Vol 37 No 5 September/October 2012

ACOUSTICS BULLETIN

in this issue… **Matching an organ to its acoustic space**

plus… **Delegates from around the world flock to ECUA 2012**

Huge response to IOA membership survey

Noise survey shows Cockneys "a disappearing breed"

Institute of Acoustics

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Vol 37 No 5 September/October 2012

Front cover photograph: The acoustic space inhabited by an organ can vary within very wide parameters and these variations will have a major effect on the musical result.

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The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society. The Institute of Acoustics is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels.

The Institute has over 3000 members working in a diverse range of research, educational, governmental and industrial organisations. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of acoustics is equally wide, embracing such aspects as aerodynamics, architectural acoustics, building acoustics, electroacoustics, engineering dynamics, noise and vibration, hearing, speech, physical acoustics, underwater acoustics, together with a variety of environmental aspects. The Institute is a Registered Charity no. 267026.

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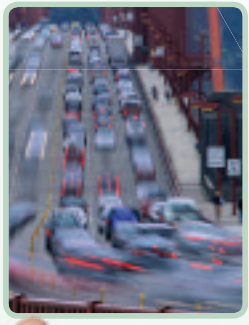

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Birmingham

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Annual Autumn Conference 2012
Birmingham

14-16 November 2012
Organised by the Electro-acoustics Group
Reproduced Sound 2012
Brighton

27 November 2012
Organised by the Measurement and Instrumentation and Young Members' Groups
Basics of measurement – practical implementations
Watford

December 2012 (date TBC)
Organised by the Noise and Vibration Engineering Group and the Health and Safety Executive
Quiet-by-design for work machinery
Venue TBC

Please refer to **www.ioa.org.uk** for up-to-date information.

Dear Members

I am writing this on the opening day of the Olympics – by the time you read it we will know whether they have had any newsworthy acoustic impact. So far I have heard several mentions on the radio of people creating "Olympic soundscapes". Otherwise the most exciting noise news so far this summer has been the silencing of Bruce Springsteen in Hyde Park!

Another recent news item concerned cow bells being banned in a village in Austria because of noise nuisance, which leads me to the current consultation on European noise policy. This is one of several recent consultations in which the Institute has been invited to participate. It is very important that members take an active part in responding to consultations on national and international standards, reports and guidance documents as it provides a major opportunity for us to influence policy and practice.

We have held several successful meetings this summer, including two arranged at short notice in response to recent developments (the guidance document on wind turbines and the Noise Planning Policy Framework). The ECUA meeting in Edinburgh was well attended by many international delegates. As always we are grateful to the IOA office, in particular Linda Canty, and to the organising committees for all their hard work.

In May I attended the education meeting in St Albans at which members described their outreach work in schools and demonstrated various kits that they use. I was very impressed by the commitment of those taking part. The meeting was great fun as we were divided into groups and had a hands-on opportunity to use the kits. The Education Committee is hoping to take the demonstration "on the road" this autumn. Look out for it at a branch near you – and, even better, volunteer to become one of our acoustic ambassadors.

I would like to thank those of you who took part in the membership survey, which was completed by nearly 40% of members. Chantel Sankey, our membership officer, has been doing an excellent job of collating and analysing responses. It was good to see so many positive comments about the IOA, and useful to note the criticisms and suggestions for improvement. It was particularly encouraging to see so many members wishing to get more involved through membership of committees. We will be doing a detailed analysis of the responses in due course, and using them in planning our future activities and long term strategy.

Those of you who were present at the AGM will know that there is an outstanding item concerning electronic communication with members. There will be an Extraordinary General Meeting as part of the Autumn Conference on 6 November to deal with this matter. In the meantime you will see from the report on page 6 that from now on all meeting notices will be sent by email, unless members specifically request otherwise. This will save us not only a significant amount of money but also a huge amount of staff time, and reflects the wishes of the majority of respondents to the membership survey.

The History Project Group is still hoping that members will provide them with information and anecdotes from the past, in particular concerning the early days of the IOA and its predecessors. The group is also interested in examining the history of women in acoustics (not necessarily as members of the Institute). It is difficult to trace the numbers of women members over the years so if you happen to be, or to know of women, who have been active in acoustics and/or IOA members over the past 50 years or so please send their or your names to myself (president@ioa.org.uk) or Sue Bird (sue@hemleyhill.me.uk).

Finally, I'm pleased that acoustics got a mention on I'm Sorry I Haven't a Clue recently – a new definition (from the Oxbridge English Dictionary) of the word acoustic: a perch for a dove.

Bridget

Bridget Shield, President

IOA launches consultation on wind turbine noise assessment

The Institute of Acoustics has launched its much-anticipated consultation on *Good Practice Guidance to the application of ETSU-R-97 for wind turbine noise assessment.*

The 80-page main consultation document (also referred to as the discussion document) has been produced by a five-strong working group and an eight-strong review panel which were set up last year following a request from the Department of Energy and Climate Change (DECC) to take forward the recommendation of the Government-commissioned Hayes McKenzie report on *Analysis of How Noise Impacts are considered in the Determination of Wind Farm Planning Applications.* (Ref HM: 2293/R1 dated 6 April 2011).

