then gave *A new procedure for assessing the speech security of meeting rooms* which was a lucid presentation of a procedure for assessing speech security in rooms by assessing the sound transmission characteristics of the partition and the ambient noise level in the receiver room. In contrast to conventional methods, the technique assessed conditions at 'more sensitive listening locations' (ie close to the partition) rather than relying on the more normal average levels of the diffuse sound field in a room.

Carl Hopkins (University of Liverpool) then showed in *Airborne sound transmission across solid homogeneous plates: A review of theory and practice for building acoustics applications* how SEA methods could be applied to the calculation of the sound transmission of homogeneous plates (masonry, concrete or plasterboard partitions) commonly found in buildings. Carl showed that, by considering the source and receiver rooms and the

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partition as separate subsystems in the model, and separating the non-resonant (mass law) transmission from the resonant transmission (modal effects, critical frequency effects and flanking), accurate predictions of the sound insulation of practical building elements could be achieved.

The final paper, presented by Jin Yong Jeon (Hanyang University, Korea) was *Investigating the characteristics of floor impact sounds in a box-frame type reinforced concrete structure*. This provided an interesting insight into measurement techniques to determine the low frequency response of floors in concrete box frame buildings. Whilst such buildings are less common in the UK, the method highlighted the differences between the conventional tapping machine used for impact testing in the UK and Europe (and the consequent limitation on the excitation of low frequency responses) and the Japanese standard 'banging test' using a car tyre dropped from 0.85m onto the floor, which excites responses below 100Hz. The paper highlighted the difference between the strategy necessary to control higher frequency impact sound (through a conventional resilient material) and controlling low-frequency floor responses using damping.

Medical Acoustics

The medical acoustics sessions were chaired by Michiel Postema and Paul Campbell. The first session focused on observations of bubble–ultrasound interaction.

First, Michiel Postema (University of Hull) opened with an overview of potential ways to disrupt blue-green algae by ultrasound insonification at low acoustic pressures. In *Bubbles, ultrasound and swimmer safety* he noted that the pressures generated by typical commercial equipment may surpass the threshold pressure to which divers could be safely exposed.

Georg Schmitz from the Ruhr-Universität Bochum presented *Acoustic characterisation of microbubbles for improved quantification*, in which he explained how individual microbubbles can be individually imaged using Sensitive Particle Acoustic Quantification (SPAQ). The statistical corrections to compensate for multiple destructions were elaborately discussed.

Then, Paul Campbell (University of Dundee) gave some *Preliminary observations on sonoporated cells via real-time fluorescence-guided atomic force microscopy*, and showed examples of bubble–bubble interaction of optically trapped bubbles. The high-speed films of jetting through coalescing microbubbles were especially fascinating.

The second session focussed on therapeutic applications of microbubbles. It began with Steve Wrenn from Drexel University, who demonstrated how to engineer a stable bubble in *Why a different tune is sung after the bubble pops*. He explained the importance of the encapsulating shell being a shell rather than a liquid. A highlight was his demonstration of a flaw in the dissolution theory of Epstein and Plesset. Futhermore, he showed experimental evidence of successful linkage of microbubbles to vesicles.

Manish Arora (University of Oxford) then presented *Harnessing cavitation for effective high-intensity focused ultrasound (HIFU) therapy*, and demonstrated that in high intensity focussed ultrasound cavitation, concentration can be directly correlated with thermal damage of cells. Locating the cavitation activity and controlling the cavitation nucleating were also discussed. Through *ex-vivo* experiments, the saturation of cavitation activity was demonstrated.

Attached ultrasound contrast agents by Mairead Butler from the University of Edinburgh was a presentation about targeting ultrasound contrast agent microbubbles to vulnerable plaques. She showed how this can be successful even under flow conditions.

Lastly, Raffi Bekeredjian from the University of Heidelberg showed how gene therapy can be achieved using virus vectors attached to microbubbles, in a paper called *Ultrasound targeted microbubble destruction augments AAV-mediated cardiac gene transfer in rats*. It followed that vectors attached to microbubbles augmented the delivery rather than merely mixing the microbubbles with plasmid DNA.

The third session on medical acoustics focussed on modelling.

Keith Attenborough gets the conference under way in the main lecture theatre

A numerous and attentive audience for the Rayleigh Medal Lecture

A particularly well-attended conference

Eleanor Stride (University College, London) discussed the modelling of microbubble behaviour in a paper entitled *Modelling ultrasound contrast agents: current challenges*. She showed how diffusion during a single ultrasonic cycle can be modelled. However, she also demonstrated that encapsulated microbubbles revealed harmonic behaviour at low acoustic pressures, leading to whole new challenges in contrast imaging.

Meng-xing Tang (Imperial College, London) gave a paper called *Quantitative imaging of ultrasound contrast agents*, which showed how the bubble concentration, ultrasonic frequency and pressure related to the backscattering coefficient. He also proposed a new imaging technique to compensate for tissue harmonics.

To wind up the medical acoustics sessions, Claudia Leavens from Sunnybrook Health Sciences Center (Canada) gave an introduction to phase codes and Golay coding in *Phase codes in ultrasound imaging: the dependence of signal-to-noise ratios on bandwidth requirements*. She showed the inevitable trade-off between axial resolution and signal-to-noise ratio.

Musical Acoustics

The musical acoustics sessions reported on a wide variety of experimental and theoretical studies carried out on string, percussion and wind instruments. A common theme which emerged from many of the papers was the crucial importance of combining physical measurements with psychoacoustical studies.

The sessions were chaired by David Sharp and Murray Campbell, and the first group of papers concentrated on stringed instruments. It began with *Plucked string sound analysis and perception* presented by Bernard Richardson (University of Cardiff). Bernard presented an overview of aspects of the acoustics of guitars and harps. He introduced a model which is helping to determine the parameters that are most important in characterising the sound qualities of different instruments.

Jim Woodhouse (University of Cambridge) then presented *Perceptual studies of violin vibrato* in which he reviewed a project carried out by Claudia Fritz: input admittance curves were convolved with various bridge force signals in order to produce synthesised violin sounds. These sounds were employed in psychoacoustical tests to establish the significance of changes in input admittance.

Next, Colin Gough of Birmingham University discussed *The real-time simulation of violin tones* using a bowed electric violin, bridge pick-up and a real-time audio signal processing system, SignalWizard, in an attempt to understand how fine Italian instruments differ from the majority of modern instruments. His talk was illustrated with demonstrations of the synthesised sounds derived from the impulse responses of Stradivari and Guarneri violins.

He followed this with *Finite element analysis of violin shell modes*, which was a preliminary analysis of the vibrational modes of a violin using a PC-based FEA package. By varying the parameters in the model, he demonstrated the significance of the mechanical properties of various component parts to the structural modes of the instrument. The main conclusion was that soundpost position had a dramatic effect on the radiated sound output, and thus the tone quality, of the instrument.

The normal modes of cymbals were then discussed by Gerry Swallowe (University of Loughborough) in a comparison of a 12-inch ridged cymbal with previous work on an 18-inch crash cymbal. He showed Chladni patterns which indicated mixing of modes at certain frequencies. This mixing was explained in terms of first order perturbation theory, an interesting link with quantum mechanics.

The same speaker proceeded to discuss *Sacred geometry and the western bell*, in which Gerry presented some observations made by Robert Perrin regarding the geometry of bells, and showed that certain aspects of the outer profiles of many western church bells, carillons and handbells are described with considerable accuracy by geometrical figures based on the 'golden ratio' of 1.618:1. This has not always been the case and it might be interesting to investigate when and why makers started to adopt the current geometry.

Jonathan Kemp (Edinburgh University) presented some *Improvements to bore profile measurement in acoustic pulse reflectometry*, a technique in which a loudspeaker sends a signal through a source tube into the object under test, and the resulting reflections are measured using a microphone. Short-duration acoustic pulse were first used, but recently, maximum length sequences have been used and the impulse response and internal bore profile calculated after a deconvolution-based calibration. This enabled bore profile measurements to be made more quickly and with greater accuracy.

The next paper, presented by Mike Hutley, was on *Quantitative optical measurements of the aperture of and form of vibrating reeds*. Mike demonstrated how reed instruments could be investigated using equipment readily available on the high street: all the apparatus that he employed was inexpensive and available from domestic suppliers, demonstrating that sophisticated measurements can be made on a shoestring. For example, air was 'sucked' through the reed using a domestic vacuum cleaner. The stroboscopic filing he achieved using an

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LED torch connected to a PC, but unfortunately the visual aids in the lecture room did not allow him to show the video results. He suggested that whereas a metrologist and player of Northumbrian pipes such as he had a particular interest in how reeds behaved, the audience of musical acousticians would be able to think of many other fruitful areas for research using his ideas.

Alan Woolley (Edinburgh University) gave *A review of an experiment on the pressure build-up in the feet of flue organ pipes originally carried out by Noel Bonavia-Hunt.* The modern work was carried out by a research student, Adam Apostoli. Bonavia-Hunt was an Anglican priest and amateur scientist who in 1923 published his treatise 'Modern organ stops'. He described in this work some experiments on the pressure build-up in the feet of flue pipes, and concluded that when a note is rapidly repeated, the pressure in the foot never reached the full steady-state pressure. Although Bonavia-Hunt did not specify how he measured the pressure, it seems likely that a water manometer was used, so the researchers set out to replicate the experiment. Using modern pressure-measuring instruments, it was found that the full steady-state pressure was in fact always reached (very rapidly). It therefore appears that the water manometer was unable to respond to the changes of pressure sufficiently quickly, and the result reported in 1923 was an artefact.

Effect of non-linear propagation on timbre of brass instruments was the title of Samuel Stevenson's paper (Edinburgh University). Sam presented measurements carried out on trombones and French horns, comparing mouthpiece pressure waveforms and radiated pressure signals at different dynamic levels. These measurements demonstrated the effects of non-linear sound propagation in generating the characteristic 'brassy' sound of brass instruments.

A psychoacoustical investigation into the effects of wall material on the playing properties of lip-reed instruments was the title of a presentation by David Sharp (Open University), in which he reviewed a project carried out by James Whitehouse in which the effect of material on the wall vibrations and tonal properties of five posthorns was investigated. Studies in which the posthorns were artificially blown were compared with findings from a series of blindfold playing tests using professional musicians.

Alistair Disley (University of Kent) discussed the difficulties of *Practical synthesis control by timbral adjectives* associated with producing a synthesiser based on timbral adjectives. He went on to describe the development of a new approach to timbral synthesis in which the user is able to adjust specific groups of harmonics by means of a set of sliders.

Allan Seago (London Metropolitan Unversity) spoke on *Timbre space as synthesis space: Towards a navigation based approach to timbre specification.* He described attempts to construct a three-dimensional timbre space in which Euclidean distances were quantitatively linked with perceived timbral dissimilarity. He presented the results of two pilot tests of different navigational strategies. He emphasised that a larger number of dimensions would be required for a fully descriptive timbral space.

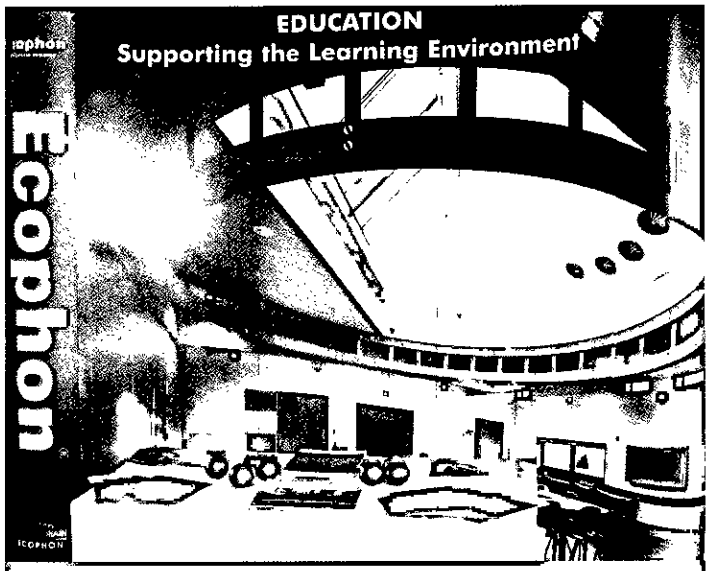
The parameterisation and measurement of expressive timbre by Andrew Earis (Royal College of Music) described spectral analysis techniques used to parameterise and measure the tone quality of individual notes in a number of recordings of a Bach Prelude played on the guitar. He demonstrated spectral effects of different expressive techniques used by the player.

Soundscapes

The first soundscapes session was chaired by Mags Adams. Yuliya Smyrnova (University of Sheffield) gave a *Subjective evaluation of urban soundscape auralisation* based on a combined ray-tracing and radiosity (CRR) model.

An activity-centric conceptual framework for assessing and creating positive urban soundscapes was then explained by Rebecca Cain (University of Warwick).

Mags Adams (University of Salford) then considered *Soundwalking as methodology for understanding soundscapes.* She described the development of the soundwalking methodology and its use as a tool to engage professionals working in the area of urban design and urban



Ecophon showed acoustical treatments for the education sector

development. The findings of the project were not reported - data collection is ongoing - but reflected on the utility of soundwalking as a methodological practice.

The classification, semantics and perception of urban park sounds: methodological issues were then discussed by Sarah Payne (University of Manchester). Sounds were generally categorised into 'human', 'nature' and 'mechanical', but for research to be carried out on lay people's perception and evaluation of environmental sounds, the results should be frames in their language and sound classifications. This paper focused on the context of urban park sounds, thus uncovering lay people's own terminology.

The canal environment soundscape in Birmingham was an attempt by Zoe Millman (Birmingham City University) in collaboration with British Waterways to interpret the city centre soundscape in central Birmingham. The study was based around an hour-long canal walk starting at Brindley Place and taking in several canalside sounds including Farmers Bridge Locks. The research aimed to investigate the sound experience as a signifier of place identity, and identify dominant sounds, their origins, associations with time and place, and their impact on security, mood, and personal identity.

The later soundscapes session was chaired by Paul Jennings. *Physiological responses and subjective estimates of sounds: initial results of a pilot study* was the title of the paper presented by Ken Hume (Manchester Metropolitan University) in which people's perceptions of a positive urban soundscape depended on what they were doing at the time of listening. An activity-based conceptual framework was under development with the idea of informing the planning process with regard to assessing and creating positive soundscapes.

This was followed by *Soundscape as a discursive practice*, a paper by James Wyness (University of Aberdeen). James sought to explore soundscape within the context of a specific work in progress, with sound excerpts to illustrate the talk. He addressed the conference theme by offering a theoretical and empirical contribution from am artistic perspective.

Isobel Clouter (British Library Sound Archive) then explained *The role of sound archives in soundscape research*. The soundscape movement, at its outset, was marked by a series of sound recording projects seeking to document the acoustical environment by qualitative and quantitative analysis. Isobel sought to promote discussion on the role of sound archive material in the growing field of acoustical environmental research, and what the response should be to a rapidly changing acoustical environment.

Christos Karatsovis (ISVR Consulting, University of Southampton) presented the development of a new type of sound classification instrument in a collaborative project between ISVR and the Universities of York and Newcastle. In *Instrument for soundscape recognition, identification and evaluation: an overview and potential use in legislative applications* the development of signal analysis techniques, recognition algorithms and hardware implementation was given an overview, and the way in which the instrument night influence and affect noise legislation in the UK was considered.

Three strategies for the design of social listening experiences were presented by Florian Hollerweger (Queen's University, Belfast), who looked at recent developments in the area of locative and context-aware media.

Measuring soundscape improvement in urban quiet areas by Gianluca Memoli (Imperial College, London) dealt with a 'sonic garden' in Florence, where special sound compositions were emitted to contract with road traffic noise affecting the area. The slope indicator (from the L_{Aeq} time histories) and classical psychoacoustic parameters such as energy level, loudness and sharpness were in the set of quantities used.

Helmut Lemke, a sound artist at the University of Salford, presented *Sound collecting methods, language, drawing, audio recording and photography: limitations and potential*, a paper based on the research 'the sound the site requires'. This examined the proposition that sound was a valuable medium for recording and interpreting physical and social landscapes. Any recording process inevitably meant transformation of the 'real thing; into electronically-created signals, and removing a sound from its source thus altered its physicality, thus making it more difficult to identify.

Florian Hollerweger (Queen's University, Belfast) then concluded the session with the 'performance' of *Ohrenli(e)der: Compositions for listener*. The title can be translated as 'earlids' or 'earsongs' depending on the inclusion or omission of the 'e' in the German word. The scores require the perpetrator to 'open' or 'close' the ears separately or together with a suitable occluder, and can be 'performed' anywhere there is ambient noise. The intention was to offer an engaging way of increasing awareness and appreciation of the personal acoustical environment.

Underwater Acoustics

Peter Dobbins was chairman for the Underwater Acoustics session of five varied and interesting papers. First was Kae Yeet Foo (University of Birmingham) who discussed *Ad-hoc time synchronisation in a multiple-hop underwater network*.

Then, Dean Waters (University of Leeds) considered *Using acoustic tomography to track echo-locating bats*. Despite the title of the session, this was not strictly an underwater acoustics matter, but was about the use of a common technique for tracking marine mammals as adapted to the localisation of bat species. Eight receiver stations were used to detect and track bats in the field, using their echo-locating ultrasonic emissions.

Acoustics application of photometric stereo was a paper given by Peter Dobbins (SEA). Peter considered potential underwater acoustical applications of an optical technique of 3D imaging, photometric stereo (PS). This derived information about the surface of an object by comparing co-register images obtained from a minimum of three different illumination sources. In principal, this would work in an acoustical, rather than a visual, context, and various means of obtaining the multiple images were proposed.

Global warming, coastal erosion, vortices and sound were elucidated by Peter Thorne (Proudman Oceanographic Laboratory) in a paper that explained how acoustics could be helpful in predicting the impact of global warming on the coastal environment, in particular the influence on sediment transport pathways. This is an area which at present is not well understood, and acoustics has begun to make a significant contribution. Peter looked at recent advances and looked forward to future developments in the field.

Biologically-inspired ultrasonic signals for physical characterisation of geological materials was the title presented by Clare Hopper (University of Leicester). Acoustical techniques had the great advantage that they were non-invasive when used to characterise geological materials in situ, but the bandwidths currently used limited the spatial resolution available. Turning to marine mammals such as dolphins for inspiration, it was found that they achieved superior resolution and energy delivery, and they

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could characterise materials using broadband ultrasonic clicks. A water-based test rig was built to investigate how such techniques could be harnessed: a range of biologically-inspired signals was developed and initial evaluations were under way.

Inverse Problems

The opening session of Inverse Problems was chaired by Phil Nelson.

The opening presentation was *Mathematics for inverse acoustic techniques, possibilities and perspectives* by Roland Potthast (University of Reading).

Having set the scene for further papers, next was Fatim Yaman (Instanbul Technical University, Turkey) with *Shape reconstructions of sound: soft obstacles buried in arbitrarily-shaped penetrable cylinders*. Takashi Takeuchi continued with *Extension of the optimal source distribution for binaural sound reproduction*.

Mun Park (ISVR, University of Southampton) then considered the *Application of an auditory process model for the evaluation of stereophonic images*.

After a break, the session resumed under the chairmanship of Simon Chandler-Wilde.

Timos Papadopoulos (ISVR, University of Southampton) presented *Inverse filtering for binaural audio reproduction using loudspeakers: potential and limitations*.

Phil Nelson (ISVR, University of Southampton) gave a paper called *Applying inverse methods to distributed source regions. Acoustic tomography by orthogonality sampling* was the subject of the next paper, by Roland Potthast (University of Reading).

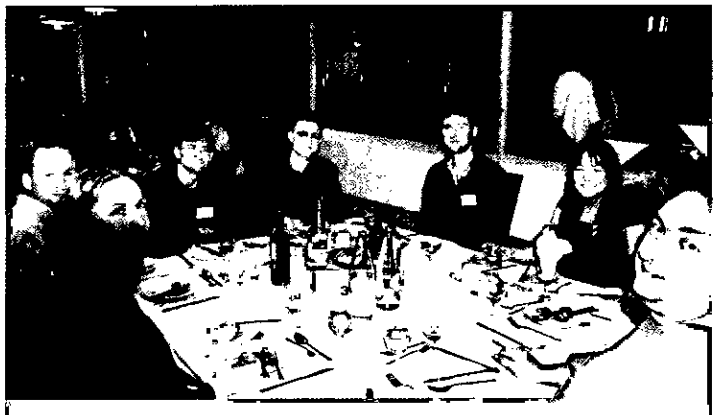
Fehmi Ben Hassen (ENIT-LAMSIN, Tunisia) then discussed *Source localisation in ellipsoids by best rational approximation in planar sections*, and the session was brought to a close by Olha Ivanyshyn (Georg-August University, Göttingen, Germany) with *Inverse acoustic obstacle scattering for far-field data without phase*.

Environmental Acoustics

Chaired by Kiril Horoshenkov and Jian Kang, the Environmental Acoustics sessions included nine varied papers from a variety of researchers. The first was *Noise from a rooftop wind turbine in London* by Stephen Dance (London South Bank University), which dealt with a 6kW horizontal turbine (made by Proven) on an eleven-storey 1960s concrete block of flats. Noise and vibration measurements on the rooftop and in the nearest flat amply demonstrated London's claim to be a '24-hour city'. Energy performance of the machine was also monitored.

Nadia Bousseksou Belayat (London Metropolitan University) then presented some *Preliminary results of noise monitoring from entertainment halls in Algeria*. Noise pollution had over the past ten years become an environmental issue, mainly because of road traffic noise, but also because of 'wedding halls': many had been built with no sound insulation measures, because of a lack of any framework or enforceable noise standards in the country. Modern sound reproduction and music amplification systems exacerbated the problem. The survey work was aimed at achieving the WHO guidelines by recommending appropriate noise regulations in Algeria.