The group has also published a second document which contains some commentary on the discussion document, and a questionnaire response for consultation feedback. Both documents can be viewed on the IOA website **http://www.ioa.org.uk/about-us/news-article.asp?id=260**

The documents have been produced specifically to promote discussion of the relevant issues during the consultation period, which has included a workshop in Dublin in July and one to be held at London South Bank University on 13 September. IOA members and other interested parties are encouraged to attend the London event, or to provide feedback to the consultation by 28 September 2012.

At the end of the consultation period the group will meet again to consider all responses, after which it will aim to produce a final version of the Good Practice Guide for publication early in 2013, which will sit alongside the ETSU-R-97 document where used for wind turbine noise assessments.

Richard Perkins, Group Chairman, said: "This consultation is an opportunity for the IOA to address some of the more difficult aspects of wind turbine noise assessment and to improve understanding of the noise assessment process for a wider audience."

All comments on the consultation should be sent by email to **IOAETSUCONSULT@pbworld.com** or by post to **IOA NWG GPG Consultation Feedback, c/o Parsons Brinckerhoff Ltd, Queen Victoria House, Redland Hill, Bristol BS6 6US**.

See also Irish Branch report on page 22 and letter on page 51.

Institute meeting notices to be sent by email only

From 10 September 2012 the IOA will no longer be automatically sending meeting notices by post. Instead we will be using email.

In the recent membership survey 84% of respondents said they would prefer to receive them that way. Only 2% of members have not provided us with an email address and we will be writing to them regarding this. If you have provided us with an email address, please ensure we have the correct one for you.

We estimate we will save at least £10,000 annually by doing this and it is also better for the environment.

Details of all meetings can be found on our website **www.ioa.org.uk /events**

If you still wish to receive meeting notices by post please contact the office so we can arrange this for you.

Appeal to track down historical records

An appeal has been made to IOA members by Geoff Kerry of the Institute History Project to track down the records of the Society of Acoustic Technology.

"Good progress has been made researching the archives held at St Albans and the Council minutes covering the activities of the Institute and its predecessors, the British Acoustical Society and the Acoustics Group of the Physical Society (IOP) which are available and being used to extract useful facts and dates," he said.

"Unfortunately, records of the Society of Acoustic Technology (1963-1966) have not yet come to light and I would like to appeal to any members who were involved in that society or members who perhaps are in touch with colleagues who were possibly involved at that time to contact either Alex Burd (**alexburd@talktalk.net**) or the Bulletin editor Charles Ellis (**charles.ellis@ioa.org.uk**).

"The post Wilson report period* was an important one in UK acoustics and we would like to cover it and its influence on the eventual development of the IOA as thoroughly as possible."

**Noise – Final Report of the Committee on the Problem of Noise,* 1963, Cmnd. 2056 HMSO.

Why don't you consider Engineering Council registration?

Peter Wheeler, IOA Engineering Manager, is urging more members to seek Engineering Council registration via the Institute.

"We have had a record number of candidates for registration this spring and we now would like to see more come forward," he said. "Engineering Council registration is a much valued and internationally recognised qualification of professional competence in acoustical engineering.

"Candidates have to prepare, and substantiate at a professional review interview with two peer Institute members, an account of their professional development and responsible experience, written in the context of a set of competencies set out by the Engineering Council in UK-SPEC and interpreted by the Institute for their particular field of acoustical engineering. Other supporting evidence of training and continuing professional development also needs to be provided.

"The success rate is close to 100 per cent, thanks in part to the support provided to candidates by the Engineering Division Committee. We also need help with our committee work, interviews and support to candidates. If you are already registered either through the IOA or another institution and would like to play a part in our work please contact us. In either case email us at **acousticsengineering@ioa.org.uk**"

Here are profiles of some recent candidates:

James Hill, AAF, IEng

James Hill, AAF, IEng

James graduated in 2008 from the University of Salford with a BSc in Acoustics. He then joined AAF as a trainee acoustic engineer and has since progressed to his current role as acoustic engineer. In addition he is the UK representative for the European Acoustics Association Young Members' Group.

"As I work primarily in an engineering environment and deal with clients from all over the world, when the opportunity arose through the Institute to achieve IEng status it seemed an obvious thing to do," he said. "The process itself helped me to understand the requirements and gave me the motivation to get my professional records in line which will hopefully help me in achieving full CEng status further down the line. I was able to achieve this important goal in my personal development without any hassle thanks to the help from the staff and the guideline documents available through the IOA."

Will Martin, Arup, CEng

Will Martin, Arup, CEng

Will graduated from the University of Salford in 1999 with a BSc in Audio Technology and went on to complete the IOA Diploma in Acoustics and Noise Control two years later. He joined Stanger Science and Environment in 1999 and has since worked for Sound Research Laboratories, Casella Stanger, Bureau Veritas and Hepworth Acoustics.

Will has been with Arup Acoustics since 2007 working in both building and environmental acoustics. He is now a senior consultant, project manager and is also responsible for developing Arup Acoustics' aviation business in the UK. Will also sits on the committee of the IOA's North West branch.