Phil Wash (London South Bank University) then took the audience through a recent study of i-Pod listening levels on London Underground for music and speech. Anecdotal evidence of the high listener noise levels were investigated quantitatively by comparing the listening levels under 'quiet' conditions and in simulated noisy surroundings, using calibrated recordings of Underground trains. Participants listened to an i-Pod whilst a binaural head and torso simulator (HATS) 'listened' to the same track. Pop music, rock music and speech podcasts were all investigated. The rock music subjected 90% of the listeners (who self-selected the levels) to excessive noise (compared with the Lower Exposure Limit) after one hour on a virtual train. The i-Pod volume was increased by a greater margin for the podcast than for speech: 22dB compared with 12dB on average.



eagerly awaiting the main course

perhaps the most musical table?

'top table' with a greater than usual accumulation of dignitaries

Linda Macan-Lind insists that the bottle really does contain water!

Designing tranquil spaces: a proposed landscape management planning tool was then presented by Robert Pheasant (University of Bradford). This research was aimed at safeguarding existing, and developing new, tranquil spaces by understanding the effects of audio-visual interaction on the perception of tranquillity. A reasonably robust linear expression to rate the quality of such a space had been established, and once fully validated could become a useful planning tool for landscape management.

Ines Kargel (Sonic Atelier, Austria) focused on *The city as a resonant space*, looking at the key role in urban acoustics played by architecture and design. The research had been independent and inter-disciplinary, and suggested that in current planning practice the complexity and diversity of the acoustic effects of architecture were generally underestimated. He showed how the construction of large-scale resonant spaces were influential on urban acoustics, and suggested that the findings could be put to use in creating sustainable environments.

Steve Mitchell (Environmental Resources Management) discussed *Aircraft noise exposure around European airports: future trends and the influence of aircraft certification.* The paper sought to investigate the effects on the noise climate around European airports of the projected growth of air travel. The noise exposure aspects of the EC Directive 2002/30 were concentrated on, and the general question as to whether airports were getting noisier, and what would happen if the noisiest types were banned, was addressed. The conclusion was that although the noise exposures of European populations, based on the usual L_{eq} metrics, would continue to increase until 2015, the effect on health at each airport was within the control of local airport management and regulation, and the response of the airport neighbours.

Peter Brooker (Cranfield University) presented his critique *ANASE: Lessons from unreliable findings* in a controversial paper about the report 'Attitudes to noise from aviation sources in England'. The quantitative findings of this report were rejected by the Department of Transport as 'unreliable'. He asked what went wrong, and sought the reasons for the failings in project management and methodology. Some lessons to be learnt by acoustics professionals were proposed.

Importing arbitrarily complex objects within a FDTD-based prediction application was presented by Ian Drumm (University of Salford). This was a fast and reliable method of incorporating surface data within a Finite Difference Time Domain based acoustical prediction application. An account was given of the scanning of a mouse figurine and its incorporation into the model. This approach had potential applications in room acoustics, musical acoustics and any scenarios involving complex surfaces.

Naoko Evans (University of York) spoke about *Automated acoustic indentification of vehicles* such as those approaching protected infrastructure. This was a project intended to develop real-time recognition of vehicles using a primarily time-domain methodology. The work is at an early stage but the background, the methodologies involved, and the results to date were presented.

Communicating Acoustics

Sound matters was the title of a presentation by Steve Dorney (ISVR, University of Southampton), who spoke about recent public engagement activities ranging from vegetable orchestras to digital storytelling. Experiences and lessons learnt by the collaborators were outlines, and possible ideas for future collaborations were floated.

Wendy Sadler (Science made Simple), the 2006 recipient of the Institute of Acoustics' Award for promoting acoustics to the public, presented her *Top tips for engaging the public.* Wendy asked what kinds of tools could be used to engage a wider audience with one's research, and how presentations should be tailored to difference age groups, and people who learn in different ways. She went on to suggest some answers based on her own experience, with practical examples of demonstration types that she had found to work well with different groups.

Artists and scientists working together was presented by Clive Greated

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(University of Edinburgh who considered the physical analogies between sound and light, and the opportunities they presented for collaborations between artists and scientists. 'Sound in a man-made environment' was one such project, funded by ESPRC, which was centred on an art exhibition. The techniques used, and examples from the exhibition material, as well as some new ideas for the future, were discussed.

Acoustics ambassadors - Geeks with cred? was the question posed by Richard Collman (Acoustical Control Engineers Ltd and Belair Research Ltd). Richard is a stalwart of the 'acoustic ambassadors' scheme run under the aegis of the IOA, and began by asking whether the audience preferred to work with competent professionals or overworked amateurs. This was his way into bemoaning the state of science education in schools, and offering a positive way out, which involves engaging school students, many quite young, in the fascinating subject of acoustics and thus (it is hoped) stimulating an interest in science generally. Without science students there would not be enough acousticians in the future, and a skills shortage was in nobody's interest. Increased environmental awareness was making the shortages acute already.

Communicating acoustics through the media was presented by Trevor Cox (University of Salford). Trevor described his experience with BBC Radio Manchester, on which he is a regular contributor. He spoke about how acoustics is portrayed in the media - TV, radio, newspapers and internet - and explored the possibility of getting more reports through in order to help acoustical engineering raise its profile among policy makers, researchers and school pupils. The perceived lack of visuals was seen as a problem in the print media, and ways were discussed to overcome this difficulty.

Charlie Mydlarz (University of Salford) considered ways of *Involving the public in noise surveys via mobile technology* through the IMPRINtS project (internet and mobile technologies for a public role in noise surveying) which is aimed at enabling and encouraging public participation in a large-scale environmental noise survey. The primary objective was to raise public awareness of the science of environmental noise and the impact of soundscapes on the quality of life. Ultimately this ought to act as a driver for better urban planning, construction and development.

Steve Mesure (The Creative Science Consultancy), who has been working in public science engagement for over 20 years, presented *How to get going in public engagement, or Everything you wanted to know about public engagement but were too afraid to ask*. He explored some of the reasons why scientists took on public engagements, and described some of the expected (and unexpected) consequences. He discussed some creative examples of public engagement in acoustics and advocated the 'ready, aim, fire' policy in order to get going in public engagement.

Acoustics by the sea with 'Coast' was a talk by David Sharp (Open University) about his work for the BBC on the 'Coast' series, at the sound mirrors of Denge, Kent and at the Mull of Galloway. The Denge mirrors were conceived as large concave reflectors of concrete, intended to give early acoustical warning of the approach of aircraft over the channel. The structures were resurrected in order to try to detect and incoming Tiger Moth (not the fastest aircraft conceivable!). The experiments in Galloway were intended to demonstrate using a piano on the beach, that low frequencies travelled over water further than high frequencies, hence the need for foghorns to be low-pitched. David illustrated his talk with location photos and video clips from the programmes.

Engineering Acoustics

This session was a particular success, with no cancellations or 'no-shows'. It was chaired by Victor Krylov and Keith Attenborough.

First, Timos Papadopoulos (ISVR, University of Southampton) took as his subject *Backscattering impulse response modelling for rigid discs: comparison of analytical prediction and measurement*. He reported the experiments on acoustic backscattering from a rigid disc and compared the results with theory.

Numerical methods for high-frequency acoustic scattering problems were then explored by Stephen Langdon (University of Reading). He discussed a


Mark Payne, ANC prizewinner


Mike Ankers


Bernard Berry


Chris Harrison


Jian Kang


Bob Peters


Wendy Sadler

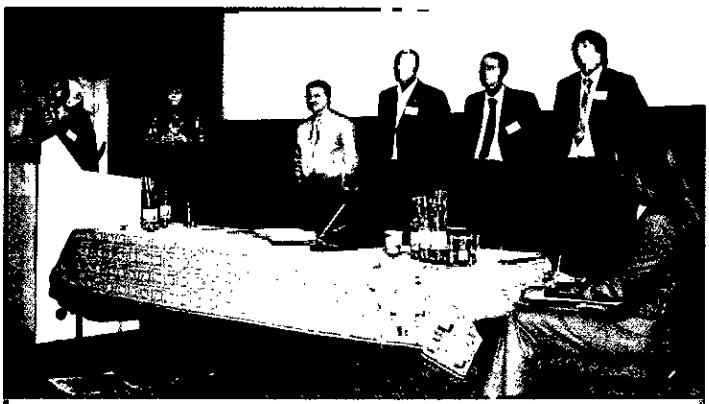

David Sharp

careers forum: Bernadette McKell

careers forum: Neil Morgan

careers forum: Richard Perkins

careers forum: Pete Theobald



careers forum: the panel answers questions from the floor

a president, three past presidents, and a soon-to-be president! [l to r] Trevor Cox, Colin English, Bernard Berry, Peter Wheeler, Mike Ankers

new numerical approach to the calculation of high-frequency acoustic scattering problems.

Radiation efficiency of finite plates with beam stiffeners were the research topic for Andreas Rousounelos (Loughborough University). He gave the results of analytical and numerical investigations of acoustic radiation by stiffened plates.

Jane Horner (Loughborough University) presented *Approximations for the properties of higher-order modes in ducts with aperture devices*. Jane described some new approximations to describe the propagation of higher-order acoustic modes in such ducts. This was followed by the *Propagation of laser-generated shock waves over rough surfaces* which was discussed by Qin Qin (University of Hull). Experimental results were presented.

Vassil Georgiev (Loughborough University) was the principal author of *Generation of flexural waves in infinite plates by laser-initiated shock waves*. He presented the team's theoretical results on how such shock waves generate of plate flexural waves and compared them with the experimental results.

Then Viktor Kralovic (Loughborough University) presented *Some new methods of damping impact-induced vibrations in badminton racquets*. He compared the results of an experimental investigation of different methods of damping of badminton racquets, in which the vibrations are always impact-induced.

Victor Krylov (Loughborough University) described an *Experimental investigation of a mono-hull boat with wave-like aquatic propulsion*. He presented and discussed the experimental results on a biologically-inspired wave-like aquatic propulsion system used on a mono-hull model boat, as an alternative to a conventional propeller.

The session was brought to a close (and a late lunch!) by a paper called *The use of spectrographic template matching to identify and classify salient sound events in tennis matches* presented by Gordon Hunter (Kingston University).

Measurement and Instrumentation

The chairman of the final session in Room C was Peter Wheeler. Six papers on several aspects of instrumentation design and implementation were presented by researchers in the field and by acoustical metrologists.

Richard Barham (NPL) looked at the *Acoustical impedance of ear simulators and the revision of IEC 60318-1*. The changes expected to the standard include an extension of the frequency range of interest up to 16kHz, an integration with IEC 60318-2, which deals with circumaural headphones, and (most importantly) a method for determining acoustical impedance. The paper looked at the research behind the new measurement method.

The work of the NPL was also scrutinised in *Airborne acoustic velocity measurement utilising laser Doppler anemometry combined with photon correlation in low seeded conditions*. Optical methods of acoustical metrology offered very attractive alternatives for calibration. One such system used laser Doppler anemometry combined with the photon correlation method, capable of measuring airborne particle velocities without additional transducers.

Hidajat Atmoko (University of Newcastle upon Tyne) described a *Wireless sensor network-based instrument for capturing soundscape*. Acoustic signal monitoring systems were required to identify and characterise sound sources automatically within a predefined area. The paper was concerned with the design of acoustic sensor arrays deployed as an integral part of a wireless sensor network. Experimental results from the preliminary work were presented.

An *Instrument for soundscape recognition, identification and evaluation: signal classification* was presented by Jon Stammers (University of York). The ISRIE project is a collaboration between the universities at York, Newcastle and Southampton (ISVR), with the York work focused on signak separation and classification. A time-domain signal coding feature extractor and a self-organising map classifier form the current approach to this part of the work.

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The *Instrument for soundscape recognition, identification and evaluation: source separation* was then continued by Oliver Bunting (University of York), who described the background to and aims of the project. A method was proposed for the separation of B-format soundscapes using directional audio coding in a short-time Fourier domain. The extension of the method by multi-resolution analysis was then outlined.

The measurement and instrumentation session was brought to a close by Richard Barham (NPL) with *Performance of a new MEMS measurement microphone and its potential application*. Low-cost microphones, especially for the mobile phone industry, were in great demand and manufacturers had responded by producing large numbers of MEMS microphones at a unit cost far lower than that of conventional microphones. This in turn meant that noise measurement applications using large numbers of microphones became feasible, but commercial MEMS devices had not been evaluated or even designed for such applications. A prototype MEMS microphone specially for measurement applications was described, and Richard looked forward to the future deployment of such devices in noise mapping applications.

Speech and Hearing

Emma Greenland chaired this session, which consisted of five varied papers ranging from the consequences of hearing loss to the development of speech recognition.

Phil Harrison (J P French Associates) spoke on the subject of *Formant measurement errors from synthetic speech*. This was an excellent presentation in which he demonstrated a 3D animated vowel quadrilateral over the entire vowel space, and considered the effects of different analysis methods on measurement errors.

Bridget Shield (London South Bank University)'s presentation *Psychosocial effects of hearing loss among adults* was a review of the literature on the psychosocial impact of hearing loss and the use of hearing aids in the UK.

Gordon Hunter and Angela Wigmore together gave us *Talk to the machine: it's listening - but the hand ain't typing! The development of the 'Ku-talk' and 'Talkmaths' speech interfaces*. These speech recognition interfaces were developed at Kingston University and the presentation included an impressive live demonstration of the 'Talkmaths' interface over a headset.

Effects of classroom noise and reverberation on the speech perception of bilingual children learning in their second language was the specialist subject of the team from University of Ferrara, Italy, represented by Roberto Bovo. The paper presented the results of a study of speech perception in Italian classrooms, quantifying the increase in speech-to-noise ratio required by bilingual children learning in their second language compared with children learning in their first language. The effects of different types of noise maskers were then considered.

Salvador Pellice Morant (JEM Safety Management Ltd) investigated *Noise exposure and hearing loss amongst classical music students*. A study had been conducted of hearing loss amongst classical music students at the Royal Academy of Music, and noise control measures for different musicians were considered in the pursuit of compliance with the Control of Noise at Work Regulations 2005.

Gratitude is owed to the organising committee - who individually acted as session chairmen - and to Keith Attenborough, whose leadership held the whole event together. Keith and the session chairmen also provided the notes from which this report was complied, for which the editor offers his personal thanks. Photographic credits are to Kevin Macan-Lind and Ian Bennett.

No major conference could be realised without the back-room efforts of Head Office staff, and Linda Canty's ceaseless patience in dealing with questions from delegates. How does she assimilate so much local knowledge so quickly?

Rayleigh Medal Lecture

The 2008 lecture was presented by C Harrison of the NATO Undersea Research Centre, Italy, in the only plenary session of the conference, which opened the proceedings on the Thursday morning. Its title was

Two minds but with a single thought: Ian Bennett and Dennis Baylis

Reflection and location using ambient noise, and was a fascinating treatment of how natural ambient noise, such as that of wavelets breaking in the open sea, could be used to investigate beneath the seabed without the need for an artificial noise source. Although military applications might be the first to come to mind, the lack of external noise was also a great benefit to marine wildlife who might otherwise be disturbed. Ambient noise was usually seen as a nuisance by researchers, and may just sound like a hiss, but it had spectral, and directional properties as well as spatial and temporal coherence that depend on the surroundings. Chris's recent work has shown that the seabed's reflection properties, sub-bottom layering and location of target-like objects can be extracted from the hiss using signal processing and innovative mathematical techniques. Potentially, a pair of hydrophones could replace active sonar. Both the theory and some experiments were described.

Tyndall Medal Lecture

The 2008 Tyndall Medal Lecture by Jian Kang was *Urban soundscape*. Although it was the focus of current practice and policies in urban sound environments, the reduction of sound levels would not necessarily lead to improved quality of life for the residents. The concept of soundscape represented a step-change in the field of environmental acoustics in that it combined physical, social and psychological approaches. Jian's team adopted an integrated programme of research, including evaluating, simulating or auralising, creating and predicting the finished soundscape by design rather than by accident. A series of soundscape surveys was undertaken in the UK, western Europe and China, and a number of simulation and prediction models were developed. Urban public open spaces were given particular attention. Although a considerable volume of work had already been completed in the field, further research was still needed in more facets: practical implementation of the research was yet to begin. One among the many problems unearthed by the surveys was that whilst British and German residents found the sound of a fountain in a public square pleasant, Italians apparently did not.

Underwater Acoustics group AGM

This was held following the technical sessions on Thursday 10 April. A report will appear elsewhere.

Musical Acoustics group AGM

This was also held following the technical sessions on Thursday 10 April. A report will appear elsewhere.

Careers forum

With the content of the Spring Conference being directed primarily (but my no means exclusively) towards academics and students, the opportunity was again taken to present a Careers Forum for those

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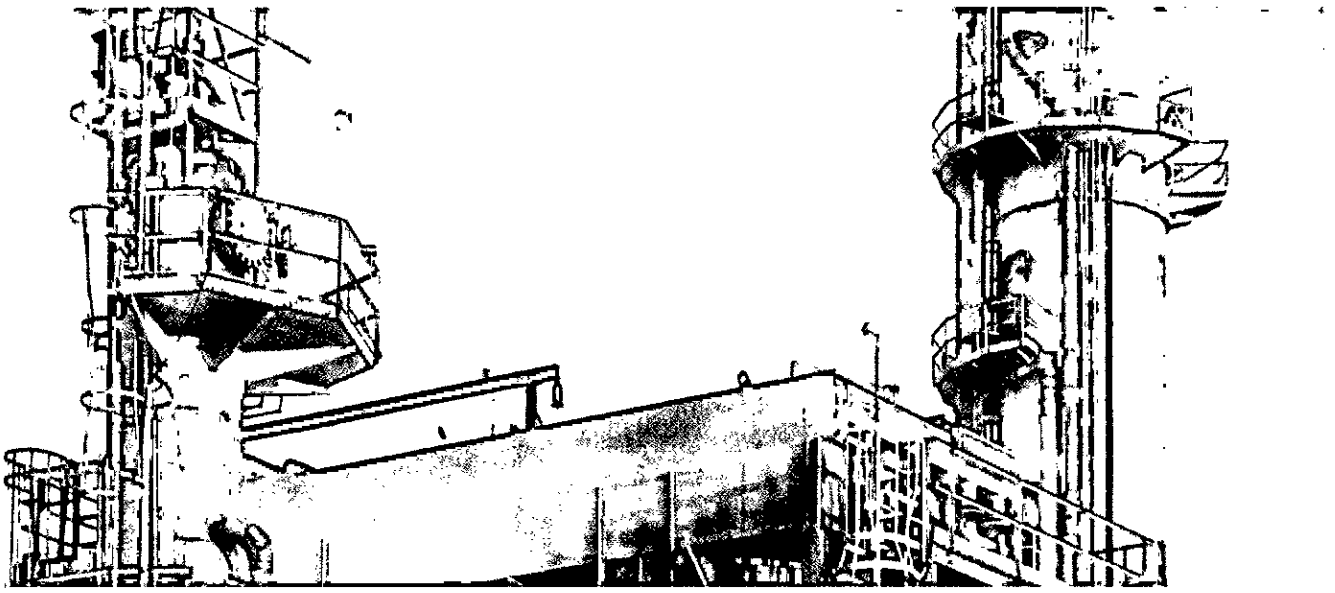

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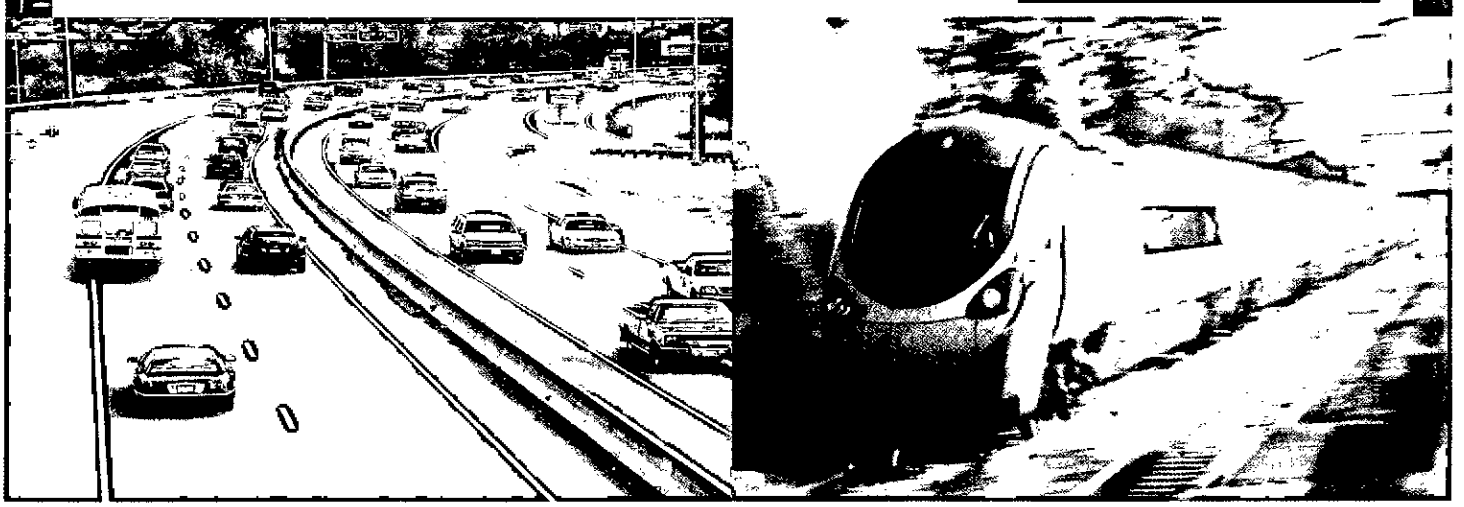

Spring Conference 2008 - *continued from page 20*

contemplating a career in acoustics-related disciplines following the conclusion of their studies. Colin English (The English Cogger Partnership), President of the IOA introduced Richard Perkins (DEFRA), Dan Cartman (Cirrus Research), Neil Morgan (SLR Consulting), Pete Theobald (NPL), and Bernadette McKell (Hamilton and McGregor) who each gave a presentation on aspects of their work in acoustics, and their need for well-educated graduate recruits. It was encouraging to see so many attending the forum, and to hear the views and aspirations of prospective employers, especially in these times of declining numbers and standards in mathematics and science education. It further demonstrates that the IOA is addressing the needs of society at undergraduate and postgraduate levels, as well as opening windows in acoustics (and the sciences in general) at secondary and even primary school levels.