Will said: "I'd wanted to do my CEng for about five years before I eventually got stuck in. Once I had started it was quite straightforward, but it did require me to think quite carefully about my professional role and responsibilities, past present and future. My CEng now signifies to clients and colleagues that I have an appropriate depth of technical knowledge, together with the associated project management, communication and leadership skills."

Derek Nash, Cole Jarman, CEng

Derek Nash, Cole Jarman, CEng

Derek is a Senior Acoustics Consultant with Cole Jarman, which he joined as a trainee in 2004 after graduation from the University of Salford with a BSc (Hons) in Audio Technology. Derek works regularly on a variety of project types, including mechanical services noise control, architectural acoustic design, and noise impact assessments for planning. These projects cover a range of sectors including education, healthcare, commercial and residential. He is currently undertaking a Master's degree in Environmental Acoustics as a distance learner at the University of Salford.

"For me registration as a Chartered Engineer is incredibly valuable as it says a lot about a person who has achieved it," he said. "It tells you about their ability to manage, participate in, and take personal responsibility for developing high level solutions to complex problems. It tells you not only that they are well educated, but importantly have demonstrated their competency in the field to their peers. It tells you that they have good interpersonal skills, and conduct themselves in a manner appropriate to their profession. As such, I would encourage anyone in the acoustics industry to pursue registration. The one piece of advice I would give to anyone who embarks on this process is be well prepared!"

Jim Nicholson, Atlas Elektronik, UK CEng

Jim Nicholson, Atlas Elektronik, UK CEng

Jim graduated in physics Newcastle University with a BSc which he followed with postgraduate experience at Durham University in X-ray topography. He began work at the Admiralty Underwater Weapons Establishment at Portland, where he specialised in sonar signal processing before broadening into experience of most aspects of sonar systems and towed systems. He later obtained an MSc in Applied Acoustics at Derby University and now works as a Team Leader in the Sonar Department at Atlas Elektronik UK.

"Those who embark on CEng registration soon find out it's not a trivial endeavour, he said. "However, the professional recognition it conveys makes the effort worthwhile. This is P8

P7 particularly clear when working with European colleagues where professional registration is the norm for the highly regarded engineer. I found the support given to CEng applicants via the IOA made the whole process quite amenable."

Dr Ning Qi, Doosan Power Systems, CEng

Ning graduated from Tsinghua University in Beijing, China, with a BSc in Process Control Engineering and a MEng in Multi-Phase Flow Measurements. He obtained his PhD in Acoustics from the University of Liverpool in 2000.

Dr Ning Qi, Doosan Power Systems, CEng

Ning worked in different academic institutions before joining Doosan Power Systems in 2007. He is now a principal engineer working in a wide range of noise and vibration projects across the company business sectors, including power generating, petrochemical, and oil and gas industries, to develop appropriate solutions to engineering problems.

"I started my application as a response to the company's 'Get Chartered' campaign," he said. "But my drive for becoming registered as a CEng was to receive visible acknowledgment of my varied experience and for my own sense of achievement. I also believe that it helps in engaging with other professionals. The registration will give my employers evidence that my experience and skills have been validated."

Peter Rogers, Cole Jarman, CEng

Peter is a Fellow of the IOA and an Associate with Cole Jarman. He joined the company in 2006 following two years with SRL and five years with Hoare Lea Acoustics. He previously worked in environmental health as an enforcer for five years in South Wales. He gained his MSc from London South Bank University after graduating from Cardiff University with a degree in Physics and Medical Physics in 1993.

Peter Rogers, Cole Jarman, CEng

"I have to admit I put off seeking CEng registration for ages, thinking that it might be just another badge, but in fact the process has demonstrated to me that this is a club very worth being a part of," he said. "My view is that registration is a valuable quality mark, which needs to be earned, and is therefore worth having.

"There is something really rewarding about being made to demonstrate your competency in the field to your peers, and it is something I'd recommend to anyone who has become established in their career. Of course, you need to be motivated and well prepared to get there, but it is a journey worth taking."

Tim Leighton becomes Fellow of the Royal Academy of Engineering

Internationally recognised acoustician Tim Leighton has been elected as a Fellow of the Royal Academy of Engineering.

Professor of Ultrasonics and Underwater Acoustics at the Institute of Sound and Vibration Research (ISVR), University of Southampton, he has been accorded the honour in recognition of "delivering world-leading engineering advances in acoustics; taking fundamental studies through to applications in oceanography, chemistry, biomedicine and zoology".

He has recently devised a new method to more accurately measure gas bubbles in pipelines, which is of vital interest to manufacturing, power and petrochemical industries. While he has advanced knowledge in areas as diverse as whale song and extra-terrestrial sound, he has also delivered pioneering engineering products, processes and practices, from award-winning healthcare to sonar.

Tim read for an MA in Natural Sciences at Magdalene College, University of Cambridge and then studied for his PhD at the Cavendish Laboratory, Cambridge, where he continued his research as an EPSRC Postdoctoral Research Fellow and then as a Senior Research Fellow. He moved to ISVR in 1992.