Evening entertainment

The drinks reception gave the chance for members to unwind and discuss their 'pet' areas of acoustics in the less formal surroundings of the The Cedars refectory. The standard of catering for the Conference Dinner was widely appreciated, and the management and staff at the University of Reading demonstrated their experience and expertise in feeding large numbers of hungry delegates with a minimum of fuss. Those of us with a 'healthier' lifestyle were even able to get additional portions of vegetables (well, we *like* asparagus!).

Speeches and presentations

A number of awards and honours were presented at the Spring Conference, as cited elsewhere in this issue of the *Bulletin*. The majority of these presentations were made after the Conference Dinner, with the outgoing President, Colin English, doing his best to be appear in as many photographs as possible (a keen lensman himself, he likes to get on the other side of the camera too).

Bernard Berry and Mike Ankers each received an Honorary Fellowship of the Institute (HonFIOA) in recognition of their sterling efforts on behalf of the disciplines of acoustics over many years. Bob Peters was presented with the Award for Service to the Institute, and Wendy Sadler and David Sharp both received the Institute's newest award, that for Promoting Acoustics to the Public, for the years 2006 and 2007 respectively. Finally, Rupert Thornely-Taylor, on behalf of the Association of Noise Consultants, presented the annual prize for the best Diploma project to Mark Payne (SFL Group).

Following the awards ceremonies, Trevor Cox gave a slightly condensed version of his practical acoustics demonstration, including the infamous radish clarinet, the world's largest whoopee cushion, and the whoopeephone. He showed again some video clips demonstrating the breaking of wineglasses with high-intensity sound, and graphically illustrated the Bernouilli effect with a leaf blower and toilet rolls.

Although the bar seemed to be hiding away in the corner of the venue, many delegates were still able to find it, and the discussions continued into the small hours.

Trevor Cox drills his radish...

... and then blows it!

What is he going to do now?

A demonstration of the Bernouilli effect

Meeting Report

Windfarm Noise 4

The fourth one-day meeting on windfarm noise was held at the Armagh City Hotel, Co Armagh, Northern Ireland on 28 February 2008 and was attended by some 52 delegates from both near and far, many making a day trip via the Belfast International Airport or George Best Belfast City Airport. People travelled from Cork, Galway, Glasgow, Dorset and London.

The meeting was organised by Oliver Hetherington of the University of Ulster who ably chaired the morning session whilst introducing a number of useful points of interest on the terrain of Ireland, the need for power generation, and the ecclesiastical uniqueness of Armagh as the Christian capital of Ireland: the city is "home" to Cardinal Sean Brady and Archbishop Alan Harper and their respective Cathedrals, both named after (perhaps not surprisingly) Saint Patrick.

The morning session was started by a presentation given by Sylvia Broneske of the Hayes McKenzie Partnership on *The mechanisms of noise generation and ways of mitigation*. Sylvia guided the delegates through the means by which noise is generated by wind turbines, including aerodynamic sources and mechanical sources. Aerodynamic sources are basically due to the motion of air around the blades and include trailing edge noise, separation-stall noise, tip vortex formation, laminar boundary layer vortex shedding, trailing edge bluntness vortex shedding, in-flow turbulence and blade swish. Such sources of noise can be minimised by reducing the tip speed, regulating the blade pitch and improved blade design. However, these measures tend to result in less power generation. Mechanical sources of noise include gearbox, generator, the yaw drive motors, cooling system pumps and power electronics. Noise control in the main can be dealt with by the isolation of the noise (vibration) generating parts from the main body (nacelle) of the wind turbine, or by again slowing the turbine down. Sylvia then talked through a case study where she compared options for reducing the number of turbines or selecting the turbines to run in 'noise reduction mode' as wind speed or direction requires.

The second presentation was given by Rey Gaston of F R Mark & Associates on *Assessment of windfarm noise: a consultant's perspective* in which he introduced the typical guidance documentation used when assessing the impact of wind turbine noise *The assessment and rating of noise from windfarms* (ETSU-R-97) and the information required in order to perform such an assessment. What appears to be an initial difficulty is obtaining sufficient information in relation to the background noise climate at sufficient noise receptor locations (as requested by the Local Authority representatives) over a suitable range of wind speeds. Difficulties that Rey had experienced included sites which crossed Local Authority jurisdictions and where different criteria were used, sites where there were a number of windfarms in proximity to a dwelling, prompting the question of who had 'priority', and the sometimes limited ability of turbine controls to exploit the benefits of greater background noise with varying wind speed and direction. Rey then talked through computer modelling programmes and the factors taken into account by such programmes. In conclusion, Rey had found that whilst there have been some cases of modulation (blade swish) there have been very few complaints about aerodynamic noise, and as there have been few complaints then this could suggest that the standard leads to little chance of annoyance or to loss of amenity. He knew of no noise-dose relationship that had been established, and there was still debate about what robust prediction model worked best for typical separation distances.

Following a coffee break, Chris Jordan of the Northern Group Systems Environmental Health in Northern Ireland presented *An Environmental Health Officer's perspective*. Chris started by outlining the way in which Northern Ireland has a split of group systems to assist local environmental health officers when specialist advice is required. Within the Northern Group area there are two main areas where winds speeds make the installation of a windfarm worth investigating. Depending upon the size of the windfarm, an Environmental Impact Statement may be required in any case, if not then the Environmental Health Department would normally request that a noise impact assessment be conducted at the developer's expense. When reviewing information provided with a planning application, Chris reads all sections as he finds that there is often conflict between sections for example in the type of turbine to be used, quoted distances between turbines and dwellings, and also land ownership which can affect which dwellings require assessment. In relation to the noise report, he reads it through once without a break, visits site and speaks to locals, and then reads the report again and at that stage notes any significant differences with the ETSU guidance. Areas where Chris had experienced difficulties included very short time periods of background noise surveying (for example a one hour period in high winds); background noise levels not taken at neighbouring dwellings but at more exposed locations, generic noise levels used rather than specific level for the proposed turbines; greater distances than shown on drawings used; screening corrections applied even though turbine will be clearly visible from dwelling; only the nearest turbine being assessed, rather than the whole windfarm; only the windfarm in question being assessed, rather than a cumulative impact of all windfarms in the locality; and the background noise climate taken with existing windfarm in operation (creeping background). He had also seen as assessment where only one or two turbine speeds, rather than the full range of possible wind speeds, had been considered. Chris then proceeded to note the consequences of poor reports including a delay in the decision of an application and the additional associated cost implication, and the resultant poor public image of the applicant. Chris gave an example of such a report which concluded that the windfarm would have no impact, and commented on the detrimental effect it had on the development in the eyes of the local residents, including the fact that a 20-page document was received by Environmental Health finding fault in the noise report. A second consultancy was employed and their findings were that the number of turbines needed to be reduced and the distance from the neighbouring dwellings increased. Whilst the neighbours are still sceptical, they are more accepting than they were.

[L to r] Gwyn Mapp, Malcolm Hayes, Sylvia Broneske, Chris Jordan, Rey Gaston and Andrew Bullmore

The last presentation before lunch was by Andrew Bullmore of Hoare Lea Acoustics on *The costs of conservatism in windfarm noise assessment*. Andrew

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Meeting Report - Windfarm Noise 4 - *continued from page 23*

talked about the underestimate of noise being the possible excessive disturbance to neighbours, expensive curtailment requirements and the loss of credibility for future proposals. The overestimate of noise levels leads to a lost renewable energy source, a lost generation revenue and a need for more developments in total to meet wind energy targets. Typical assumptions which can lead to an overestimate of noise levels included: all turbines emitting sound power greater than manufacturer's data; assessment based on hub-height wind speeds; conversion of wind speed with height to assume a 'worst-case' wind shear; all turbines experiencing the same wind speed; the receiver assumed to be located downwind of all turbines; the ground acting as a flat and perfectly reflecting surface; no benefit from terrain screening. Whilst all these are theoretically possible, they are unlikely to exist simultaneously. Andrew suggested that a 2dB conservatism could reduce the power generation of a windfarm by 10 to 40% depending upon the design and curtailment approach. On a national basis, this loss related to between 0.6 to 2.5 times the power of an early nuclear power station. In relation to the 'errors' in windfarm noise predictions, Andrew suggested that these included the true wind shear gradient which is dependent on ground roughness, trees and atmospheric stability; the wind speed variations across a site (downwind turbines are exposed to lower wind speeds than upwind turbines); air absorption which is greater at higher frequencies tended to result in the main problem being in the region of the 250Hz octave band; ISO9613 conditions covered what occurs for around 5% of the year, which may be over-cautious. Andrew talked through two field studies and noted that predicted noise levels from both sites were at the upper end of the measured range of noise levels over an extended monitoring period. Careful consideration as to the input data for noise modelling is therefore required in order to not be over-cautious and place undue restrictions on the times or speed of operation of a windfarm, or the size of a windfarm, as mitigating a 2dB 'excess' in noise from a windfarm can have a significant financial implication.

After lunch Gwyn Mapp of Bureau Veritas gave a presentation on *Micro-turbines - to plan or not to plan?* in which he outlined the current proposals under discussion whereby no specific noise assessment will be required as part of planning, although guideline limits are proposed (there is currently no system to ensure that they are achieved). At the stage of current discussions Gwyn was unfortunately limited in what he could say, but what appears to be the 'push' is that micro-generation is the way forward for the UK. Self-generation is an attraction, but there appears to be no suitable assessment methodology, just a blanket methodology.

The final presentation of the day was they given by Malcolm Hayes of the Hayes McKenzie Partnership on *Low-frequency and infrasound noise immission from wind farms and the potential for vibro-acoustic disease.* Malcolm talked through the perception that there is a low-frequency noise (20 to 160 Hz range) or infrasound (below 20Hz) problem associated with the operation of wind turbines that gave rise (in some circumstances) to vibro-acoustic disease. Malcolm has been involved in a low-frequency noise study to review three UK sites where the neighbouring residents had complained of low frequency noise. The study entailed the measurement of infrasound and low-frequency sound over an extended period of time (two to four weeks) and analysis of periods when occupants considered the noise from the windfarm to be audible and unacceptable. Malcolm explained the criteria against which the sound levels measured outside and inside the dwellings of concern were compared, and presented an analysis of the periods when the occupants were disturbed. Whilst there was an increase in the noise levels in the 200 to 315Hz third-octave band frequency range associated with blade swish, there was no evidence of noise within the low-frequency or infrasound ranges. It was similarly found that the magnitude of the sound was not sufficient to give significant risks of vibro-acoustic disease. It therefore appears that whilst it was accepted that there was a contribution of noise associated with the operation of wind turbines occurring within the lower range of mid-frequency hearing (200 to 315 Hz third-octave bands), there was no evidence to show infrasonic or low-frequency components of noise associated with wind farms.

Following the presentations there was an interesting discussion period following which Martin Lester (chairman of the afternoon session, and chairman of the Irish branch of the IOA) thanked the speakers, Oliver Hetherington for organising the meeting, Martin Grainger for providing and manning the audio-visual equipment and Kevin and Linda Macan-Lind for manning the registration process.

New members

The following were elected by Council on 13 March 2008 to the membership grades shown.

Fellow

Wise, S P

Member

Badham, S P
Canning, D
Cecil, T
Chapman, P J
Clothier, S N
Gunston, T P
Hall, R B
Hill, T J W
Hung, E W S
Keegan, M J
Lalley, C J
Maclagan, M
McNally, I H
Nash, A M
Parker, C
Rogerson, F E
Saher, K
Sullivan, R P
Tan, J
Templeman, B J
Viveiros da Silva, E
Wright, R A

Associate Member

Arthurs, I J
Atha, J A M
Blacklock, J D
Browne, S D
Corfield, J
Culhane, S
Dawood, A L
Day, M L
Emery, A J
Hampton, RJ
Hands, A M
Haynes, S L
Hu, B
Keen, J M
Leslie, S C
Liley, G R
Marriner, R E
McKeever, S
Mejer, K S
Minifie, S A
Mottershead, A J
O'Connor, C
Qi, M
Rattigan, I G
Rees, A J
Rene, J C
Richards, G M
Simons, J
Thrussell, M W J
Weatherall, I

Affiliate

Ford, R J
Grech, J
King, W J
Lucas, T J
Sharples, J
Trim, R M

Technician

Abram, M J
Attwood, T E
Clifton, M M
Farmer, C R H
Morton, D J

Student

Alli-Balogun, I
Collett, A G
Daymond-King, A L
Harrison, E L
Hinds, M R
Murfet, H
Nicholls, M S
Stewart, D M
Tebbs, R

SRL Acoustics Day

Hollickwood Primary School, Muswell Hill

On Thursday 30 January, Hollickwood Primary School in Muswell Hill, north London approached Alex Krasnic of SRL to present an Acoustics Day to their children as part of their Science Week. He taught a total of eight classes (four in the morning and four in the afternoon) some basic principles of waves in different media, and basic acoustics, leading up to slightly more complicated acoustical topics using a Brüel & Kjær type 2260 sound level meter to show to the older children how noise levels are measured. The ages ranged from three to eleven years.

He demonstrated simple experiments with musical instruments (triangles and drums with rice on top), asked the children to hold balloons in their hands to feel the vibrations in the air, and made paper cup telephones. He also used two tuning forks of different lengths, dipped in water and to show how different waves looked and sounded. All in all, the class teachers and the headteacher were very pleased with the presentation to their school, and we felt that the children benefited greatly from their first-hand insight into the workings of acoustics at primary school level. It was a good opportunity to expand the knowledge of science and especially acoustics for the benefit of the community.

Alex Krasnic explains the vibrations from a tuning fork

...and this is what we use to measure it

Rice on a drum head shows a group of children how sound is emitted into the air

Meeting report: Midlands Branch

Outdoor sound prediction: grounds for improvement

This evening meeting on Wednesday 19 March attracted a large audience (27 members, two non-members) who crammed into Scott Wilson's meeting room to hear Keith Attenborough's informative presentation. His talk covered the various ground interference effects, which is an important factor in outdoor sound prediction.

He then went on to describe the recently developed HARMONOISE scheme which includes seven ground categories, compared to ISO 9613-2 where outdoor sound surfaces are either acoustically 'hard' or 'soft'.

The presentation outlined methods of predicting, measuring and controlling outdoor ground effects. Keith discussed the pros and cons of various ground impedance models, and reviewed the methods of measuring ground impedance. He concluded his informative presentation with a review of research into hooded crow calls. He then answered a large number of questions from the floor.

Thanks are offered to Keith for an excellent presentation, and to Scott Wilson for their hospitality.

Workplace Noise Certificate Goes Abroad

IOA's five-day Certificate of Competence Course in Workplace Noise Assessment

Currently the Certificate of Competence in Workplace Noise Assessment is delivered twice a year by twelve IOA-approved Institutions within the UK. As a result of an approach from Princess Cruises, one of these institutions (RRC Training) delivered the March presentation in California. Since Princess Cruise ships fly the red ensign, their emphasis was on British health and safety standards. Having shipped essential equipment in advance, David Wenham of RRC Training flew out to tutor this pioneering presentation of CCWPNA and invigilate the exam which was taken first thing in the morning on Friday 7 March, to coincide with the UK examinations. Davd said that unfortunately he was only flying out for the presentation and would not have time to look around.

Dates of courses vary depending on the Centre (see www.ioa.org.uk/education.asp). The Institute also offers two other Certificate courses:

- The Certificate of Competence in Environmental Noise Measurement, aimed at producing delegates who are able to make and report environmental noise measurements in a competent manner;
- The Certificate in the Management of Occupational Exposure to Hand-arm Vibration, which is aimed at producing delegates who are able to appreciate the nature of HAV in the workplace and advise employers how to meet their legal duties.

For further information on the Certificate courses, please contact the IOA on telephone **01727 848195**, e-mail **education@ioa.org.uk** or visit the IOA web site at **www.ioa.org.uk/education.asp**

Measurement and calculation errors in environmental noise assessments

Martin Williams.

Introduction

The correct measurement and use of noise parameters associated with environmental noise is essential as important decisions are made on the results of these investigations. Most modern noise measuring instruments and associated PC software generate a plethora of noise results and it is easy for the user to blindly accept the results.

This article explores the method behind the measurement and calculations associated with the widely-used statistical noise parameters such as L_{AF90}, L_{AF50} and L_{AF10}.

Statistical noise parameters

Many British Standards and codes of practice require the measurement of statistical noise parameters such as L_{AF90} (the background noise level defined in BS.4142) and L_{AF10} (used in the measurement section of the Calculation of Road Traffic Noise, 1988).

The International Standard for Sound Level Meters (IEC 61672 (2002) - Part 1: Specifications) is a very detailed document in defining the performance of such an instrument, but unfortunately does not specify the method required for statistical noise parameters. This is understandable as the only country to use such noise parameters seems to be the UK! It is therefore left to the manufacturers of sound level meters to set their own methods and this could obviously lead to some differences in techniques and therefore differences in measurement results.

The first 'official' guidance as to how these parameters might be calculated in the instruments appeared in an Annex (Approval of Measuring Devices and Conditions to their Use) of the Environment Circular 8/97 concerning the Noise Act 1996 issued by the Department of the Environment in July 1997. Here it was stated that for the $L_{AFN,T}$ statistical noise parameters, the sound pressure level shall be sampled at a rate of not less than 10 times per second and that the statistical calculation class intervals shall be no greater than 0.5dB.

Let us look at these parameters in a bit more depth.

The processes to find statistical parameters are as follows. First the noise signal (fast exponentially-time averaged and A-frequency-weighted) is sampled at regular intervals as shown schematically in Figure 1.

Each sampled value of the noise signal is then entered into the appropriate level interval to form a noise level distribution as shown in Figure 2.

The next stage is to calculate how much of the noise has exceeded each level - in this example 100% of the noise is above the lowest value of about 40dB(A), and 0% is above about 72dB(A). This leads to a cumulative distribution of noise levels (Figure 3).

The statistical noise parameters commonly used in environmental noise measurements (like L_{AF90} - the background noise level) can now be found as shown in Figure 4.

Accuracy of the results

Assuming the instrument meets all the specification requirements of IEC 61672 - Part 1 (2002), and has undergone the pattern evaluation tests of Part 2 of that standard, then the fundamental measured electrical signal can be assumed to be identical for all sound level meters.

As explained above, this varying sound pressure level signal representing the acoustic noise must now be sampled at regular time intervals to find the variability of the acoustic noise. Apart from the Environment Circular 8/97 mentioned above, there is little guidance as to what is an acceptable sampling rate.

Early instruments had a maximum sampling period of 10 per second. This was gradually improved (typically 64 samples per second) and modern instruments boast 100 samples per second (10 millisecond intervals between samples).

The second influence on accuracy for statistical parameters is determined by the width of the individual 'decibel bins' which collect the sampled noise levels. An instrument with its measurement range divided into 1dB 'bins' cannot be expected to give as accurate a result as one with a 0.5dB width.

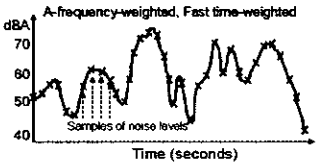

Figure 01

Noise level sampling

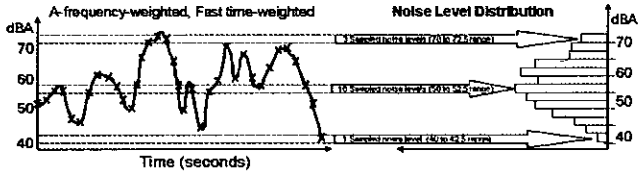

Figure 02

Noise level distribution from samples

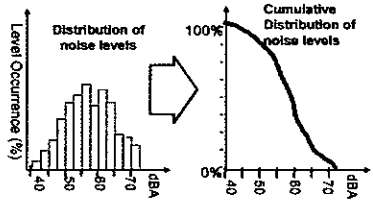

Figure 03

Cumulative distribution of noise levels

This parameter and the total measurement range (sometimes called 'dynamic range') has improved with modern instruments typically having a 120dB dynamic range (measurement range from 20 to 140dB) with 0.2dB intervals for their bins to generate the statistical parameters.

So in principle, the statistical parameters can be very accurately determined. However there are still pitfalls for the unwary!

Combining statistical noise results

With the improvements in measuring instruments and in particular the ability to store masses of data to memory cards, it is now sensible common practice to take a series of shorter duration measurements rather than single long-term measurements.

This has the distinct advantage of demonstrating the variation of the noise parameters during an investigation, as well as giving the 'final' answer over the total time period.

continued on page 28

Measurement and calculation errors... - *continued from page 26*

For example, a required $L_{Aeq,16hr}$ measurement for comparison with Noise Exposure Categories given in Planning Policy Guidance 24, Technical Advice Note (Wales) 11 and Planning Advice Note 56 (Scotland) is far better made at five-minute intervals rather than a single 16-hour interval, so that the variation in noise level can be seen and then combined to give the required overall value.

This works fine with L_{Aeq} values but it is not so straightforward when combining statistical parameters.

Let us assume that the noise being measured varies in the range 20dB(A) to 50dB(A) and a measurement is made over a five-minute period. The instrument will sample the sound pressure levels ('A' frequency-weighted, 'fast' time-weighted) as explained above to form the normal distribution and then the cumulative distribution of noise levels shown in Figure 5(a).

Now let us assume that for the next five-minute period, the noise varies over a 30dB(A) to 60dB(A) range, for which the sound level meter is reset and a new measurement started. At the end of that period the cumulative distribution for the second five-minute measurement is that shown in Figure 5(b).

It is now necessary to know the L_{AF90} value over the entire ten-minute measurement period.

If the instrument has stored just the L_{AF90} values, or any other individual statistical parameters like L_{AF50} and L_{AF10}, then this calculation for the combined ten-minute period is not possible. The only way to combine them and find the correct value over the ten-minute period is to store the complete cumulative distribution for each period. Then the two cumulative distributions can be combined to form an 'overall' cumulative distribution from which we calculate the true statistical parameters.

As an example of the errors that can arise, the author has seen reports where the individual values for each measured time period have been mathematically averaged or, even worse, logarithmically averaged.

The mathematical average of the two L_{AF90} values above is simply (and incorrectly!) (25 + 37)/2 = 31dB(A). The true answer of 28dB(A) is as shown in Figure 6, as a result of combining the two cumulative distributions.

How can you be sure your instrument and calculations are correct?

The simplest way is to make some test measurements by applying a sound level calibrator to the microphone of a sound level meter. A series of measurements can then be made with the calibrator switched on and off. Figure 7(a) shows three such measurements at 30 second intervals.

To calculate the L_{AF90} value for the total measurement time (marked '■ Combined'), we must firstly combine the three cumulative distributions for the three individual measurements to form a combined cumulative distribution. Now it can be seen that the L_{AF90} for the total (combined) measurement time has been correctly calculated at 19.7dB(A). The cumulative distribution for the total (combined) measurement is shown in Figure 7(b).

For comparison, a mathematical average of the three L_{AF90} values 20.6, 93.6 and 19.7dB(A) gives a resultant value of 44.6dB(A) and a logarithmic (energy) average or L_{eq} gives 93.6dB(A)!

Obviously this example is somewhat extreme to illustrate the point, and in practice the measured L_{AF90} values will be much closer to each other. However the principle holds that the full individual distributions for each measurement period must be measured and stored (not just the derived $L_{AFN,T}$ values), if it is wished to calculate statistical noise parameters correctly over longer time periods than those measured.

Exception to the rule

There are two noise measurement situations where the above rule is not applicable because a Memorandum and a Code of Practice dictate otherwise.

If one is taking measurements of traffic noise, rather than the preferred prediction techniques (see Section III of the Calculation of Traffic Noise, 1988), the 18-hour L_{A10} value is the arithmetic mean of the individual $L_{AF10,1h}$ values from 06:00h to 24:00h. The second situation where incorrect calculations of L_{AF90} are allowed occurs in the Code of Practice on environmental noise control at concerts (Noise Council, 1995). In this document the background noise level L_{A90} is defined correctly in the definitions (apart from the vital 'fast' time weighting) yet it finishes up as the arithmetic average of the hourly L_{A90} measured over the last four hours of the music event.

Conclusion

When undertaking measurements of statistical noise parameters associated with environmental noise assessments and subsequently carrying out calculations on the results, it is important that the investigator understands the limitations of the instrumentation and calculation software.

Martin Williams MIOA is with Brüel and Kjær UK

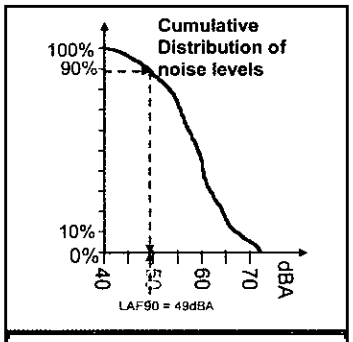

Figure 04

Derivation of statistical noise parameters

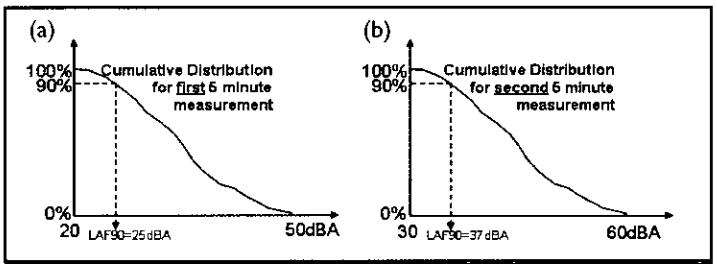

Figure 05

Level distribution and derivation of L_{AF90} for successive measurement periods

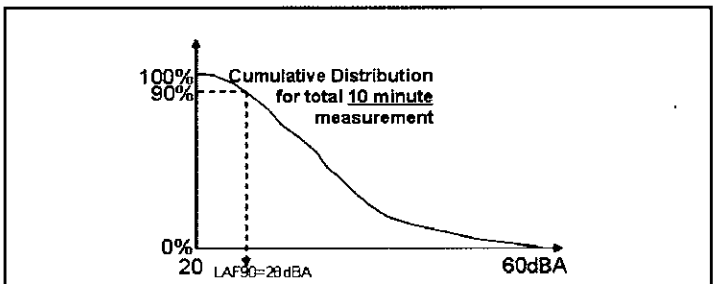

Figure 06

True cumulative distribution and derivation of L_{AF90} value

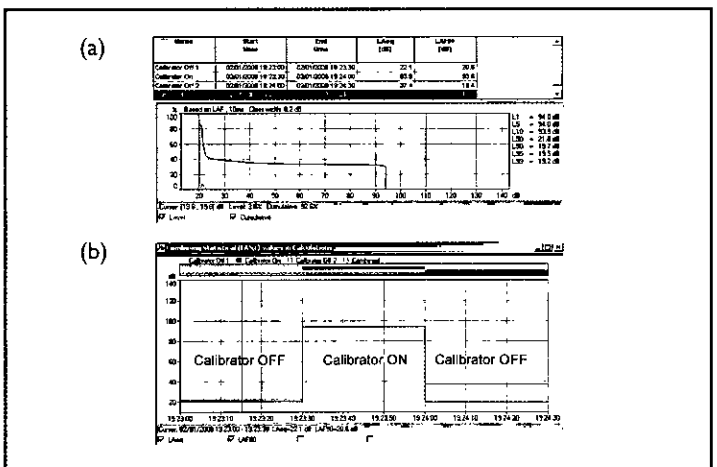

Figure 07

a series of measurements with calibrator on and off

Rain noise testing on lightweight roofing

Tim Spencer. Combined acoustical benefits of Rockwool four-in-one insulation and Rockwool Rockfon ceilings

Introduction

To be (as we believe) the first organisation in the UK to complete testing in accordance with the published version of ISO Standard BS EN ISO 140–18:2006 Measurement of rain noise on building elements[1] was quite an achievement for Rockwool Ltd.

BS EN ISO 140-8 describes a laboratory method for the measurement of sound generated by rainfall on building elements, using artificial raindrops produced by a water tank. Ideally, test specimens should be exposed to real rain for such measurements. But real rain is neither steady nor continuous with respect to time. Furthermore, raindrops can vary in diameter owing to several factors, including the geographical location, which introduces variability in measured values.

Artificial raindrop generation systems (other than the water tank used in this part of ISO 140) do exist, hydraulic spray nozzles being one example. However, nozzles corresponding to the specifications given in this part of the standard are not, so far, commercially available: indeed, their flow rate is too high when the drop diameter is correct, and the drop diameter is too small when the flow rate is correct. Only the water tank method appears in the standard.

An alternative to real rain or artificial raindrops is the dry mechanical excitation of the test specimen. Researchers have used different methods, such as excitation by an impact hammer or other mechanical impacting simulators with the aim of simulating the noise of real rain. These methods invariably suffer from the drawback that the noise source generates sound levels and sound spectra that taken together, do not compare well with corresponding values generated by the real rain on various types of test specimens. Further research work is encouraged to develop mechanical methods of rain noise generation that can match both the sound levels and spectra of real rain.

With increasing focus on noise issues and the need for proven, sustainable, good whole life value-for-money, and safe building solutions, Rockwool Ltd working with sister company Rockwool Rockfon Ceilings got on with the task of roof rain noise testing.

The testing, carried out at the end of 2007 at the Building Research Establishment, is believed to have been the first to be completed in the UK, and probably internationally, in accordance with the recently published International ISO 'rain noise' standard.

The tests demonstrated that Rockwool insulated roofs with the addition of a straightforward Rockfon low weight stone wool suspended ceiling can ensure that rain noise resistance, reverberation time and speech intelligibility criteria, together with all the other necessary performance requirements in terms of fire safety, thermal performance, light reflection and sustainability are fully satisfied for all sectors. The testing further confirmed the superior performance, enhanced practicality and peace of mind when using Rockwool insulated roofs compared with foam insulated varieties.

Test programme

The comprehensive test programme was completed at the BRE acoustics laboratory within the extensive Building Research Establishment at Garston, Watford in November and December 2007. BRE Acoustics specifically configured one of their existing laboratories to allow for the construction of roofs and ceiling elements together with the 'rain' water tank and all of its necessary supports allowing for easy tank movement so that measurements could be made in different roof positions. The rig also included water run-off and collection systems, water collection and recycling being particularly important to minimise the amount of water being used. Because the tests took place indoors, the 'rain' water was fed from and collected in a separate supply and recycling tank on the ground floor.

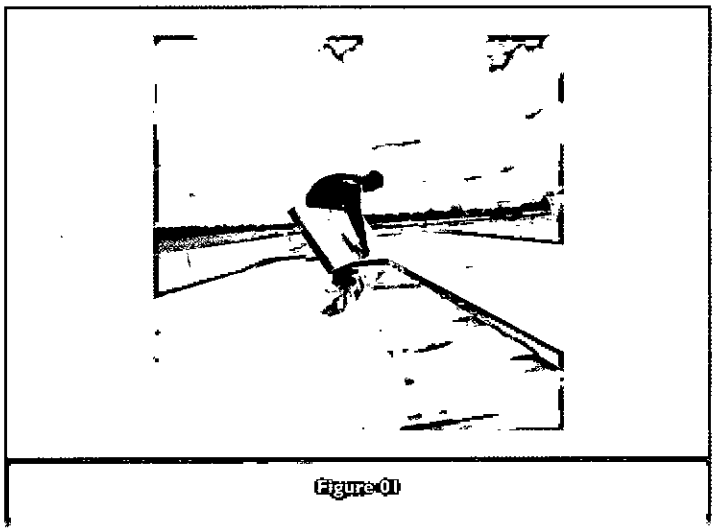

Figure 01

A Rockwool roofing system being installed

Testing indoors proved to be a great benefit compared with the outdoor option, because ironically the use of a test rig built outside would be weather dependent. In other words, tests would only be possible when the weather conditions allowed, and the ambient sound level was sufficiently low. Tests would certainly be impossible when ... it was really raining! Everyone is well aware how much rainfall there can be in the UK, and the past 12 months have been exceptionally wet. Programme predictability, and completion of the tests as quickly and as efficiently as possible were key factors in laboratory design and choice.

In a nutshell, the testing was completed indoors in accordance with the published International Standard (as opposed to the previous drafts) in a closely controlled laboratory environment with very low background noise levels and very high flanking limits, all as required by the new ISO standard.

The results obtained on the straightforward, economical, fire-safe and easily built roof and ceiling constructions were impressive, with the

continued on page 30

Rain noise testing... - *continued from page 29*

samples performing well, and demonstrating their ability to achieve results well within 'best practice' target values and the guidelines for resistance to rain noise.

Designers can be confident in the use of this data and the constructions used, compared with any other previously obtained data and any subsequent predictions in accordance with previous draft or ad hoc standards and laboratory set-ups. When looking for data and making comparisons for designs to resist the negative effects of rain noise, it is prudent to ensure that the test results are current and obtained in accordance with the published standard. The solution put forward should be straightforward and easy to construct.

A BRE report from January 2008 contains all the test data and results. Further details are available from Rockwool Rockfon.

Why do the tests?

Appropriate background sound pressure levels and the need for appropriate levels of resistance to noise generated by rain are 'must haves' in modern buildings. In any built environment, an appropriate background sound level should not be exceeded no matter what the weather conditions. In design work the sound pressure level due to rainfall in the room beneath the roof element should be of considerable interest.

In some buildings the background noise levels created by rain on the roof are unacceptable - the rain is simply too loud. The noise can be disruptive to learning and concentration in the education and commercial sectors, and is not conducive to health, wellbeing and efficient healing in the healthcare sector. The problem is becoming more recognised in various best practice codes and guidelines.

To date some installations have used complex and costly multi-layer ceilings to provide appropriate room acoustics (speech intelligibility and reverberation times) and to combat the high level of rain noise generated by lightweight foam insulated roofs. Our goal was to prove that by using a Rockwool insulated roof and a single layer Rockfon ceiling there would be no need for complex multi-layer ceilings with overlays or other devices. The focus was on exploiting the damping and acoustical performance of Rockwool Hardrock insulation as well as reducing reverberation times and enhancing speech intelligibility. The sound absorption and sound insulation characteristics of Rockfon ceilings were known to be excellent. Of course, the programme was also intended to add peace of mind for acousticians, particularly as they are nowadays being pressed by architects and main contractors for solutions that reduce risk to their indemnities by providing good, up-to-the-minute data and reliable, safe value-for-money solutions for all.

Benchmarks for acceptable performance

Building Bulletin 93[2] sets out the performance standards for the acoustics of new school buildings, and one of these performance standards is the indoor ambient noise level in unoccupied spaces. This noise level excludes contributions from rain noise, but the guidance states that it is essential that rain noise is considered in the design of lightweight roofs as it can significantly increase the indoor ambient noise level. When BB93 was published in 2004 the international standard for measuring rain noise was still being developed. The intention is that in the future, consideration will be given to including a performance standard for rain noise in BB93. Until this time, it is appropriate for design teams to provide evidence to Building Control that the roof has been designed to minimise rain noise.

In the meantime some specific benchmarking is available in the form of BREEAM for schools. The values stated in BREEAM for schools are likely to become the norm in future editions of BB93. BREEAM provides credits for roof designs that can demonstrate in the event of heavy rain that the ambient sound pressure level will not exceed normal allowable ambient sound levels by more than 20dB. Reference needs to be made to Table 1.1 of BB93 to determine the maximum levels allowable in the many different room types in educational buildings. Predictions for rain noise can then be accurately made based on test data and formulas in accordance with BS EN ISO 140–18: 2006.

Figure 02

Rockwool Hardrock being laid on vapour control layer

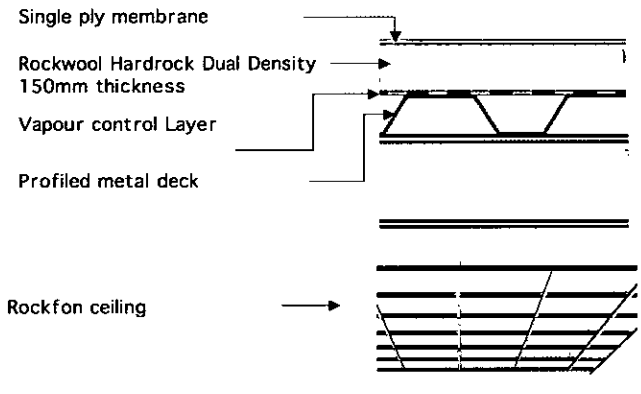

Figure 03

Sample configuration for rain noise test

Resistance to rain noise and its importance will also be covered in HTM 08-01 Healthcare premises - acoustics (soon to be published as a replacement for HTM 2045).

Results

The roof construction without a suspended ceiling performed well, achieving 59dB $L_{Aeq,30min}$ (based on probable use in a typical classroom with a T_{mf} of around 0.6 seconds). This was certainly an impressive result, but as expected it was found to fall short of the target values when calculations were made for other types of spaces.

By adding a straightforward and widely used Rockfon Scholar sound absorbing ceiling, installed using a RockLink 24 exposed T-grid to create a 600mm square module, an improved performance was achieved, meaning that in a typical classroom with dimensions 8m × 7m × 2.4m the sound pressure level from rain noise would be 51dB LAeq,30min and therefore well within the target value of 35 + 20 = 55dB.

Table 1 shows some examples of the performance achievable based on the data obtained from the test roof with and without Rockfon Scholar 20mm and Rockfon Sonar 44dB 50mm lightweight suspended ceiling tiles.

The Rockwool insulated roof provides a high level of rain noise resistance and the addition of a Rockfon ceiling provides a significant improvement owing to its pure stone wool construction (it is made

from resin bonded mineral wool). The weighted sound absorption coefficient of both the fronts and the backs of the tiles exceeds 0.9, giving them a Class A (the highest) rating. This high performance is a feature of resin bonded mineral wool ceilings, which are superior to the traditional wet felted mineral fibre ceilings. The use of the Rockfon ceiling and the Rockwool Hardrock insulated roof is enough to meet the rain noise target: there is also a performance and cost-savings benefit because the Rockfon ceiling makes a significant contribution to achieving the reverberation time and speech intelligibility requirements of many areas, specifically those covered in BB93.

The tests proved there to be no need for additional intermediate dense ceilings or overlays, thereby maintaining simplicity and reducing the installation time and cost.

Method of measurement

A tank positioned above the test roof is filled with water and constantly recharged. The flow rate is calibrated and monitored to ensure a correct rainfall. Sound pressure level measurements are taken below each roof or roof/ceiling construction in the frequency range 100Hz to 5kHz. The rain noise standard describes various types of artificial rainfall that can be used, as shown in Table 2. Real rain can be classified in terms of rainfall rate, typical drop diameters and fall velocities.

The artificial rainfall parameters that affect the noise generated by roof

continued on page 32

room type	area (m²)	height (m)	ceiling	upper limit L_{Aeq} (dB)	internal L_{Aeq} (dB)
Primary classroom	56	2.4	none	55	59
Primary classroom	56	2.4	Rockfon 20mm Scholar	55	**51**
Secondary classroom	63	2.7	none	55	60
Secondary classroom	63	2.7	Rockfon 20mm Scholar	55	**51**
Lecture room Large	180	3	none	50	61
Lecture room Large	180	3	Rockfon 50mm Sonar 44 dB 'sandwich'	50	**45**
as above	180	3	Rockfon 20mm Scholar	50	52
'Inclusive' classroom for use by hearing impaired	56	2.4	none	50	58
as above	56	2.4	Rockfon 50mm Sonar 44 dB 'sandwich'	50	**42**
as above	56	2.4	Rockfon 20mm Scholar	50	**49**

Table 01

Sample performances in schools

Note: Lower values of internal sound pressure level indicate a better performance. All ceilings consisted of Rockfon tiles in 600mm × 600mm modules and a RockLink 24 exposed grid.

Rain noise testing... - *continued from page 31*

rainfall type	rainfall rate mm/h	typical drop diameter mm	fall velocity m/s
moderate	up to 4	0.5 to 1	1 to 2
intense	up to 15	1 to 2	2 to 4
heavy	up to 40	2 to 5	5 to 7
cloudburst	greater than 100	>3	>6

Table 02

Classification of rain type according to IEC 60721-2-2

elements are controlled in the laboratory. At present, the intention is that 'heavy' rainfall shall be mandatory for the comparison of products and solutions.

Using the laboratory data to calculate the sound pressure level in rooms

Based on the results of the test programme the BRE has produced an easy-to-use calculator to predict roof rain noise in a wide variety of spaces. This is based around the spaces and reverberation time limits set by Building Bulletin 93, but it can also be set to user-defined requirements. The calculator can be made available to acousticians on loan: contact Rockwool Rockfon for details.

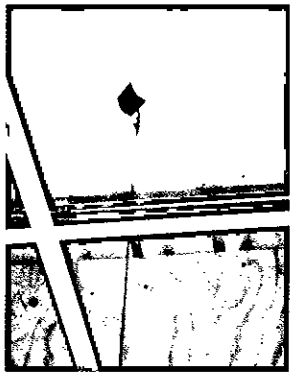

Figure 04

Suspended ceiling hanger connection to roof deck

Figure 05

Complete Rockfon suspended ceiling

A example calculation is shown in the panel. (see Figure 07)

Rockwool and Rockfon would like to thank Dr Robin Hall and the team at BRE Acoustics for their assistance and involvement in the completion of the tests on which this article is based.

Sustainability

Finally, a word on sustainability, understandably a subject of increasing popularity and one that is quite rightly entering into and becoming part of an ever-increasing holistic approach by acousticians.

The diabase rock from which Rockwool insulation and Rockfon ceilings are manufactured possesses a rare quality among the many types of raw materials used to manufacture insulation. The natural process by which diabase is formed is taking place continuously all over the world. Volcanic activity and plate tectonics mean that mother nature creates new reserves of diabase rock every year - around 38,000 times more than is extracted by Rockwool. This unique process of natural renewal completes the rock cycle and delivers sustainability. Not only does Rockwool enhance the environment for all, but it can continue to do so for thousands of years to come.

Rockwool and Rockfon ceiling tile offcuts have for many years been recycled at the large and long-established Rockwool UK manufacturing facility just west of Cardiff.