Tim is a Fellow of the IOA and his work was been officially recognised by the Institute by the award of three of its most prestigious honours, the AB Wood, Tyndall and RWB Stephens Medals. Other awards include sharing in 2011 the £250,000 Royal Society Brian Mercer Award for Innovation with his friend and colleague

Tim Leighton (left) receiving the RWB Stephens Medal in 2009 from then IOA President John Hinton

Dr Peter Birkin for ultrasonic cleaning technology which is now licensed to several users and manufacturers in the UK and abroad.

Commenting on his Fellowship, he said he believed engineering excellence was key to UK success: "The country needs engineering innovation, rigorously tested and followed through to impact. It is an inescapable fact that on average this process takes 10, 20 or even 30 years (depending on the discipline). That is a long time to keep an idea progressing and to protect intellectual property rights; it is usually perceived as unaffordable unless the winners are accurately identified so that investment is focused on them.

"The almost impossibility of picking winners has been replaced by criteria based on guarantees of impact in three to five years, which results mostly in restricting sponsorship to safe research that will produce incremental changes to the problems we should have solved 10 years ago. We must also strongly support the broader research base that will give us the solutions to the problems we will face in 40 years' time, that have not even been identified yet."

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Delegates from around the world flock to Edinburgh for ECUA 2012

Report by Andrew Holden

Between 2 and 6 July the Institute of Acoustics had the pleasure of hosting the 11th European Conference on Underwater Acoustics (ECUA) in Edinburgh.

ECUA is a key international forum for the presentation of the latest research and developments in underwater acoustical science and engineering from a diverse range of sources including universities, public and private research institutes, companies and corporations. It attracts researchers from Europe, the United States, Canada, Australia, China, Japan and Korea, as well as many other countries.

ECUA was initiated by the European Maritime Science and Technology (MAST) programme in 1992 and since then it has been held every two years in different European countries including France, Italy, the Netherlands, Greece and Denmark. This year was the first that it had been held in the UK.

Planning for ECUA 2012

Just before ECUA 2010 in Turkey, the IOA Underwater Acoustics Group (UAG) committee decided to offer to hold ECUA 2012 in the UK. This was accepted by the ECUA standing committee and thus began two years of planning.

The first stage was to determine a venue and various cities including London, Oxford, Cambridge and Bath were considered. It was finally decided that Edinburgh, which is steeped in history and maintains a vibrant and cosmopolitan atmosphere, would be the best city to hold the conference and would attract researchers. After an investigation of suitable conference centres in Edinburgh, Heriot-Watt University was chosen as it offered the best value for money. Then we needed a chairman and Chris Capus, who works at Heriot-Watt, stepped forward to take on the challenge. He was supported by Linda Canty and her IOA team, and by the UAG committee.

Then the hard work began. We needed to determine which sessions would be run, contact researchers to find those willing to chair the sessions and then work with the chairs to contact people to submit abstracts and papers. We were never quite sure how many papers we would get and initial low numbers meant that like many other conferences we extended the abstract deadline. Then, with the help of further emailing, a sudden surge in the last week saw a total of more than 400 abstracts submitted, which exceeded our expectations and then set us a new challenge of how we could fit all these papers into a week's conference.

During the week of the conference we had more than 400 attendees registered and more than 360 papers submitted. These were scheduled into 40 structured sessions, a poster session, three keynote speakers and the AB Wood Medal award and talk.

Keynote speakers

On Monday, Tuesday and Thursday, the conference was opened with a keynote speaker and on Friday it was opened by the AB Wood Medal presentation and talk.

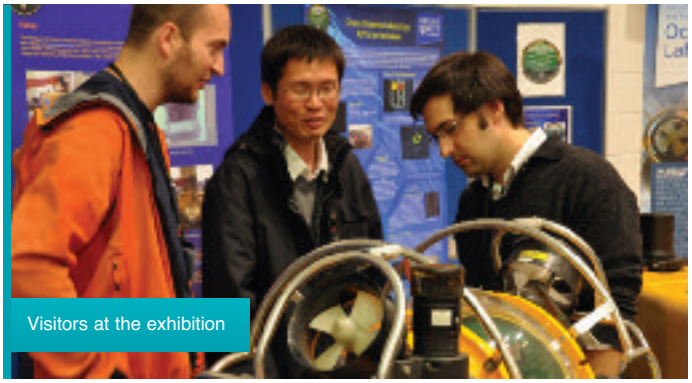
The first keynote speaker was Michel André from the Technical University of Catalonia in Barcelona. He gave a presentation on how over the next few decades the increasing levels of offshore industrial development will almost certainly lead to increased amounts of noise pollution. Recent laboratory findings indicate that cephalopods could be sensitive to low frequency noise. If these results are correct, the deleterious effects of marine noise pollution would go well beyond those observed in whales and dolphins.

The second keynote speaker was Terry Ewart from the University of Washington Applied Physics Laboratory (APL) who gave a talk on wave propagation in random media (WPRM) dedicated to the life and work of Dr Barry Uscinski. Barry was a theoretician based in the Department of Mathematics and Theoretical Physics (DAMTP) at Cambridge and Terry showed how the Fourth Moment equations he developed were able to P12

Conference chairman Chris Capus

Michel André

The conference gets under way



Visitors at the exhibition

P10 combine oceanography and acoustics to predict the phase and intensity fluctuations measured in a number of large scale, long range, low frequency propagation experiments. However, the real point of the talk was not just that Barry was an outstanding mathematician, but that he led an amazingly productive life, including flying and music among his many interests, yet still found time to be a friend and helper to everyone he was involved with.