Tim Spencer is with Rockwool UK Ltd, Bridgend

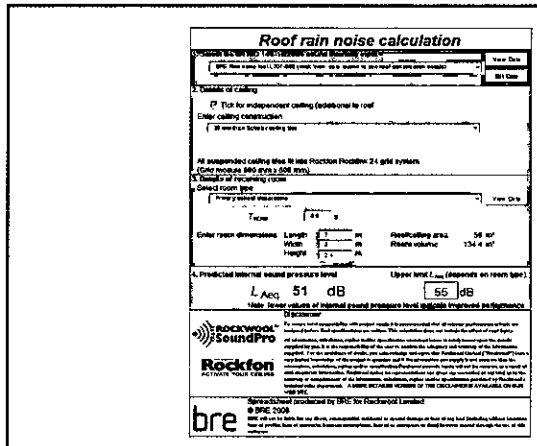

Figure 07

screenshot of the BRE/Rockwool rain noise prediction program

Figure 06

Rain tank and support structure

Referneces

[1] International Standards Organisation
BSEN ISO 140 Acoustics – Measurement of sound insulation in buildings and of building elements – Part 18: Laboratory measurement of sound generated by rainfall on building elements.

[2] Department for Education and Skills.
Acoustic design of schools. DfES Building Bulletin 93. London, The Stationery Office, 2004.

Subjective Impression to Objective Product Noise Testing

Peter Wilson.

Introduction

As well as detecting product faults that could cause premature failure, noise and vibration production testing can also be used to detect more subtle subjective noise problems that can cause warranty claims. This article uses case studies from the automotive, electronic and other industries to illustrate the process involved in creating objective production line tests that accurately predict subjective, qualitative customer judgements. It also includes practical, automated implementation of the results in the production environment using a PC based test system at a fraction of the cost of conventional systems.

Devising objective product noise tests from subjective data

Noise nuisance from office a/c pumps

The noise from these geared peristaltic pumps, which are used to pump condensate in quiet air conditioning units for offices, could sometimes cause complaints - not so much about the level of noise (although this was sometimes the case) but more about the character of the noise. Minor gear faults or changes in tolerances could cause the sound to vary in one or more of several different ways that made it more likely to be noticed. Descriptions of the nuisance features included 'beat', 'modulation', 'rumble', 'graunch' and 'groan'. Any pump could exhibit one or more of these features.

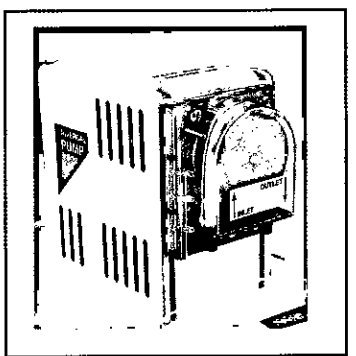

Figure 01

geared peristaltic pump

Recordings of a selection of 'faulty' (subjectively noisy or annoying) and 'acceptable' pumps were compared and analysed for each of the different features that could cause problems. To some extent, this was a subjective process closely allied to a set of objective data analysis tools. These allow both time-based and frequency-based features to be compared and combined. Moreover, as the noise levels from the pumps are low and production areas tend to be intermittently noisy, vibration is often a much more effective and practical measurement parameter, provided that the faulty units can still be detected.

The upper trace in Figure 2 shows vibration against time traces for a selection of good and faulty pumps. Some of the faulty pumps can be differentiated by level or the degree of modulation. However, many faulty pumps have very similar time domain signatures to those of good pumps. A shift to the frequency domain is required in order to provide the differentiation required. The lower plot in Figure 2 shows the frequency signature for the pump selected in the top trace. However, this is not always as useful as might first appear, because averaging hides some of the features such as modulation.

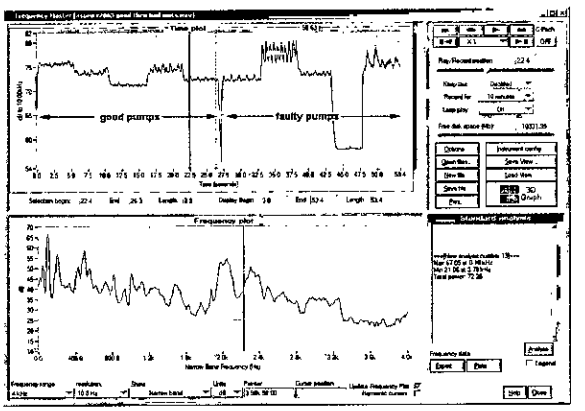

Figure 02

upper plot: a range of good and faulty pump vibration time histories; lower plot: a frequency signature for the selected pump

Consequently, it is often useful to compare the signatures in the form of a 3D waterfall plot as shown in Figure 3. The left-hand section of the plot is a good pump, and the right-hand section a faulty pump. This approach allows a judgement of both the time and frequency variations between pumps to get a feel for those features that cause a pump to be considered 'noisy' (ie one that generates noise that is considered a nuisance).

In this case, it was necessary to devise a series of separate tests which, applied in series to each pump, gave a 100% correlation with the subjective impression of the noise: ie if the pump failed any of the tests, then it would be considered a nuisance.

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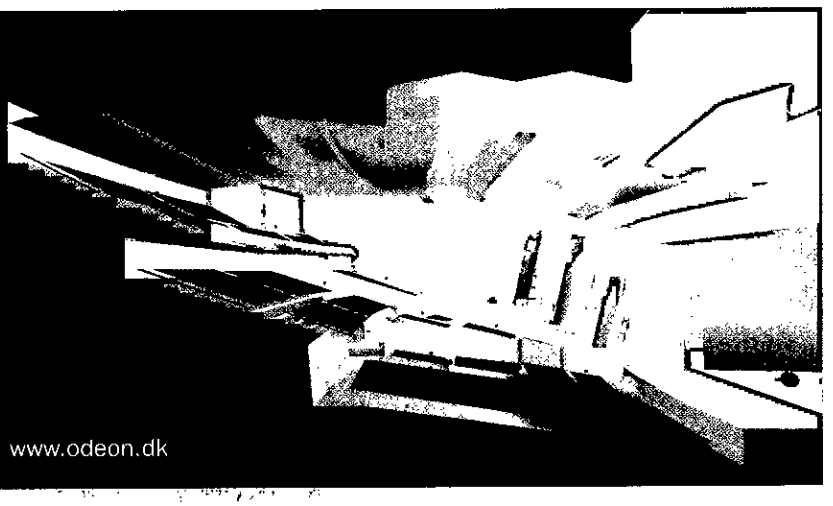


Subjective Impression... - *continued from page 33*

The most effective objective tests include:

i) overall amplitude

ii) modulation of overall amplitude

iii) modulation of specific frequency bands

iv) time-based vibration statistics ('graunch' and 'ticks')

'Annoying' in-vehicle warning sounders

Buyers of new cars complain if the various warning sounders do not sound sufficiently mellow to fit with the interior design. Consequently, this can be the source of costly warranty claims. In each case, the problem is the same: how to differentiate between good and bad sounding sounders due to different faults in a noisy production area (vibration measurement was not possible as the instrument packs are only tested once assembled - the sounders are buried within the units).

The best approach is to compare the sound from selections of good and bad sounders in both the time and frequency domains as shown in Figure 5. The top trace (sound level against time) illustrates that some sounders are easy to detect using level alone (the low level is caused by tape inadvertently left over the sounder grid). However, there remains the issue of using sound to discriminate in a noisy production environment. The key to an objective evaluation of the sound is that of the relative amplitudes of the harmonics. Whilst the overall noise level may be similar, variations in the relative amplitudes of the higher harmonics (either higher or lower) has a large influence on the perceived character.

The best approach was to select some of the high frequency harmonics for the tests: the higher the frequency the better, as the background noise in production areas tends to fall with increasing frequency. As the frequencies of the harmonics are also fixed within narrow constraints, it was also possible to frequency-gate a number of tones quite tightly in order to increase the signal-to-noise ratio and improve the immunity to variations in background noise.

'Unpleasant' motorised steering column noise in up-market cars

The noise and vibration from motorised steering columns is complex and difficult to control within acceptable parameters for a variety of reasons. During operation, geared motors drive screws that move the column in rake and reach. The load on the drives varies over the stroke and the drives are also susceptible to modulation at the (low) rotational speed of the screws. In some cases, there is also the possibility of judder from stiction in the splines. Moreover, there are also tolerances on the time taken over the full range of movement in each plane.

As the complexity could raise issues of the repeatability of any test, one of the first concerns was to confirm the tolerances between tests on the same unit for both noise and vibration. The results are shown in Figures 6 and 7. As can be seen, there is the occasional excursion in the noise traces due to intermittent background noise in the quiet workshop where the units were tested. This would become very much worse on the production line, making noise unsuitable as a test parameter without building a costly acoustic enclosure.

The vibration traces, however, show a high degree of repeatability and would be immune to background noise.

The next step was to collect an extensive range of vibration data for a selection of quiet and noisy columns (determined by subjective listening). As with the pump in 2.1 above, the best tests are a combination of statistical time based analyses coupled with frequency analysis (including modulation of specific frequency bands) plus the overall time for each run.

High frequency set-top box 'whistling'

The power supplies for a few television set-top boxes generate low

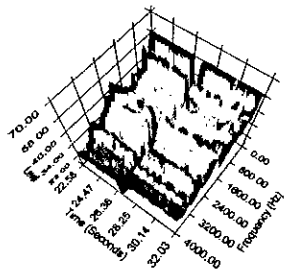


Figure 03

waterfall plots for [l] a good pump and [r] a faulty pump

Figure 04

dashboard sounder problems on a Mini

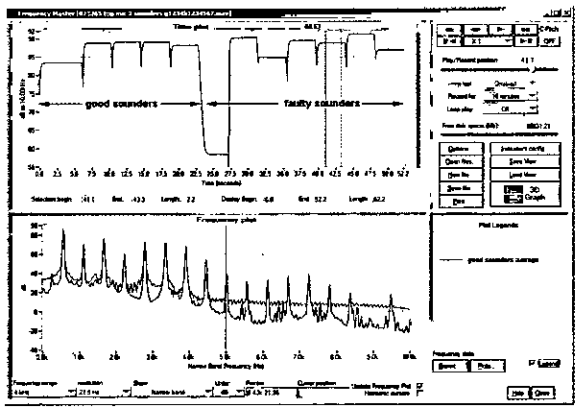


Figure 05

upper plot: sounder levels against time for various dashboard sounders; lower plot: variations in the relative amplitudes of the higher harmonics influence the perceived character

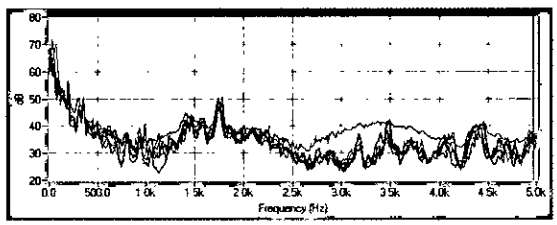


Figure 06

steering column geared motor: noise vs. frequency

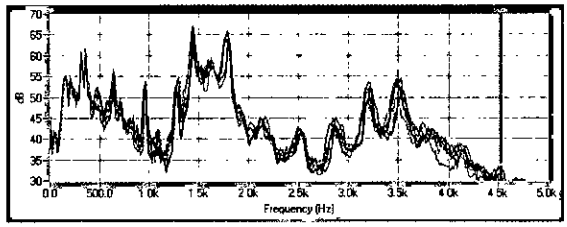


Figure 07

steering column geared motor: vibration vs. frequency

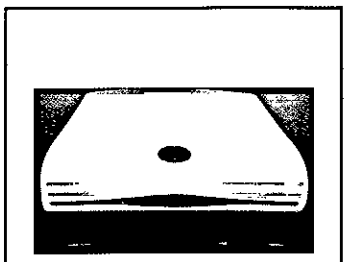


Figure 08

a set-top digital TV box

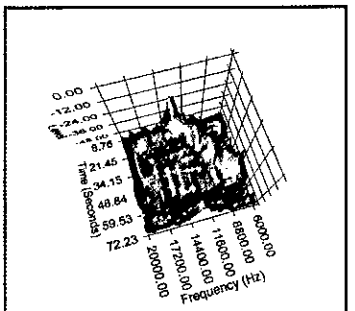


Figure 09

3D plot of frequency signature with load, quiet and 'noisy' units

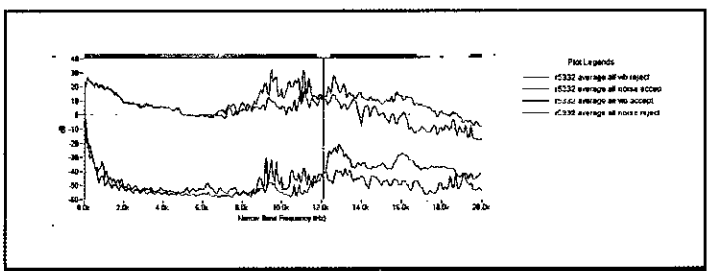


Figure 10

averaged signatures for noise and vibration, quiet and noisy units

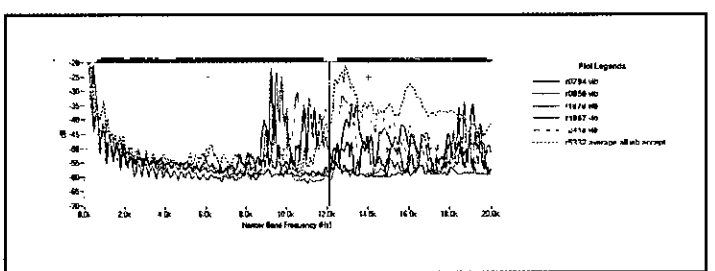


Figure 11

averaged vibration signature for the quiet units overlaid with a cross-section of noisy unit signatures

levels of very high frequency tonal noise. Whilst most people cannot hear these tones (even in quiet living rooms), those that can find the sound highly irritating. The nature of the sound also poses a problem for objective testing as the levels are very low (about 25dB(A) at close range) and many operators cannot hear the sound.

Once again, the solution is to measure the vibration on the unit base, once it has been proven that vibration signatures are well correlated with the equivalent noise signatures and the optimum load on the power supply required to generate the noise has been established. The latter was determined by varying the load and displaying a 3D plot of the frequency signature with load for quiet and noisy units as shown in Figure 9.

In this case, a magnetic base was used on the accelerometer attached to the base-plate of the box. Whilst theoretically the maximum frequency for linear measurements using a magnetic base is about 5kHz, it is possible to acquire very repeatable results for comparative measurements by this means.

Figure 10 shows overlays of the average signatures for noise and vibration for both quiet and noisy units (the upper pair of traces is for noise and the lower pair for vibration). In both cases, the key difference between the noisy and quiet units lies in an increased level in the 8kHz to 12kHz range which also tends to be tonal. Interestingly enough, the noisy units actually generate significantly higher levels of noise at frequencies above 12kHz. The typical difference in the key band levels is 20dB or more for both noise and vibration.

The averaged vibration signature for the quiet units (dashed line) is overlaid with a cross-section of noisy unit signatures in Figure 11.

This data was used as the basis for setting the pass/fail amplitude limits for the optimum frequency band. In addition, this criterion was also refined to produce a more reliable result by measuring the statistical noise floor of the overall level within the defined frequency band to minimise the effects of intermittent background noise.

Implementing the product tests on the line

The production test equipment used is a proprietary PC based system with USB connected data capture hardware that can be used with microphones or accelerometers (or both) with additional inputs for speed sensors etc. The advantages of this approach are a much lower implementation cost compared with conventional systems, plus an inherent flexibility with respect to the variety of analysis parameters and algorithms that can be used: new or bespoke analysis algorithms can easily be added as required.

One of the key features of any system designed to make extensive product testing practical on the production line is speed of operation - the ability to operate within an existing test cycle. In this case, the system can be set to record the raw data from a single test. Consequently, an extended series of completely different analyses can then be applied to the same data off-line at many times real-time speed.

This allows as many independent tests as necessary to be applied to the data, each of which can be specifically designed to detect a feature or particular fault. This means that it is not necessary to compromise on the reliability of any one test to accommodate other fault features, making the test system more accurate and sensitive. In some cases, this can also be used to provide a diagnosis of the specific fault that caused the 'fail' condition, particularly as the results of tests can be combined to provide even higher sensitivity to a specific fault.

In practice, it is important to identify the best test technique for each unacceptable feature of the subjective 'noise' that provides as great a difference as possible between the good and bad units. This must also take account of the production line environment, which means that vibration will often be a better assessment parameter than noise as the signal-to-noise ratio will be higher. Experience has shown that initial diagnostic testing that combines both subjective and objective data is the key to developing a reliable and effective production test system that can be used to detect any noise feature that is unacceptable to the human ear.

Peter Wilson is Director of the Industrial Noise and Vibration Centre (INVC), Slough, UK

This article is closely based on his paper of the same title, presented at the IOA Autumn Conference in Oxford, October 2007

From bell to broadband

Geoff Leventhall. Auditory warnings and the environment

The classic image of train or fire engine, with hand-operated bell clanging its message 'Get out of my way!', is preserved only in old movies and fond memories. Even police cars used bells as warning signals in the earlier part of the twentieth century.

The train bell was replaced first by steam whistles and then by air operated horns, whilst electroacoustics took over for the majority of other applications. This led to a number of alarms, referred to by the nearest descriptive term:

wail a conventional siren sound, cycling over a few seconds

yelp a rapid siren

hi-lo alternating high and low notes

whoop repeated low to high frequency sweep

yeow repeated high to low frequency sweep

horn quasi-continuous steady sound

beep slow intermittent horn, say 60 cycles a minute

stutter rapid intermittent horn, say 140 cycles a minute

The development of this wide range of alarms was partly because electronics made them possible, and partly to gain a commercial advantage with something different, and perhaps more useful. There was a need to improve the effectiveness of alarms, although some problems could be solved only with very high sound levels. Currently, the most widely used of the alarms above are the whoop, for emergency vehicles and the beep, for vehicles to indicate reversing. Outputs of alarms are often specified at 1m distance. A powerful emergency alarm might be around 120dB(A) at 1m. A reversing alarm could be from 60dB(A) to over 100dB(A), chosen in relation to the vehicle noise and local ambient sound levels. As most of the energy in alarms is above 1000Hz, there is little difference between their A and C weightings.

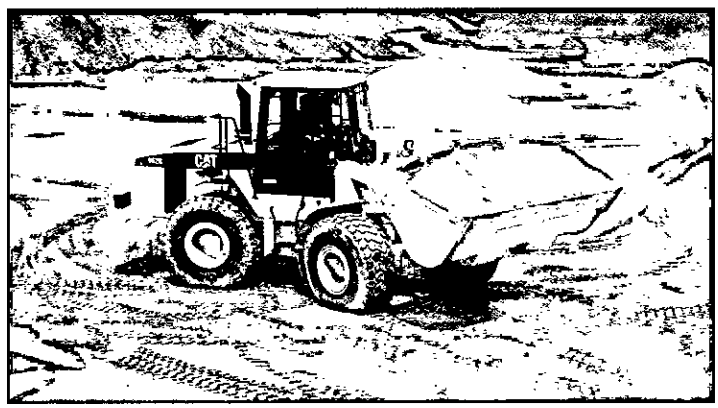
We may dislike, but can forgive, the whoop of the ambulance or police car, but are less tolerant of the incessant beeping which comes from vehicles in reverse gear, whilst either on the road or on off-road work sites. Nobody likes being woken by early morning beeps from the refuse truck reversing down a street, which is too full of overnight cars for the truck to turn. Similarly, a quarry or opencast working may be a source of reversing beeps, disturbing the neighbourhood, as might the reversing beep-beep of fork-lift trucks in a local yard.

For a long time it seemed that in the conflict between on-site safety and environmental disturbance, safety must win and the environment accept the consequences. Then along came broadband sound.

Broadband sound as an alarm signal

The initial development of broadband sound as a component of alarm signals was as an addition to existing tonal alarms, in order to improve the locatability of the alarm, since the broadband sound gives additional information to the listener (see Appendix). The broadband sound is typically from about 1kHz to 4kHz, falling off at each side of this and sounds like a 'sschh... sschh... sschh'. In contrast, a tonal alarm often contains a single frequency plus a few lower level distortion harmonics.

Some emergency vehicle alarms alternate whoops with broadband sound. The whoops attract attention whilst the broadband sound helps locate the direction from which the vehicle is coming[1],[2],[3]. Broadband has also been used to guide occupants to an emergency exit when there are problems, for example, in smoke filled buildings and aircraft or from power failures[4]. Another application is as a guide for the blind at road crossings.



Caterpillar 962G wheeled loading shovel in a sand quarry

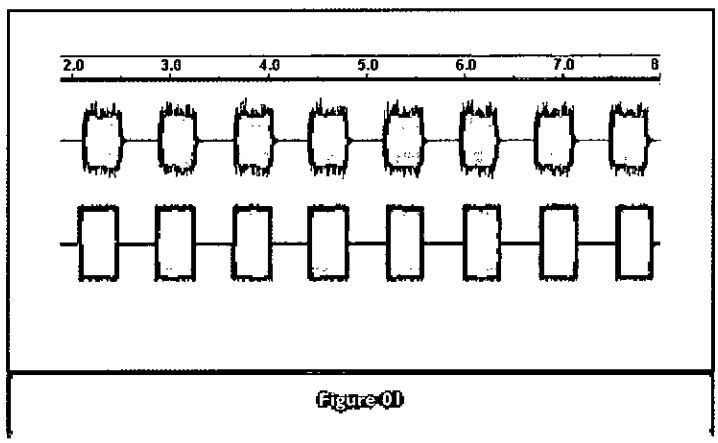


Figure 01

Broadband and tonal alarms

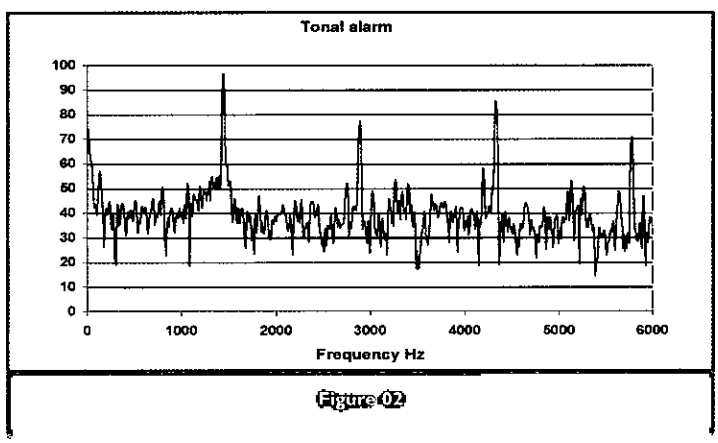


Figure 02

Spectrum of tonal alarm, 1450Hz fundamental

An important breakthrough came when it was realised that, for many purposes, the tonal component was not required. A broadband sound could serve as both alarm signal and locating signal, bringing welcome environmental benefits with it [5].

Broadband and tonal alarms

Both alarms operate with approximately equal on-off times of about 0.4s. Figure 1 shows typical switching for the two types of alarm. The

top scale is in seconds, the upper trace is the broadband alarm and the lower trace is the tonal alarm.

Figure 2 shows the averaged spectrum for a tonal alarm of 1450Hz and Figure 3 is the spectrum for a broadband alarm. Figure 2 represents a rather distorted sound wave, with very little energy in the region between the harmonics. Figure 3 shows continuous energy from below 1000Hz to over 4000Hz.

Alarms are designated by their A-weighted levels, measured at 1m. The A-weighted level of a tonal alarm is largely determined by its main component, whilst the level for broadband alarms is given by the summation of all its energy. This is shown in the third-octave analyses of Figure 4, which compares a 97dB(A) tonal alarm with an 87dB(A) broadband alarm. This tonal alarm peaks in the 1250Hz third-octave band. The apparent component in the 1600Hz band at about 88dB breaks through into this band owing to the alarm frequency being towards the upper end of the 1250Hz third-octave band: this spans from 1120Hz to 1410Hz. Each third-octave band for the broadband alarm represents the presence of continuous acoustic energy and the total level is the summation of all the bands.

A problem with tonal alarms is that interference between the direct and ground- reflected wave may cause local variations in level of around 15dB, occurring over distances of a few centimetres [6]. The ear nearest to a machine in reverse gear could receive a lower level than the further ear, causing confusion to the listener. This does not occur with broadband alarms as, although some frequencies may interfere destructively, others interfere constructively, so that there is very little local change in level.

Loudness of alarms

The main function of a reversing alarm is to warn those in a danger area, which is typically close behind the vehicle, that they must take precautionary measures[7]. Whilst intermittency is one characteristic in alerting, loudness is another important factor, as the alarm must be at a level well above that of its masked threshold in the background noise[8]. For some time there has been anecdotal evidence that, in listening to tonal and broadband alarms of equal A-weighted level, the broadband alarms 'sound louder', although the reason for this was not known. A sound level difference of 5dB was suggested for equal loudness[9]. The reason becomes clear if the frequency regions of tonal and broadband alarms are related to the equal loudness contours [10]. Figure 5 shows the contours in which the frequency region for broadband alarms is contained in the rectangle and the vertical line is at a typical frequency region for tonal alarms (1200Hz to 1500Hz). Tonal alarms are situated in the least sensitive local region of the hearing contours, whilst broadband alarms spread across the region of increased local sensitivity between 2000Hz and 4000Hz, which is attributed to resonance of the ear canal. This explains the difference in loudness.

Loudness comparison measurements were made using a CEL 593 sound level meter which was fitted with a loudness module, giving the Zwicker loudness. The microphone was removed and recordings of alarm sounds fed to the sound level meter as electrical signals, through an adapter. Comparisons are shown in Table 1, from which it is seen that, for given A-weighted levels, the broadband sound is louder than the tonal sounds, the difference reducing for the complex tone at 1450Hz, which has a component at 2900Hz.

The sound level meter calculates loudness from a third-octave band analysis of the equivalent level in the bands, which is lower than the level of the 'on' period, and 3dB lower for equal 'on' and 'off' periods. The following should be noted.

- It has been known for some time that full loudness sensation is achieved in about 100 milliseconds[11],[12], which is rather less than the duration of an alarm 'on' period
- Different types of alarms with closely similar 'on' and 'off' periods will have similar differences between their L_{eq} and maximum levels.

Consequently, the loudness measurement is a valid comparison of the loudness of the alarms.

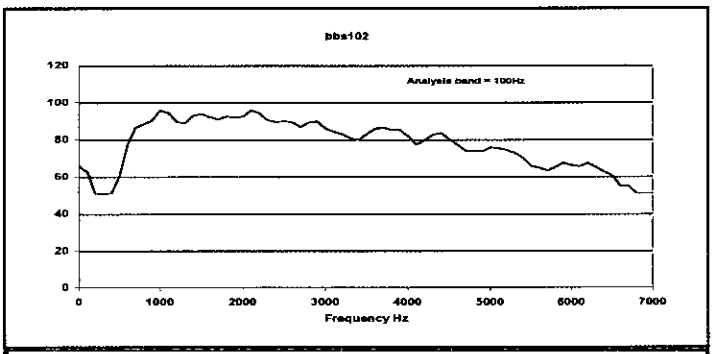


Figure 03

Constant bandwidth analysis (100Hz bandwidth) of broadband alarm

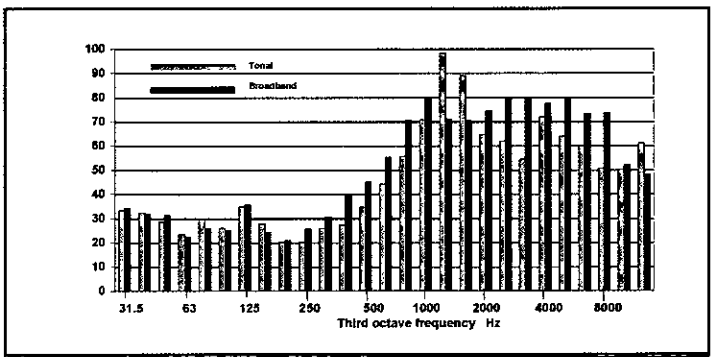


Figure 04

Third-octave spectra of tonal and broadband alarms

Environmental effects

Complaints of beeping alarms have led to local authorities specifying broadband reversing alarms for vehicles as a planning condition (for further information try a Google search for 'broadband alarm planning permission'). This has applied to quarry workings, superstore deliveries etc. The broadband sound is an effective alarm when close to the vehicle, whilst also sounding more pleasant and less intrusive than a beeping alarm does when at a distance. Broadband at a distance has a bland and characterless sound quality.

When tonal and broadband alarms have the same A-weighted level, the component of a single frequency tonal alarm might be 8 or 9 dB greater than the third-octave bands which comprise the spectrum of the broadband alarm, depending on the total bandwidth of the broadband alarm. The relative levels close to the alarm are indicated in Figure 6. At a distance from the alarm, the effects of air and ground absorption are more pronounced for the higher frequencies of the

continued on page 38

alarm	L_{Aeq}	loudness
broadband	92.3	103.2
tonal 1250Hz	93.0	95.0
tonal 1450Hz	92.2	95.8
complex 1450Hz	92.1	98.5

Table 01

Loudness comparisons

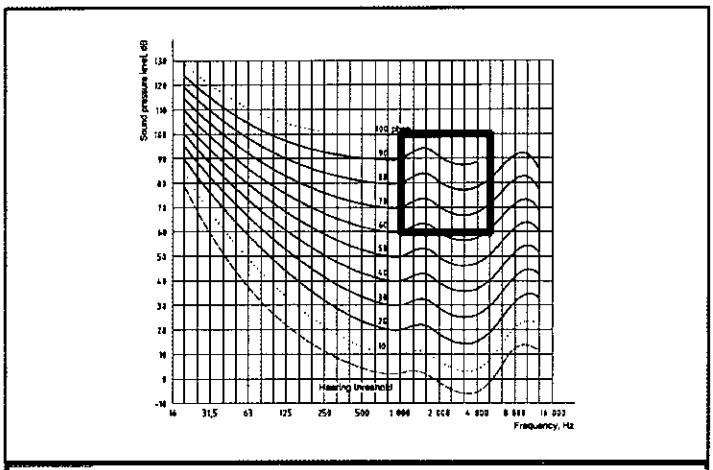


Figure 05

Hearing contours and alarm frequencies

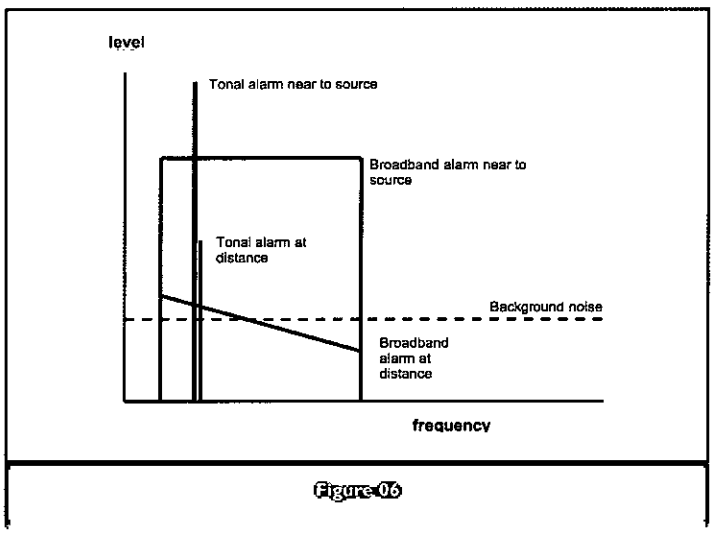


Figure 06

Propagation effects on the sound from tonal and broadband alarms

From bell to broadband - *continued from page 37*

broadband alarm. This leads to a greater reduction of the levels at the higher frequencies of the broadband alarm and a tilted spectrum into higher frequencies as in Figure 6. The A-weighted levels of the alarms, although equal at 1m, are different at a distance. Estimation shows that at 500m, for propagation over grass, the broadband alarm might be at an A-weighted level 4 or 5 dB lower than the tonal alarm. Other beneficial effects of barriers, absorption by foliage, ground type *etc* also increase with frequency. In addition, the components of the broadband alarm fall below the background noise at a position nearer to the source than the tonal alarm does. This leads to a manufacturer (Brigade Electronics) to refer to broadband alarms as 'noiseless', which effectively is true at distances when they cease to disturb listeners, although the tonal alarm may still remain annoyingly audible.

Penetration into buildings

Disturbance inside buildings may be very pronounced for tonal beeps from an alarm, especially when the occupant is resting. The higher frequency components of a broadband alarm have greater attenuation by the building envelope than the single frequency tonal alarm. The frequency dependent increase of attenuation by the building might be about 5dB per octave. Assuming a 1.5dB per third-octave increase in attenuation, it is possible to show that for tonal and broadband alarms which have the same A-weighted level close to the source, the internal level of the broadband alarm is about 4dB lower than that of the tonal alarm. Additionally, the sound has a less disturbing quality.

Directional radiation

It is clearly advantageous if an alarm radiates mainly in the area which it is intended to protect, and does not spill into other directions, where it might cause unwanted disturbance. The directivity of a source depends mainly on the ratio R, which is the source dimension divided by the wavelength of the sound radiated. A typical reversing alarm may include a small loudspeaker of diameter about 0.06m, with a waterproof cone. Then at 1250Hz the wavelength is 0.27m and $R \sim 0.25$, whilst at 4000Hz the wavelength is 0.085m and $R \sim 0.7$. The change of R from 0.25 to 0.7 indicates greatly increased directivity of the higher frequencies of the broadband alarm. Thus the energy of the alarm is concentrated into the areas in which it is required, reducing disturbance to other areas.

Summary

Some advantages of the newer broadband alarms over tonal alarms are:

1 They are about 5 phon louder than tonal alarms of the same A-weighted level, which means that a broadband alarm has a lower level for equal loudness.
2 Improved locatability comes from higher frequencies
3 Radiation is more directional than for tonal alarms
4 Propagation absorption is greater than for tonal alarms
5 Penetration into buildings is less than for tonal alarms.

Much of the interest in broadband alarms has developed for their environmental advantages, in addition to their use as a hazard warning. Tonal alarms still hold their traditional position as a familiar warning signal, but it must be remembered that alarm signals have changed considerably over a period of less than 100 years in their progression form bell to broadband, each phase gaining acceptance as it became familiar. At the present time it is too early to say whether broadband sound will be the alarm of the future, but its current rapid acceptance, for both environmental and safety reasons, is a positive indication.

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Appendix

Locatability of alarms

Locatability refers to the ease of determination of the direction of an unseen source of sound and estimation of its distance. Direction is far easier to determine than distance, which requires different clues including sound spectrum, level, quality etc. There are three main frequency regions which determine the locatability of a sound[13], although these are heard simultaneously.

1. At low frequencies (about 1.5kHz and below) the brain can process the time difference between the sound arriving at one ear and then the other. This is known as the Interaural Time Difference (ITD). However a 'cone of confusion' remains, in which sources on the surface of a cone have the same time delay between the two ears.
2. At mid frequencies (around 3kHz and above) the brain senses the intensity difference of the sound at each ear, *ie* the brain determines that the ear receiving greater sound intensity is closer to the source. The difference is known as the Interaural Level Difference (ILD) or Interaural Intensity Difference (IID). This frequency range permits us to decide if the sound is to the left or right.
3. Owing to the shape of our outer ear, higher frequencies of

about 5kHz are modified before entering the ear canal. This is an individual response and becomes significant when the wavelength of the sound is similar to or shorter than the dimension of the outer ear. Its use is a learned skill and assists front/rear sound source location.

The effects in these three frequency ranges combine to produce the head related transfer function (HRTF) between an external source and the sound into the ear.

A broadband alarm contains frequencies in all the three regions and gives sufficient information for rapid source location. A tonal alarm has components mainly in the first region and is more difficult to locate.

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Studying acoustical engineering

Danny Taylor.

University is a massive part of your academic life, where the average person commits to three or four years of study on a course which will give them a base for their future career. The choice of course is therefore crucial and having started university this year I am sure I have made the right choice.

From my interest in physics, maths and music I have started a four-year MEng Acoustical Engineering degree (accredited by the Institution of Mechanical Engineers and the Institute of Acoustics) at the University of Southampton. Acoustical engineering sounds like a very specific subject with little opportunity to pursue a career in a different form engineering on graduating. This is not the case.

The course for the first year is fundamentally a 'core' year with modules in mathematics, dynamics and the properties of materials and numerous laboratory classes, although there are interesting acoustics modules thrown in, such as physical acoustics and vibration.

The second and third years (BEng) and fourth year (MEng) of the course become much more acoustics orientated and include a research project in the third year. For students on the MEng programme there are compulsory management modules in the third year and a group design project in the fourth year. In addition, students following the MEng programme are required to complete summer placements at the end of years 2 and 3 which give a great insight into the types of work carried out by acoustical engineering companies.

Thanks to the 'core' engineering modules taught throughout the course a graduate has not only a firm grasp of general engineering, but also has the option to specify in acoustics , and with so many jobs in these fields available such qualifications are desirable to employers. In fact, graduates from the ISVR are frequently head-hunted before they even complete their courses.

So far the course has been challenging, interesting and enjoyable. The lecture hours are considerable though I find this beneficial, for the obvious reasons of more teaching time, though it is also very hard to fall behind with work if you attend regularly. Furthermore the amount of help on hand and the general working atmosphere within the ISVR (Institute of Sound and Vibration Research) is very good. If a student has any kind of problem with an assignment, or shows an interest in a certain field there are many academics around to help out.

The cliché 'work hard, play hard' is very apt for student life. The University Student Union throws regular club nights, and with numerous bars on campus a night out to relax is very easy to arrange. Moreover the grounds of the University are well kept, with large expanses of grass on which to sit and relax or revise.

The course you choose to pursue at University is very important, because if you are not passionate about what you are studying it will be a challenge to motivate yourself and do background research and reading. However, university life is not all just hard work, and there is a massive scope to pursue any hobbies or interests that you may have, or to take up new ones. I am having a great time at Southampton studying Acoustical Engineering and I look forward to putting my hard work into practice.

Danny Taylor is a first year undergraduate student at the ISVR, University of Southampton.

HRH the Duke of Edinburgh visits Salford Acoustics Labs

Andy Moorhouse

On 28 February 2008 the staff and students of the University of Salford's acoustics laboratories played host to HRH the Duke of Edinburgh. The Duke engaged with undergraduate and postgraduates students and with researchers on a tour of the test facilities which lasted nearly an hour and a half. As many readers will be aware, the Salford acoustics laboratories were officially opened by Andy Bower of BBC Future Media and Technology in October 2007 after having been completely rebuilt: the current facilities are Salford's third generation of acoustics labs. Having been Chancellor from 1967 until 1991 Prince Philip has maintained a keen interest in the University ever since.

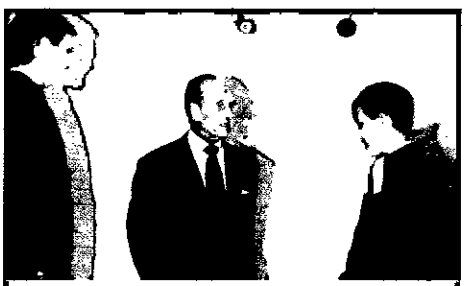
HRH kept undergraduates from Salford's acoustics, audio and video programmes on their toes by demonstrating a detailed knowledge of the concept of reverberation time. MSc students from the environmental acoustics and audio acoustics courses similarly faced some tough questioning on time windowing techniques for semi-reverberant rooms. The tour continued with demonstrations of a rain noise simulator, and a full ambisonics playback system with recorded soundscapes from Manchester and Prague, as well as an impressive recording of a Spitfire flying right through the semi-anechoic chamber. The international dimension of Salford's acoustical research came across as HRH met staff and students from Lebanon, Italy, Chile and Russia who demonstrated their research on novel porous absorbers and the low frequency impedance tube. The Duke also experienced the extreme quiet of our full anechoic chamber, and participated in a lively discussion over our hearing protector test rig about whether military personnel should wear ear defenders on active service (later that evening the first footage appeared on TV of the Duke's grandson in Afghanistan – firing a machine gun without ear defenders!).

By pure coincidence the Duke's visit coincided with an annual re-accreditation visit by UKAS for the Salford laboratory's commercial services in acoustic testing and calibration. Whilst this made the day somewhat demanding for the staff involved it gave the opportunity to demonstrate a novel aspect of our operation as a modern university, that besides using the laboratories for teaching and research we also run a fully fledged, accredited commercial test house employing four full time staff. We were able to introduce the UKAS inspector to the Duke and demonstrate a sound insulation test in our transmission suite.

To wind down at the end of the tour one of Manchester Cathedral's top boy choristers sang a Bach aria in our large reverberation room, after which the tour party was offered tea in the listening room to a background of choral music in 5.1 surround.

Lab Director Andy Moorhouse explains how to model a dodecahedron loudspeaker to the Duke and students from MSc Audio Acoustics and Environmental Acoustics [l to r] Ben Piper, Ian Drumm, HRH, Andy Moorhouse, Victor Chen

The Duke experiences the extreme quiet of Salford's anechoic chamber [l to r] left to right Andy Moorhouse, HRH, Danny McCaul



A Bach aria in the reverberation chamber sounds as if it is being sung in a cathedral [l to r] left to right Andy Moorhouse, HRH, Ben Davies

The Duke hears about research on porous absorbers at Salford [l to r] Rodolfo Venegas, HRH, Olga Umnova, Fouad Bechwati, Diego Turo

Sounds great

Arup Acoustics amazes at gala opening of Oslo Opera House

When journalists and assembled VIPs visited Norway's stunning new Operaen – the Oslo Opera House – for its inaugural gala performance on 12 April 2008, they were prepared to be impressed. They were not disappointed, either with the stunning architecture or the acoustics. The opera house, which seats 1,450, is the new home of Den Norske Opera, the national opera company of Norway. In addition to the main space – the Store Sal – the building contains a second, flexible format auditorium, the Lille Sal, plus rehearsal, production and administrative facilities befitting of a major international opera company.

A comprehensive brief for the opera house facilities written by Statsbygg, the Norwegian State Property Service, called for 'excellent acoustics for traditional proscenium-type grand opera', and the tender for acoustic design was won by BrekkeStrandArup (BSA), a joint venture between international auditorium acoustic design company Arup Acoustics and local consultancy Brekke Strand Akustikk. BSA combines local knowledge and presence with international design expertise.

The House's Oslo-based architect, Snøhetta, worked closely with BSA to develop the room form and finishes, integrating the functional, aesthetic and acoustic requirements in a homogenous and harmonious manner. The balance between words and music is critical in opera, and the careful balance between clarity of the sung words and reverberance has dominated opera house design.