After Terry's talk, Mike Buckingham from the Scripps Institution of Oceanography talked about the time he had spent working with Barry and gave some entertaining stories about Barry's many flying experiences.

Citation for A B Wood Medal for Dr Kyle M Becker

Kyle Becker is with the Office of Naval Research in Arlington, Virginia. From the beginning, he has been a leader in his research area but, in addition to his fundamental research efforts, Kyle has been instrumental in the establishment of transition programmes that exploit the advances in basic research and apply them to problems facing the operational Navy.

He started his research on geoacoustic inversion as a PhD student with the Massachusetts Institute of Technology and Woods Hole Oceanographic Institute, Joint Program in Oceanography and Oceanographic Engineering. Kyle joined the group at an exciting time when they were initiating a series of shallow water acoustic experiments entitled Modal Mapping Experiments (MOMAX). These experiments involved the use of drifting research buoys, similar to naval sonobuoys, enabling the creation of synthetic aperture horizontal arrays as the buoys drifted away from the source. This configuration resulted in high resolution measurements of the magnitude and phase of the acoustic field from which characteristics of normal mode propagation in the waveguide could be extracted.

Kyle's work is both analytic and experimental, as he has both participated and been a principal investigator in a number of sea cruises. He is extremely active in the Acoustical Society of America, publishing papers, serving on technical committees, reviewing papers, chairing sessions and presenting both invited and contributed talks.

In sum, Kyle has, and continues to make, distinguished contributions to both the fundamental science of ocean acoustics and to its applications towards working in the sea.

The Institute of Acoustics is very proud to award the 2012 A B Wood Medal to Kyle for his significant contributions to the areas of statistical scattering from rough seafloors, sound propagation in shallow water waveguides, adaptation of alternative signal processing techniques for determining the modal content of propagating fields in waveguides and the application of mathematical methods for reconstructing ocean sub-bottom velocity profiles.

The third keynote speaker was Peter Tyack from the University of St Andrews, Scotland. He talked about how toothed whales and dolphins use short broadband clicks to detect, classify and capture prey. Understanding how much whales rely on sound raises concerns about the impacts of anthropogenic sounds in the ocean. Peter discussed the evidence that naval sonars cause lethal strandings of beaked whales and presented results designed to establish safe exposure thresholds.

Sessions

The main body of the conference were the 40 structured sessions. It is not possible to summarise all of these technical sessions, but below are brief reports from a few of the sessions.

Fluctuations and scattering:
Barry Uscinski Memorial Session

This memorial session for Barry Uscinski of DAMTP, Cambridge University, began with four invited papers by people who, like the keynote speaker Terry Ewart, had worked with Barry throughout his long and productive career. The first, Eric Thorsos, from APL, Washington, made the comparison between the application of moment equations applied to propagation through internal waves, as done by Barry and to propagation and reverberation accounting for sea surface forward scattering. Next, Peter Wadhams, of DAMTP, University of Cambridge, talked about the acoustic shadowgraph technique developed by Barry in 2001 to study subsurface convection processes in the Greenland Sea, and a new reciprocal shadowgraph that has yet to be tried in practice. Then, Mike Buckingham, from the Scripps Institution of Oceanography, described an instrument platform known as "Deep Sound" which collected ambient noise data during a round trip from the ocean surface to a depth of 6 km, and an inversion technique for recovering the sound speed profile from the noise. The final invited speaker, Peter Dobbins, Ultra Electronics Sonar Systems, spoke about the degrading effects of fluctuations on array directivity and how these can be predicted using a plane wave spectrum theory suggested by Barry Uscinski.

Seven contributed papers followed, including Purnima Ratilal on a formalism for calculating various second moments of the field for propagation through a waveguide containing three-dimensional random inhomogeneities, John Colosi talking about a transport theory formalism for low-frequency propagation through random sound-speed structure, and Alexey Shmelevon the effects of focused and strongly refracted scattering in shallow water on the acoustic scintillation index. After lunch the first paper was presented by Kunde Yang and concerned arrival time fluctuations in short range propagation experiments in shallow water. Mikhail Salin presented the second and third papers, both of which dealt with 3-D characteristics of surface roughness. The last paper of the afternoon, presented by Kyle Becker, concerned acoustic intensity fluctuations in shallow water.

Habitat mapping: techniques and applications

The seven presentations covered the acoustic mapping and monitoring of shallow (< 100 m) habitats. Developments in the evidence-based analyses of seabed properties from single-beam and multibeam echosounder measurements were presented, along with promising advances in sonar fusion and marine GIS (this one-paper session was "adopted" by the habitat mapping session, taking place in the same room and finishing just before). A significant portion of the papers presented investigated the acoustics of seagrass, kelp and macrophytes in general, reflecting their ecological and economic importance in habitats around the world. Lively discussions during the session and afterwards showed the growing importance of this topic, and the converging approaches of the different teams.