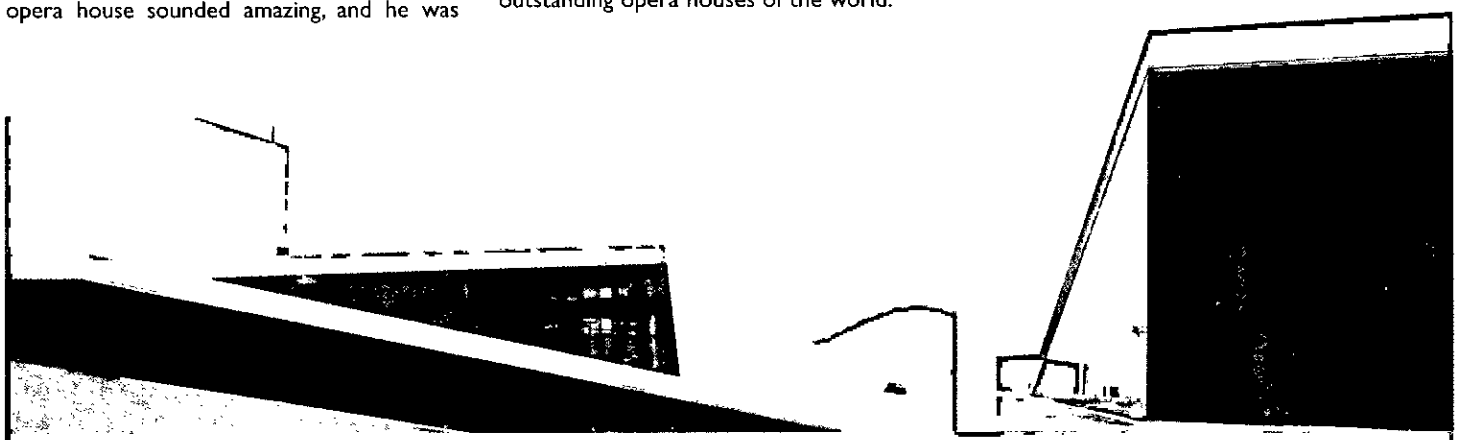
Rob Harris, director of Arup's Performing Arts Sector says that many old (Italian) opera houses have short reverberation times of about a second, making the words sound clear but the orchestra dry; modern houses tend to have longer reverberation times, perhaps two seconds, producing a more concert-like orchestral sound. The brief in Oslo followed this trend, so the challenge for BrekkeStrandArup was to provide the right balance between the two. The team carried out acoustical analysis of the developing design using room acoustics software, then fed the results back into the design process. This allowed the designers to actually listen to the room before it was built. Over 200 versions of the model were made to investigate the effects of proposals. In addition, a 1:50 scale model of the Store Sal room was built to carry out further tests.

It was necessary to maximise the volume while still providing intimacy in the relatively small space. So the room structure was left exposed and the idea gave 'ears' for the room, stepping out the auditorium walls at high level above the seating tiers. The room is narrow low down (which provides clarity and intimacy) and wide at the top (which provides

reverberance). Because the ideal acoustics of a hall are different for different performances, the House includes large area of curtains. These can be extended into the room, using computer-controlled motors, to provide a less resonant acoustic for contemporary (electronic) opera and for the occasional amplified concert.

Gunnar Ihlen, a member of the DNO orchestra with a particular interest in the acoustics of the new theatre, said that the new opera house sounded amazing, and he was excited to be in the orchestra playing in the inaugural concert. As time progresses, he looked forward to playing in different types of opera and hearing for himself how the acoustics can be changed by use of the different technologies which have been employed. The auditorium gave an astonishing experience of what natural acoustics could be like. The orchestra enjoyed a wonderful range of dynamics, and felt a freedom of musical expression which compared with the most outstanding opera houses of the world.

After the gala opening, the first production in the new opera house was the world premiere of the ballet *A Modern Place* by renowned Norwegian choreographer Ingun Bjørnsgaard. This is to be followed on 24 May, when *Worlds Beyond* by the celebrated Czech choreographer Jirí Kylián will open.



Operaen, Norway's new Opera House

Tesco powers ahead with TNEI

Quiet renewable energy to be introduced by supermarket chain

One of the most extensive wind energy programmes to be implemented in the UK is currently being championed by supermarket giant, Tesco in collaboration with energy consultants, TNEI Services Ltd.

The scope of the whole project is enormous and spans Tesco's network of over 2,000 supermarkets and depots in the UK. The first stage in the programme involved TNEI assessing all 2,000 plus Tesco sites to determine their suitability for their own on-site energy generation. Ten percent of the sites were found to be suitable and now these 200 will be developed with turbines ranging in size from 6kW to 3MW.

Prior to this year's main roll-out two small, 20kW turbines have already been successfully installed at the Tesco store in Barrow, one in Crewe and two at its headquarters in Welwyn Garden City, along with one micro-turbine at an urban supermarket site in the north-east of England. These turbines are now up and running and are contributing to the energy supply to these sites. The programme is gaining momentum with around 20 further sites having received planning consent and a raft of new applications submitted and awaiting approval. A large scale tendering exercise is under way to source suitable wind turbines within the required time frames.

TNEI has a dedicated team of environmental and planning experts who work on the Tesco programme along with other major developments. Their role is to assess the sites, conduct feasibility studies and prepare environmental statements and reports then navigate the applications through planning. Another sub-division of the planning team also works with Tesco to procure machines and project manages their installation. In addition to its core environment and planning expertise, TNEI has its own noise team with extensive experience in conducting noise impact assessments for wind farms, and individual turbines, as well as other renewable energy sources.

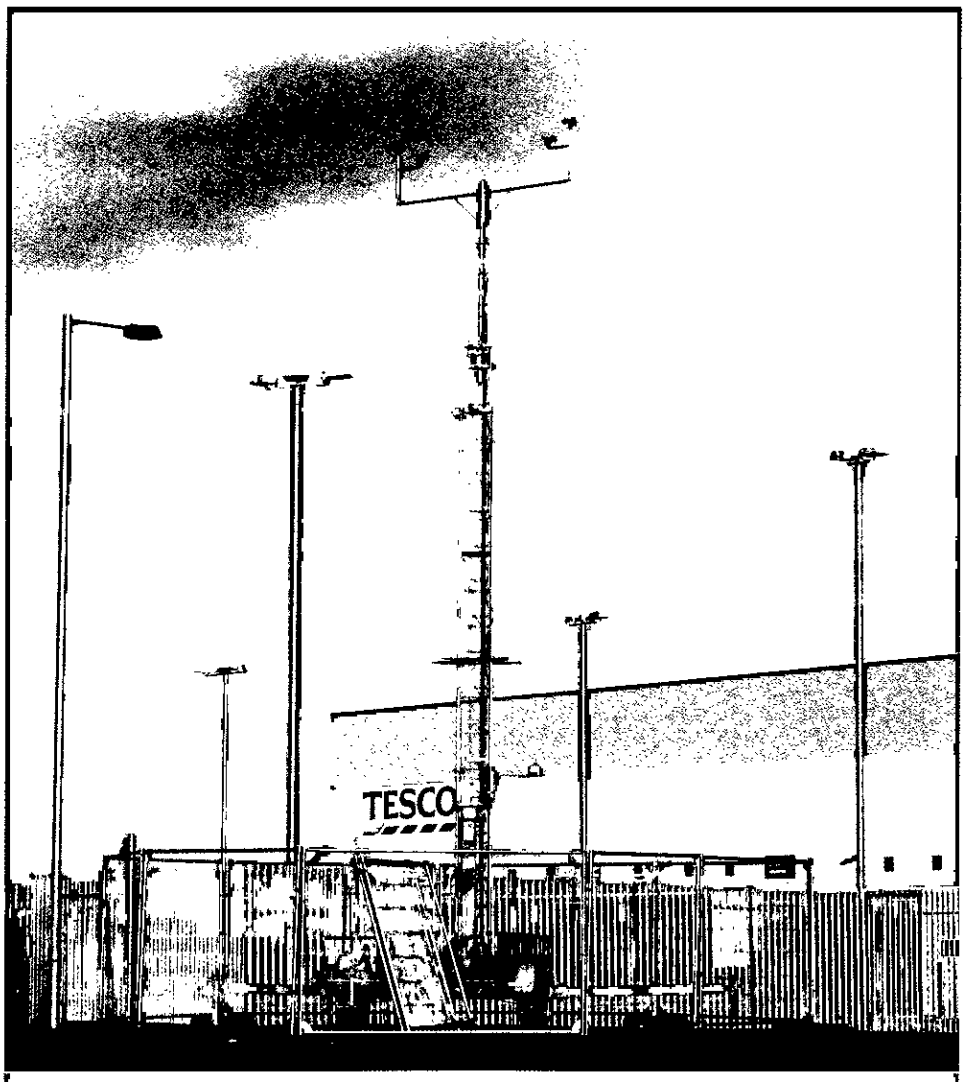
Turbine noise is a particularly sensitive issue in urban areas due to the proximity to houses. Noise assessments are essential and independent tests are being considered to determine the noise levels of various micro wind turbines. Many micro-turbines have not been effectively tested for noise and can therefore be problematic when included in planning applications. A trailer-mounted wind monitoring mast has been developed for use in areas where space is limited, or where time constraints prevent the installation of a traditional mast.

Before a turbine can be installed in some constrained environments, detailed assessments have to be made of the potential impact of any noise generated by the turbine. The evaluation includes the use of acoustic equipment positioned at various critical receptors. The assessment also measures wind direction and speed at 10m above ground. These tests help to determine whether sites are viable and provide figures that feed into ETSU-R-97 assessments, the regulatory guidelines for wind farm noise.

To gather the information, it is usual to erect a monitoring mast and leave it in place for between two and six weeks. However, on the Tesco project, the logistics of erecting a traditional guyed mast posed a serious challenge. Digging foundations for a substantial, semi-permanent fixture with a large footprint in a Tesco car park was not practicable. Facing this problem for the first time prompted the construction of a mobile monitoring mast that can be moved into urban areas on the back of an integrated trailer, erected and then completely removed at the end of the exercise without disruption to the site. The TrailerMast has an installed footprint of only six car parking spaces. This ensures that Tesco's day-to-day shoppers remain unaffected by the mast.

Another innovation is in the use of vertical axis micro-turbines. The first 6kW Ropatec turbine was installed at a Tesco store in Newton Aycliffe. A traditional turbine is not always feasible in a supermarket car park in the middle of a town, but micro-turbines are quieter and more responsive to turbulent wind conditions. They offer a solution to the problem of energy generation at supermarkets within densely populated areas, and assist with Tesco's ambition to raise awareness and provide leadership in sustainability. The sheer scale of the programme and the exposure to local authorities unfamiliar with planning applications for wind turbines has presented a number of interesting issues.

TNEI built its reputation on wind turbine installations and it was as a direct result of this expertise that Tesco first started working with the company. Generating energy close to where it is needed and the intelligent management of that energy will be critical to the UK's energy mix - now and in the future.



TNEI's temporary meteorological mast at a Tesco site

New-look HSE

The Health and Safety Commission (HSC) and the Health and Safety Executive (HSE) merged on 1 April 2008 to form a single national regulatory body. The decision to merge HSC and HSE was reached after extensive consultation, in which 80% of respondents favoured the move.

Announcing the merger, Health and Safety Minister Lord McKenzie said that the Health and Safety Commission and Health and Safety Executive had done an excellent job over the last 30 years in bringing about significant improvements to health and safety at work. However, to face the challenges and demands of the changing world of work, now was the right time to merge the organisations into one which could provide a platform for further improvements to health and safety at work across Great Britain.

The current chairman of the Commission, Judith Hackitt, becomes chairman of the board of the new Executive. Welcoming the merger, she added that the new Health and Safety Executive would strengthen the importance of workplace health and safety in Great Britain. With a single regulatory body it would be able to strengthen the links between strategy and delivery in order to provide the accountability expected of a public body in today's workplace climate. The merger would not fundamentally change the day-to-day operations but would set the tone for closer working throughout the organisation. HSE would build on the independence, good relationships with stakeholders and in particular its relationship with local authorities to develop a revised strategy for health and safety in Great Britain.

ICSV16

Congress dates announced

The Sixteenth International Congress on Sound and Vibration (ICSV16), sponsored by the International Institute of Acoustics and Vibration (IIAV) and the Polish Acoustical Society (PTA) will be held in Krakow, Poland from 5 to 9 July 2009, in cooperation with the International Union of Theoretical and Applied Mechanics (IUTAM), the American Society of Mechanical Engineers International (ASME International), and the Institution of Mechanical Engineers (IMechE). The congress has the honorary patronage of the mayor of the city of Krakow. The venue of the ICSV16 is the AGH University of Science and Technology.

Theoretical and experimental research papers in the fields of acoustics, noise and vibration are invited for presentation. Companies are invited to take part in the ICSV16 exhibition or to sponsor the event.

Krakow has traditionally been one of the leading centres of Polish scientific, cultural and artistic life. The intellectual potential of Krakow is created by 22 universities, nearly 20,000 academic lecturers and 190,000 students. As the former capital of Poland, with a history encompassing over a thousand years, the city remains the spiritual heart of the country. It is a major attraction for local and international tourists and welcomes seven million visitors annually. In 1978, UNESCO added Krakow's historic centre to the list of World Heritage Sites.

The deadline for submission of abstracts (**http://www.iiav.org/icsv16**) is 1 December 2008. The deadline for proposals for structured sessions (**icsv16@iiav.org**) is 1 November 2008.

The chairman of the ICSV16 local organising committee is Marek Pawelczyk (**marek.pawelczyk@polsl.pl**), vice-president of the International Institute of Acoustics and Vibration, and vice-director of the Institute of Automatic Control, Silesian University of Technology Akademicka 16, 44-101 Gliwice, Poland (tel: **+48 32 237 10 46**, fax: **+48 32 237 21 27**. The congress web site is at: **www.icsv16.org**

IIAV is an international non-profit scientific society affiliated to the International Union of Theoretical and Applied Mechanics (IUTAM). IIAV currently has over five hundred individual members in 55 countries and is supported by 32 national and international scientific societies and organisations.

Parliamentary reports

From Hansard

Commons Written Answers

4 March 2008: Aviation

Norman Baker: To ask the Secretary of State for Transport what discussions her Department has had or plans to have on the past and potential future impact of changes in noise levels permitted from individual aircraft, and changes in the size of aircraft upon past increases and future total passenger and freight numbers, and past and future economic, environmental and social impacts; and what representations have been received on these matters.

Jim Fitzpatrick: The Future of Air Transport White Paper set out our key aim to limit and where possible reduce the number of people in the UK significantly affected by aircraft noise. In the White Paper, we highlighted the importance of promoting research and development into quieter aircraft and airframe technology. We are pursuing this aim through both international and national forums.

Although technological change is a long-term issue, the aviation industry has made encouraging progress in addressing the noise of the airline fleet. For example, the newest generation of wide-bodied aircraft is expected to make significantly less noise on arrival than the largest aircraft currently operating. We have also seen the introduction of new engines which include innovations to reduce noise and improve fuel efficiency.

Possible future technological change and related impacts are taken into account in our forecasting. For example, the current consultation on the future expansion of Heathrow has been prepared against this background. Paragraph 3.82 of the consultation document notes that although there were 73% more aircraft movements in 2005 compared with 1975, the number of people significantly affected by noise has fallen by 87%, and the area affected reduced by 86%. In addition, the night flights regime introduced in October 2006 at Heathrow, Gatwick and Stansted recognises technological change by providing incentives for introducing quieter aircraft. The regime was only introduced after an extensive two-stage public consultation exercise.

All major UK airports (those with 50,000 annual movements or more) have been required to map aircraft noise in compliance with the European Environmental Noise Directive. Later this year, the airports will have to prepare strategic noise action plans setting out noise mitigation measures. These plans will have to be prepared in consultation with the local community and provide an opportunity for relevant local issues to be considered. In addition, we regularly receive representations on aircraft noise issues which help inform the Department's policy making.

11 March 2008: Pollution control - Noise

Geraldine Smith: To ask the Secretary of State for Environment, Food and Rural Affairs what steps may be taken by local authorities to deal with noise pollution.

Jonathan Shaw: A number of key statutory duties are placed upon every local authority in England and Wales by the Environmental Protection Act 1990, as (i) the duty to inspect its area from time to time to detect any statutory nuisances which ought to be dealt with; (ii) the duty to take such steps as are reasonably practicable to investigate a complaint of a statutory nuisance made by a person living in its area; (iii) the duty to serve an abatement notice where the local authority is satisfied that a statutory nuisance exists or is likely or occur or recur within the area of the authority.

Night noise (11pm to 7am) from dwellings and licensed premises can be addressed under the Noise Act 1996, as amended by the Clean Neighbourhoods and Environment Act 2005. The night noise offence for licensed premises was introduced by section 84 and Schedule 1 of the Act, which came into force in England on 1 October 2006. We have revised the directions for permitted noise levels and an approval for devices measuring noise levels, which came into force on the 28 February 2008.

Offenders who exceed the 'permitted level' for night-time noise as measured from within a complainant's dwelling can be issued with a fixed penalty notice under the Noise Act 1996. Alternatively, the local authority can prosecute under the Noise Act 1996 or consider issuing an abatement order under the Environmental Protection Act 1990, which also allows for immediate confiscation of equipment responsible for the noise.

The new permitted level is 34dB(A) where the underlying level does not exceed 24dB(A), or 10dB above the underlying level where this exceeds 24dB(A). This permitted level applies to both domestic and licensed premises.

The Environmental Noise Directive applies to environmental noise from sources including agglomerations and major airports, roads and rail. The Directive requires member states to produce strategic noise maps and action plans to manage and reduce noise from these sources where necessary. English local authorities will be encouraged to participate in the process of drawing up action plans for agglomerations. Where action plans identify a local authority as responsible for a particular action, the authority is required to treat the action plans as its policy insofar as it relates to that action.

19 March 2008: Council Tax - Valuation

Mr Pickles: To ask the Chancellor of the Exchequer what use the Valuation Office Agency's automated valuation model for English council tax valuations makes of locality adjustment factors.

Jane Kennedy: Locality adjustment factors are not currently used for council tax valuations in England.

Mr Pickles: To ask the Chancellor of the Exchequer whether additional noise and disturbance arising from a change in road traffic is a material change affecting a dwelling for the purposes of council tax valuations.

Jane Kennedy: Clarification of the law on this matter is currently being sought from the Court of Appeal.

25 March 2008 : A47

Mr Stewart Jackson: To ask the Secretary of State for Transport whether any proposals for sound attenuation in respect of traffic and carriageway noise on the A47 in the Peterborough area exist; and if she will make a statement.

Mr Tom Harris: There are currently no specific plans for sound attenuation in respect of traffic and carriageway noise on the A47 in the Peterborough area. However, resurfacing of sections of the A47 in the Peterborough area is planned for 2008-9, and low noise surfacing material will be used.

Mr Stewart Jackson: To ask the Secretary of State for Transport whether the Highways Agency intends to utilise whisper quiet sound attenuation technology as part of resurfacing in respect of its planned maintenance programme or any discrete projects on the A47 in the Peterborough area; and if she will make a statement.

Mr Tom Harris: Since 1999, it has been the Highways Agency's policy to use low-noise surfacing materials for all new roads and when resurfacing existing roads. Planned re-surfacing works for 2008-9 include sections of the A47 between junctions 16 and 15 westbound, and sections of the A47 from

junction 15 westbound towards Castor.

Mr Stewart Jackson: To ask the Secretary of State for Transport what recent measurements of sound levels from traffic noise and carriageway have been undertaken on the A47 by the Highways Agency between Milton Park and Eye in the Peterborough area; and if she will make a statement.

Mr Tom Harris: The Highways Agency has not recently undertaken any measurements of noise levels between Milton Park and Eye in the Peterborough area. After local complaints a study was undertaken by Peterborough city council in 2005 near the A47 trunk road. This was deemed unsuitable by the Agency as it omitted certain essential information for determining its status as a 'hazard' site.

In October and November 2005 the Highways Agency's managing agent took noise readings at Eye on the A47. This section of the A47 in Peterborough was identified owing to a number of complaints of excessive traffic noise received from the local residents associations. A roadside level of 79dB was recorded. This location therefore did not meet the required roadside threshold of 80dB, and no further study work was undertaken.

2 April 2008: Wind power - Noise

Mr Gale: To ask the Secretary of State for Business, Enterprise and Regulatory Reform pursuant to the Answer of 19 February 2008, on wind power - noise, when he expects installation and product standards for micro wind turbines to be published.

Malcolm Wicks [holding answer]: Under the Microgeneration Certification Scheme (MCS) installation and product standards for micro wind, which address noise issues, will be published shortly. More information on development of the standards is available on the MCS website: **www.microgeneration.org**

Lords Written Answers

11 March 2008: Emergency services - Sirens

Lord Steel of Aikwood: Does HM Government plan to hold discussions with the police, fire and ambulance authorities with a view to reducing noise and light pollution from sirens and blue lights in central London, especially during the hours of darkness.

Lord Bassam of Brighton: The use of sirens by the police and other emergency services is controlled by Regulation 99 of the Road Vehicles (Construction and Use) Regulations 1986. This permits the use of sirens only when it is necessary or desirable to do so either to indicate to other road users that the vehicle is responding to an urgent incident or to warn other road users of the presence of the vehicle on the road.

Use of blue warning lights is controlled under the Road Vehicles Lighting Regulations 1989, as amended. These permit blue lights to be fitted to emergency vehicles, including vehicles used for police purposes. The aim is to prevent excessive use, as this could diminish the impact of the lights. Use of the lights is not mandatory but they may be used at emergency scenes, to indicate urgency when on the way to such scenes, or to warn others of the presence of the vehicle or a hazard on the road.

It is for the emergency services to consider how best to use sirens and lights for maximum effectiveness and minimum environmental disturbance. Subject to the regulations and any guidance from those services, drivers of emergency vehicles are expected to use their professional judgment to decide when and where the use of sirens and blue lights is appropriate. Drivers ought to be fully aware that sirens must be used with restraint, particularly at night, so as not to cause a nuisance to residents or other road users. There will, however, always be occasions when it is necessary for the emergency services to use sirens or blue lights or both, in the interests of road safety and the protection of the public.

I am grateful for the letter from Neil Gross in the January/February edition, responding to my previous 'urban myth' article. I have briefly read the New South Wales industrial noise policy that he referred to and also believe that other members who are involved in the assessment of industrial and other 'environmental' noise may find it thought provoking. From my initial reading, it appears that the approach used in NSW is somewhat more sophisticated than the simplistic criterion of source L_{Aeq} relative to background L_{A90} that is often used in this country. As Neil points out, this methodology 'sets a procedure for determining the most appropriate criterion to apply' which takes account of the existing acoustic climate and nature of the environment being considered.

I also note Neil's comments regarding the practicability and reasonableness of a criterion that is 10dB below the background (L_{A90}) noise level. He refers to an article in the previous (September/October 2007) 'new products' section regarding directional noise monitoring. I should perhaps point out that the organisation that Neil represents markets this system in Australia. My understanding of the system is that it uses a triangular array of three microphones, with some sophisticated software, to identify the direction of sources of noise that contribute to, but do not necessarily dominate, the ambient sound level at the monitoring position. This system looks very useful for some applications, such as environmental noise monitoring, but I believe that it does have some limitations. If a reflective surface is within a few metres of the array I understand that it may create 'ghost' images. In a reverberant area such as a light well I fear that this system may be of little use. The three microphone system provides angular resolution in only one plane, but I understand that three dimensional resolution can be achieved by adding a fourth microphone to form a three dimensional array. Aside from the limited use of this (or any other similar systems?) I am also concerned as to the ease of use of this system for many relatively small scale noise assessments. I believe that the system is useable in the field as a 'ruggedised notebook' platform. Clearly this is somewhat more sophisticated than the simple integrating sound pressure level meter that is often used for this type of assessment and may be more difficult to use in some circumstances.

Although I believe that this system can provide many benefits and is extremely useful for many environmental noise assessments (although I have yet to find out the costs involved), I do not believe that it is likely to be in widespread use in the near future. I could certainly think of several sites where such a system could be of great assistance and I am grateful to Neil for bringing the system to my attention. However, it would not be reasonable to impose a planning condition that is dependent upon the use of such a system for its enforcement (even if the system is able to provide the necessary resolution in the particular site conditions).

It was good to receive a response to the original article. I would like to take this opportunity to encourage other members who have an interest in the measurement and assessment of industrial and other 'environmental' noise sources to contribute their experience to this debate.

Richard A Collman BSc CEng MIOA TechIOSH

Maxideck

High performance acoustic floor

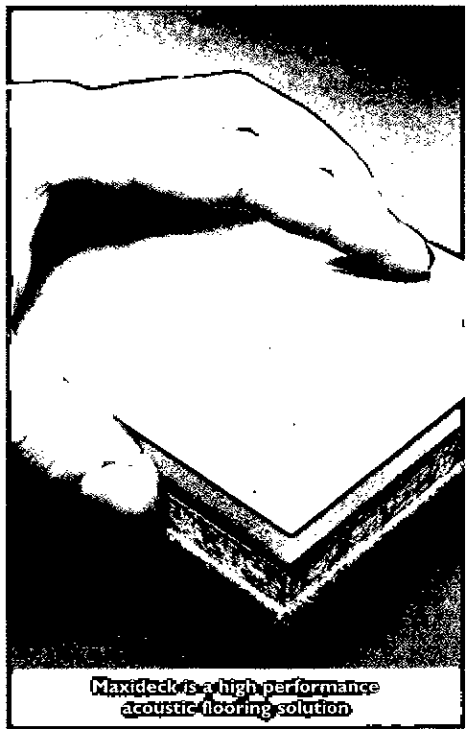
Acoustic insulation innovator Sound Reduction Systems Ltd (SRS) is proud to announce the launch of its latest product, Maxideck.

Maxideck is a high performance acoustic flooring solution, designed to comply with Building Regulations Part E. Ideal for conversion or newbuild projects, it is a cost-effective and time-efficient method of meeting both the airborne and impact noise standards. It is a composite of four materials, each chosen for their own unique acoustic properties. The result is an extremely high-performance product having minimal floor build-up. At only 28mm thick, the panels have demonstrated compliance with the Building Regulations in many different constructions, even installed on a standard chipboard floor above a directly fixed plasterboard ceiling.

Maxideck is an extremely versatile product, and can be used in all areas. The incorporation of a moisture-resistant material on the upper face ensures the product is suitable for wet surface areas such as kitchens and bathrooms. SRS has created a product that satisfies the needs of everybody involved in construction, from specifier to installer to end-user. The company claims that being easy to specify, simple to install and having a great acoustic performance makes its new product the future of timber-based acoustic flooring.

SRS has a wide range of acoustic insulation materials and the technical team is happy to talk to anybody about their acoustic insulation problems, no matter how large or small.

For further information,
please phone **01204 380074**
or email **info@soundreduction.co.uk**
Web site: **www.soundreduction.co.uk**



Maxideck is a high performance acoustic flooring solution

Campbell Associates

Training days 2008

Campbell Associates has announced the following training sessions.

28 May 2008, London
CadnaA user group training day, free to CadnaA maintenance contract holders

2 June 2008, Nottingham
half-day seminars in building acoustics (morning) and environmental noise measurements (afternoon)

4 June 2008, London
half-day seminars in building acoustics (morning) and environmental noise measurements (afternoon)

For more information contact Campbell Associates on **01371 871030** or visit **www.campbell-associates.co.uk**

Tools of the trade

Intrinsically safe noise dose meters available from Brüel & Kjær

Comprehensive noise exposure measurements, within potentially explosive environments, are easily achieved with Brüel & Kjær's 'intrinsically safe' version of its noise dose meter, type 4445E.

The 4445E can be enhanced with Brüel & Kjær's unique Protector software for use on a PC, which offers users a host of valuable post-measurement facilities, including data comparisons and statistical analyses.

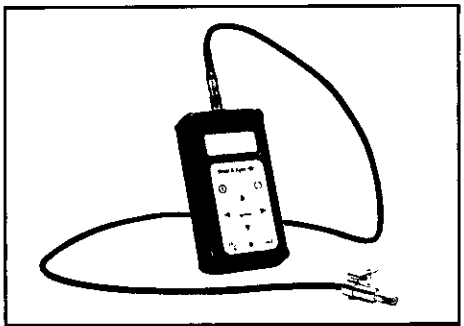
Statistical analysis of noise levels establishes a general 'picture' of the noise situation, showing how much the noise level varies and whether excessive exposures stem from a generally high noise level or a few isolated incidents. This makes the meter ideal for use in many different work environments, such as factories, chemical plants or construction sites.

The Protector software also has the ability to present logged noise exposures, making it much easier to visualise the variation with time of the measured noise levels. With the data logging tool, numerous measurements can be made over an extended period of time and a time stamp added to each data point. This set of time history data reveals a variety of information, including frequency and times when noise levels were excessive, making it possible to link noise problems to specific processes or events throughout the day. It also allows users to decide whether excessive measured values should be discarded from the record and whether further investigation is needed.

The timer feature allows an entire week's worth of measurements to be set up, eliminating the user's need to attend to each measurement personally. The user has only to enter the date and time for the measurements to begin, before switching the noise dose meter on. The instrument can then be left unattended, until switched off, once the required period of measurement has finished.

Since 2003, all noise dose meters used within hazardous or volatile atmospheres must have the ATEX (intrinsically safe) approval. Brüel & Kjær's model meets the requirements associated with ATEX certification code EEx ia I M1 and EEx ia IIC T4 II 1 G, making it particularly suitable for use in dangerous areas such as mines, printing works, petrochemical plants and other areas that require the use of Ex-rated instruments.

Damage caused to workers' hearing by long-term exposure to high levels of noise is the primary cause of occupational hearing loss, yet many are still unaware of the potential for damage. Noise dose meters such as the Brüel & Kjær Type 4445E are valuable tools in the fight against noise-induced hearing loss.



type 4445E noise dose meter

A noise dose meter is worn with the microphone fastened close to the ear. It measures the sound pressure level and calculates the so-called noise 'dose' received by the individual during the day. The noise dose is expressed as the equivalent average sound level for an eight-hour period (reference duration) and this level must be below the limit (or criterion level) specified in the relevant occupational health regulation - often an 87dB limit is used.

For more information about Brüel & Kjær's noise dose meters and software, contact: **heather.wilkins@bksv.com**

Casella CEL

New noise dose badge

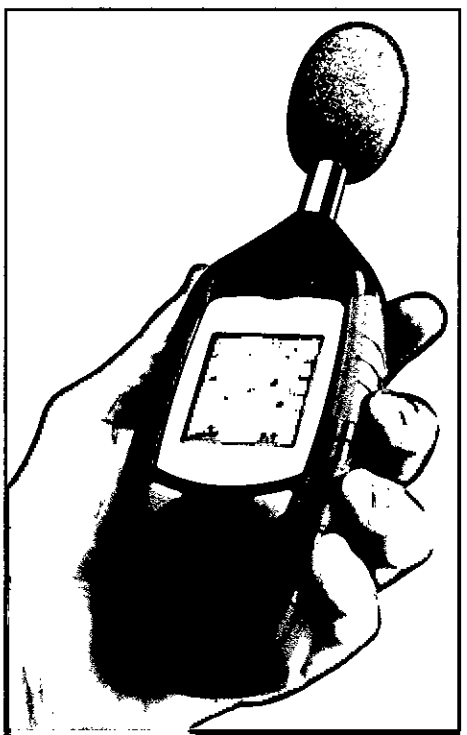
The existing CEL-350 dBadge has been available on the market since May 2006 and has proved hugely popular. The dBadge is versatile because it is cable free, it is totally reliable owing to the digital technology used, and it is ahead of its time with a robust, small and lightweight (68 gram) ergonomic design. The unit measures all occupational noise parameters, as well as the time history of an individual's noise exposure throughout the day. A visual exposure alarm is included to easily see in an employee's exposure is being exceeded.

A world's first for a badge-style noise dosimeter, the new CEL-352 dBadge 'Plus' measures the parameters necessary for the selection of hearing protection by the HML or SNR methods. These are internationally recognised methods which use simple calculations from attenuation values provided by manufacturers of hearing protection.

The dBadge uses the latest digital technology allowing miniaturisation of the design and incorporation of a built-in graphic display. This is used to display status information and completed noise exposure results, whilst the display can also be 'locked' during a measurement so noise level information is not visible to the employee wearing the device.

The CEL-352 dBadge 'Plus' has a level of sophistication not seen previously on noise dosimeters. It allows health and safety professionals ensure adequate hearing protection is provided to their employees, using only a noise dosimeter where previously a second instrument would have been required.

CEL-352 dBadge 'Plus'



CEL-240

Affordable noise monitoring is a sound investment

Casella CEL engineers have redefined high quality, affordable noise monitoring. The popular CEL-200 range of sound level meters now has a new member. The CEL-240 sound level meter is completely innovative to the market, offering technology and ergonomics not seen before for this price. It has been launched to meet the need for a low-cost yet fully compliant basic sound level meter. It is based on the digital signal processing (DSP) technology recently introduced in the popular CEL-350 dBadge dosimeter and it offers the new user an easy way to make simple noise measurements with the minimum of fuss.

The CEL-240 features an instantaneous sound level display and a non-decaying maximum hold on a number of displays showing the A or C frequency weighting with the slow, fast or impulse time response. A large high-resolution display is provided to show the noise levels numerically, on a bar graph or on a time history trace showing the trend in the last minute or last five minutes of the measurement.

The unit will be attractive to those users who need a simple, low cost meter, yet still must ensure they have one that is fully compliant with all the national and international accuracy standards. It has all the features expected in a simple instrument, as well as some that are not even found in instruments double the price.

The meter is available on its own or as part of a full measurement kit (CEL-240/K1) with a matching acoustic calibrator and other accessories.

For further information: Tim Turney, Casella CEL, tel: **01234 844100**, email: **timturney@casellameasurement.com**

PCB Automotive Sensors

High temperature preamplifier

The Automotive Sensors division of PCB Piezotronics (PCB) has announced release of a new high-temperature preamplifier, designed to overcome high temperature testing challenges associated with NVH powertrain and vehicle under-bonnet testing applications, and to broaden options for NVH test engineers collecting acoustical data in high temperature areas.

Automotive engineers routinely perform NVH tests in areas around the powertrain, where elevated operating temperatures can present major measurement challenges. Under-bonnet temperatures can reach 125°C under normal driving conditions, and can be significantly higher near turbochargers and exhaust system components such as manifolds and diesel particulate filters. In the past, test engineers were limited by preamplifiers offering operating temperature ranges to 70°C. Model HT426E01 is a half-inch preamplifier operating from ICP sensor power, terminating with a BNC connector and using standard coaxial cables. The model also features a low attenuation factor (-0.06 dB) and low noise characteristics (4.9μV) when measurements are A-weighted.

Common automotive applications include under-bonnet measurements for benchmarking and issue identification, including engine radiated, induction, ancillary and turbocharger noise; near-field measurements on manifolds; silencers; exhaust after-treatment components; and tailpipe noise. NVH groups involved with testing of powertrain components, including engine, engine ancillaries, turbocharger, transmission, intake, and exhaust, will benefit most from this product.

For more information on these and other automotive product, contact PCB Automotive Sensors via email: **automotivesales@pcb.com**. The company's web site is **www.pcb.com**.

HT426E01 preamplifier

RNIB

Guiding engineers to help disabled and older people

Now in the marketplace is a comprehensive guide aimed at engineers and technicians to make the accessible ICT systems they design and manufacture more useable by disabled and older people. A wide range of application areas and technologies is covered - from household appliances and transport to biometrics and information displays.

Guidelines for the design of accessible ICT systems is divided into four sections:

User groups provides demographic information and details about the types of disabilities that designers need to consider, including impairments such as visual, hearing, deaf and blind, physical, cognitive and language, and how to cater for older people. There are direct web links to each area.

Application areas are the everyday situations and environments where accessibility should be a major consideration.

The **technology** section refers to specific technological systems such as radio frequency identification (RFID) and smart media and how accessibility issues can be addressed within these.

Related aspects are the more general areas and everyday situations that people with disabilities and older people will encounter, where accessibility is again an issue.

The information contained in the Guidelines document, and more detail, can be found at **www.tiresias.org/guidelines**.

Tiresias, which is the RNIB scientific research unit's web site, also offers in-depth information on more than 2,000 devices, some 1,000 agencies for blind and partially sighted people, current and future research across 33 countries, and more than 100 scientific and technological reports on topics ranging from smart cards and biometrics to Braille and tactile data.

Dr John Gill, chief scientist at the RNIB, who produced the Guidelines, said that the greater enjoyment of life of people with disabilities and older people lay in the hands of our engineers and technicians. They were the people who design and make ICT systems and they were urged to look at the recommendations contained in Guidelines and give some thought on how greater improvements could be made. The need to do so was growing apace as, added to the several millions of Britons with disabilities, the increasing numbers of older people also had to be helped. Dr Gill said that people with disabilities had very varied needs and aspirations. When designing systems for use by the general public it was important for engineers and technicians to have an understanding of the implications of different impairments. For instance, 8% of the male population had difficulties in distinguishing red and green. The number of people with impairments would increase as life expectancy increased: among older people it was common to have a combination of impairments which could result in problems in using information and communication technology systems.

Dr John Gill, chief scientist of the RNIB, can provide copies of the Guidelines document on application to RNIB, 105 Judd Street, London WC1H 9NE, tel: **020 7391 2244**, email: **john.gill@rnib.org.uk**

Dr John Gill

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Applications for Sponsor Membership of the Institute should be sent to the St Albans office. Details of the benefits will be provided on request.

Committee meetings 2008

DAY	DATE	TIME	MEETING
Thursday	8 May	10.30	Membership
Wednesday	21 May	10.30	CCENM Examiners
Wednesday	21 May	1.30	CCENM Committee
Thursday	22 May	11.00	Publications
Tuesday	3 June	10.30	CMOHAV Examiners
Tuesday	3 June	1.30	CMOHAV Committee
Thursday	5 June	11.00	Executive
Thursday	**19 June**	**11.30**	**Council**
Thursday	26 June	10.30	Distance Learning Tutors WG
Thursday	26 June	1.30	Education
Thursday	3 July	10.30	Engineering Division
Tuesday	8 July	10.30	ASBA Examiners
Tuesday	8 July	1.30	ASBA Committee
Thursday	10 July	10.00	Meetings
Tuesday	5 August	10.30	Diploma Moderators Meeting
Thursday	4 September	10.30	Membership
Thursday	11 September	11.00	Medals & Awards
Thursday	11 September	1.30	Executive
Thursday	18 September	11.00	Publications
Thursday	**25 September**	**11.30**	**Council**
Thursday	2 October	10.30	Diploma Tutors and Examiners
Thursday	2 October	1.30	Education
Thursday	16 October	10.30	Engineering Division
Thursday	30 October	11.00	Research Co-ordination
Thursday	6 November	10.30	Membership
Tuesday	11 November	10.30	ASBA Examiners
Tuesday	11 November	1.30	ASBA Committee
Wednesday	12 November	10.30	CCENM Examiners
Wednesday	12 November	1.30	CCENM Committee
Thursday	13 November	10.00	Meetings
Tuesday	18 November	10.30	CMOHAV Examiners
Tuesday	18 November	1.30	CMOHAV Committee
Thursday	20 November	11.00	Executive
Thursday	27 November	11.00	Publications
Tuesday	2 December	10.30	CCWPNA Examiners
Tuesday	2 December	1.30	CCWPNA Committee
Thursday	**4 December**	**11.30**	**Council**

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 2008

13 May
Noise and Vibration Engineering Group
Consulting in Occupational Noise – Getting it Right
HSE, Bootle, Merseyside

15 May
Noise and Vibration Engineering Group
Consulting in Occupational Noise – Getting it Right
Unilever, Bedfordshire

17 June 2008
Environmental Noise Group
The Art of being a Consultant
Southampton

3-5 October
Building Acoustics Group
Auditorium Acoustics 2008
Oslo, Norway

14-15 October
Underwater Acoustics Group
Underwater Noise Measurement, Impact and Mitigation
Southampton

21-22 October
Measurement & Instrumentation Group
Autumn Conference 2008
Oxford

20-21 November
Electroacoustics Group
Reproduced Sound 24
Brighton

Further details can be obtained from Linda Canty at the Institute of Acoustics
Tel.: **01727 848195**
or on the IOA website:
www.ioa.org.uk

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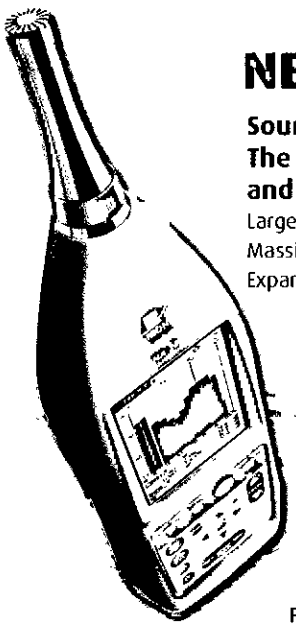

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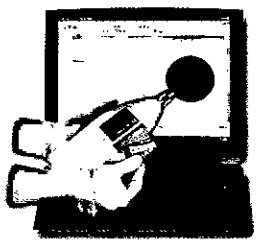
Expandable functionality using program cards



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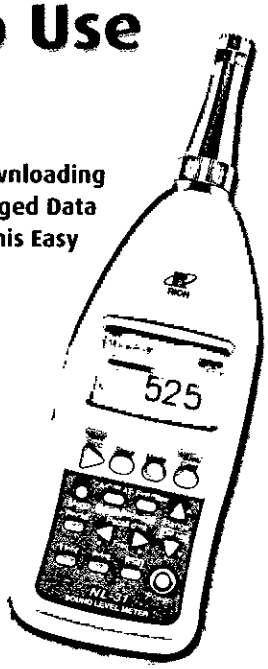

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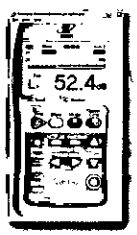

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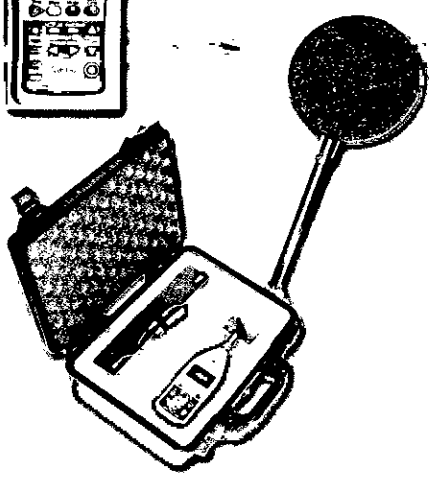

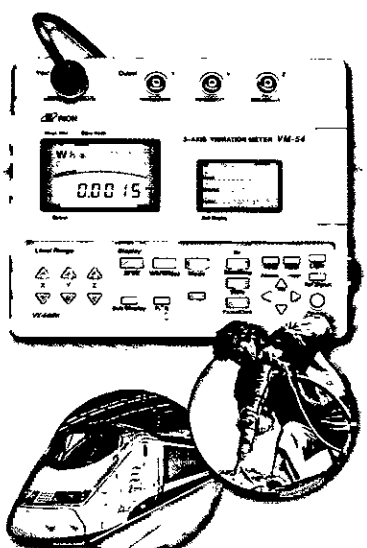

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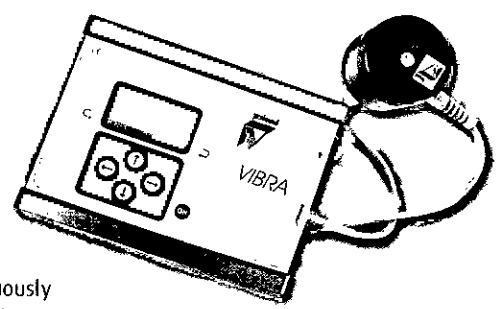

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