Impact of underwater sound on marine life

The session consisted of 15 presentations discussing the challenges involved with assessing risk and mitigating the impact of sound impact on marine life. A variety of noise sources were covered, including pile driving, sonar, seismic surveys, and operational wind farm noise. Multiple approaches for studying the effectiveness of ramp-up and shut/power down of sonar and seismic sources were presented. In an impressive talk, Roberto Racca gave a demonstration of how his team combined propagation modelling and real-time monitoring of seismic survey activity to adaptively adjust shut-down zones in response to real-time changes in propagation conditions.

Marine renewable energies:
mapping and monitoring of devices and their environment

The nine presentations followed the session title, using a variety of instruments and with a clear emphasis on ambient noise measurements. The presentation of facilities and expertise available at the European Marine Energy Centre (EMEC) were extremely well received. The next presentation showed results acquired a few days before, during long-term deployment of a sonar imaging suite near one of the tidal turbines at EMEC. Other presentations showed the role of turbulence and the presence of fish at specific sites around the world.

Operational noise from marine renewable energies

The seven presentations showed a broad range of analysis techniques and their applications, from the full modelling of the noise produced by tidal turbines to actual measurements at several sites around Europe. A very entertaining talk,

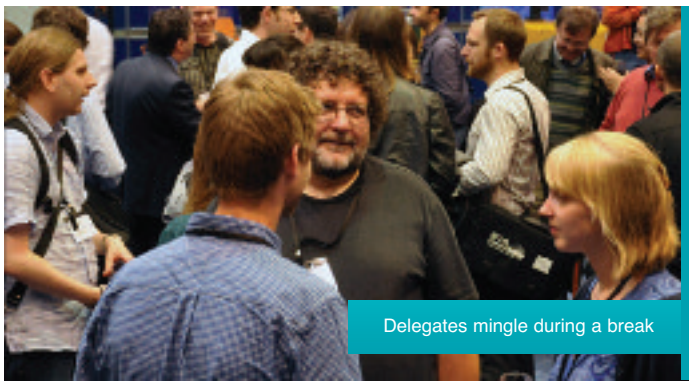
information-packed, was presented on instrument deployments in the Bay of Fundy, obviously one of the most challenging environments in the field of marine renewables. Attendees took good notes of how to use this experience in their own instrument deployments, existing and future.

Radiated noise from ships and surface platforms

Increasing concern about the impact of shipping noise on marine life has led to a much wider interest in this topic than the traditional interest from navies and the fishery research community. Consequently, this turned out to be the largest session of the conference, with 19 papers addressing experimental and theoretical work on underwater radiated noise of ships and other surface platforms. The interest was also clear from the large audience during the session. Naval experts presented the first results of NATO measurement campaign RIMPASSE 2011, in which the radiated noise of a Canadian and a German research vessel was measured at various locations, to investigate the influence of the environment on the measurement results and to explore the possibilities of monitoring the radiated noise on the basis of on board measurements. These papers provided an interesting match with studies of the uncertainties involved with the application of recent ANSI and ISO standards for measuring surface ship radiated noise in deep water and with papers that proposed novel methods for radiated noise measurements in shallow water. Many new results of radiated noise measurements on different types of ships were presented. Theoretical and numerical work concerned the prediction of propeller noise source mechanisms, of sound radiation from vibrating ship structures and of the effects of the environment on ship noise measurements. Finally, the last two papers in the session described initiatives from industry (dredging and shipbuilding) to address the concerns about the environmental impact of ship noise.

Seabed interactions

The 16 presentations covered a broad spectrum of topics associated with acoustics and the seabed. The classical problems of surface and volume scattering and their combination were examined both theoretically and experimentally. A number of contemporary formulations on seabed attenuation were assessed using new observations. Developments on the use of acoustics for measuring nearbed suspended sediment and hydrodynamic P14



Delegates mingle during a break

Peter Dobbins

P13 processes were presented. Papers on synthetic aperture sonar, Bayesian inversion and propagation modelling contributed to the range of subjects covered.

Sonar performance measurement and modelling
The sonar performance session lasted one day, neatly divided between measurements (morning) and modelling (afternoon). It turned out to be a truly international session, with presentations by scientists from seven nations and four different continents. The morning (measurements) included two contributions from the USA (D Tang, APL University of Washington; W Kuperman, Scripps Institution of Oceanography), one from Italy (M Coulliard, NURC) and one from Sweden (L Abrahamson, FOI). These papers explored reverberation measurement design requirements, analysis techniques for ocean environmental parameter estimation, and range localization. The main theme of the afternoon modelling presentations was progress on the test scenarios from the reverberation modelling workshops of 2006 and 2008 (held at the University of Texas at Austin, USA) and the Weston memorial workshop (Validation of Sonar Performance Assessment Tools) of 2010 (University of Cambridge, UK). Three papers were from the USA (H Weinberg, Alion Science; Z Lowe,and J Preston, both of Pennsylvania State University), two from Canada (both by D Ellis, DRDC), and one each from Italy (G Canepa, NURC), Australia (A Jones, DSTO), Taiwan (C Chen, National Taiwan University) and the Netherlands (M Ainslie, TNO).

Transducers
Kazuyoshi Mori, from NDA Japan, talked about the tests on a metre diameter perspex lensed hydrophone. This, they hope, will have uses for passive detection of intruders, but was tested on snapping shrimp, whose amazingly loud sounds provide serious interference. Another matter of military interest, a photonic crystal structure, was discussed by Takenobu Tsuchiya, also from Japan. Nihed El Allouche described how to use sound to monitor sand beds used to filter drinking water in the Netherlands. The Russian, Igor Esipov, described a very high power parametric array, and Unnikrishnan Chandrika from Singapore described the use of a fibre optic sensor attached to a diaphragm hydrophone. This wide variety of techniques provided an interesting session for 2 July.

List of ECUA 2012 sessions
- Acoustic mapping for underwater archaeology
- Acoustic sensing for oil and gas industry
- Advances in finite-element and spectral element modelling
- Automatic target recognition
- Autonomy and underwater sensing
- Bathymetry and multibeam sonar
- Behavioural response to underwater sound
- Biosonar and biomimetics
- Fluctuations and scattering – Barry Uscinski memorial session
- Habitat mapping: techniques and applications
- Hearing response
- High-frequency midwater mapping
- Impact of underwater sound on marine life
- Passive acoustic monitoring
- Marine gis and 3d/4d visualisation & mapping
- Maritime security
- Metamaterials
- Marine renewable energies: mapping and monitoring of devices and their environment
- Monitoring techniques and long-term trends in ocean ambient noise
- Multibeam echo sounder calibration methods
- Noise and vibration from marine piling
- Operational noise from marine renewable energies
- Polar acoustics
- Signal processing
- Processing of bioacoustic signals
- Propagation
- Radiated noise from ships and surface platforms
- Seabed interactions
- Seafloor characterisation
- Sonar and transducer test and calibration
- Sonar performance measurement and modelling
- Synthetic aperture sonar
- Targets and scattering
- Transducers
- Underwater communications
- Vector acoustics
- Volume scattering and bubbly media

Springer Prize in Underwater Acoustics 2012
The Institute of Acoustics was proud to award the Springer Prize in Underwater Acoustics, made available through the generosity of international science publisher Springer. The prize was for "the best presentation in the conference, showing the big picture as well as the most innovative science". Session chairs were asked to nominate worthy candidates. Twelve nominations were P16


Terry Ewart


A session in full flow


Michael Buckingham


Paul Lepper

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P14 received and assessed by a representative subset of the local ECUA/IOA organising committee. The prize went to Tom Weber (University of New Hampshire, USA), for his presentation entitled Acoustic sensing of gas seeps in the deep ocean with split-beam echosounders (co-authors Kevin Jerram and Larry Mayer). The enthusiastic nomination, by session chairs Tim Leighton and Lee Culver, reads: "Tom gave a clear and charismatic presentation describing observations of a deep-sea bubbling gas emission at a depth where hydrate forms. Photographic observations from a submersible were supplemented by split-beam echosounder data. The images, moves and slides were very well presented and the whole talk was extremely clear. The responses to questions were excellent." Tom was awarded a voucher for one of the many books published by Springer in the domain of underwater acoustics.

Student prizes

The Institute of Acoustics awarded four student prizes to recognise and encourage high quality student contributions to the conference. The winners were Carolyn Binder, Gim Hwa Chua, Nathan Merchant and Yan Pailhas.

Social events

As well as all the technical sessions, there were also some social events for the conference participants to enjoy.

A tutored whisky tasting was laid on at the Scotch Malt Whisky Society where participants were able to sample excellent single malts from Scotland's main whisky producing regions: Highland, Lowland, Islay and Speyside. An expert guide illuminated the experience, providing historical context, production information and tasting notes, highlighting the unique qualities and striking differences between the whiskies produced in each region.

The conference dinner was held at Prestonfield. The grand 17th century house was designed by the king's architect, Sir William Bruce, for Sir Alexander Dick, an eminent physician and founding member of the Royal Society of Edinburgh. Sitting in 20 acres of private gardens adjacent to Royal Holyrood Park, it has been run as a hotel since the 1950s, welcoming a succession of world leaders, royalty and stars of stage and screen. The magnificent grounds and stunning location in the heart of the city made Prestonfield an ideal events venue. The participants enjoyed a fine dinner followed by a show of Scottish singing and dancing.

A musical evening was held with the music of Castle & Kirk. Edinburgh University hosts a fine collection of historical musical instruments from all periods and places, and many are on display in the Reid Concert Hall Museum of Instruments. There are nearly 1,000 items including stringed, woodwind, brass and percussion instruments from Britain, Europe and beyond. Attendees spent a pleasant 45 minutes exploring the Victorian showcases full of instruments they may never have seen before, or even heard of, with a glass of wine. Then they heard Professor Murray Campbell describing the instruments and the physics underlying their sounds, and then listened to the playing of the Edinburgh Renaissance Band, a group of 12 Edinburgh-based musicians specialising in the performance of music from the period 1200 - 1600. The sounds of the band are many and varied: the sonority of the sackbuts and cornetts, the clear, loud tones of shawm and rauschpfeife, the sweetness of recorders and gemshorns, the subterranean buzz of rackets, the serenity of viols.

Peter Tyack

Kyle Becker (right) receives the AB Wood Medal from Peter Dobbins

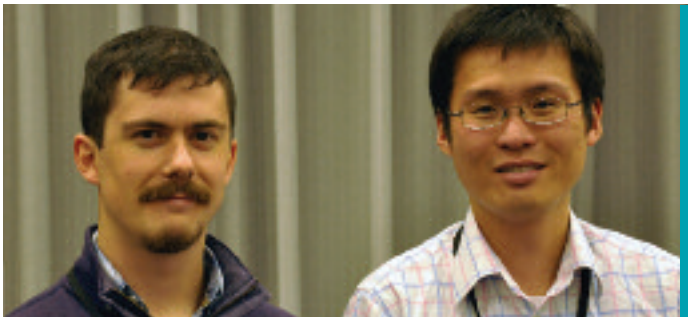
Scots piper

The future

During the conference dinner it was announced that this would be the last ECUA in its current form as no nation was willing to take on ECUA 2014. The future lies with a merger with the other major European acoustics conference, the Underwater Acoustics Measurements (UAM), to form a joint conference which will run regularly from 2013 onwards.

The author thanks the IOA UAG committee, Mark Spivack, Christ de Jong, Dale Ellis, Charles Holland, Jennifer Miksis-Olds and Sander von Benda-Beckmann for their timely contributions.

AB Wood Medal winners: l-r Victor Humphrey, John Colosi, Mike Ainslie, Peter Thorne, Mike Buckingham, Gary Heald, Tim Leighton, Kyle Becker and Anthony Lyons



Nathan Merchant, University of Bath and Gim Hwa Chua, ISVR, two of the student prize winners

Huge response to IOA membership survey

More than one-third of members give their views on the Institute

More than 1,070 members took part in the Institute's membership survey this spring. The response equates to well over a third of the membership (the current total is just under 3,000), which compares with a response rate of about eight per cent in 2005, the last time a survey was carried out.

The aim, as before, was to obtain members' views on the type and quality of service they are receiving from the Institute and what they want in the future. The results are being sent to all relevant groups and committees for discussion. They will be asked to suggest the main points for action which will then be presented to the Executive Committee.

As well as providing a comprehensive overview of members' backgrounds and views, the survey also generated a vast number of individual comments and suggestions of all aspects of the Institute and its workings, which are too numerous to list here.

Adam Lawrence, chairman of the Publications Committee, said: "The committee has been pleased to receive many positive comments from the survey including the Bulletin, e-newsletter, website and library.

"The two issues which gained the most comments were making publications electronic and the technical contributions in *Acoustics Bulletin*. The majority of respondents were in favour of electronic meeting notices with mixed views on the Bulletin. Many people commented that they would like to see more technical contributions, with others commenting about the topics covered and the length, quality and balance of articles, including peer review. On this last point members should note that the Bulletin is a news magazine, and the Institute's formal technical output is through conference proceedings. We can only publish articles that have been written, and Charles Ellis (the Editor) would welcome articles on any topic for publication. We have guidance for potential authors for technical contributions and would be pleased to support authors through the process."

Below and on the following page are listed the main findings. Please contact Chantel Sankey, the Membership Officer at **membership@ioa.org.uk** if you want a full summary.

10. Would you be willing to be a member of any of the following IOA Committees?

	Response Percent	Response Count
Council	30.0%	72
Education	37.1%	89
Engineering Division	**42.1%**	**101**
Meetings	20.0%	48
Membership	20.0%	48
Publications	24.2%	58
Research Co-Ordination	25.4%	61
	answered question	**240**
	skipped question	**837**

11. Would you be willing to be a member of any of the following IOA Specialist Group Committees?

	Response Percent	Response Count
Building Acoustics Group	35.6%	150
Electroacoustics Group	11.9%	50
Environmental Noise Group	**54.2%**	**228**
Measurement & Instrumentation Group	10.9%	46
Musical Acoustics Group	11.4%	48
Noise & Vibration Engineering Group	26.6%	112
Physical Acoustics Group	5.2%	22
Senior Members Group	4.0%	17
Speech & Hearing Group	5.2%	22
Underwater Acoustics Group	6.7%	28
Young Members Group	13.5%	57
	answered question	**421**
	skipped question	**656**

13. Who pays your subscription?

	Response Percent	Response Count
Myself - personal	41.0%	435
Myself - via my company (single person business)	9.9%	105
My employer	**45.9%**	**487**
Not applicable	2.0%	21
Other	1.1%	12
	(please specify)	22
	answered question	**1,060**
	skipped question	**17**

15. Please rate the following aspects of IOA membership to indicate how important they are to you. 1 means completely unimportant and 5 means extremely important.

	1	2	3	4	5	Response Count
Membership of an active Institute	2.3% (23)	3.6% (36)	11.7% (119)	37.6% (381)	**44.9% (455)**	1,014
A recognised qualification	3.4% (34)	4.5% (45)	7.6% (77)	32.1% (324)	**52.4% (529)**	1,009
Acoustics Bulletin	2.0% (20)	6.7% (68)	24.1% (243)	**46.6% (471)**	20.6% (208)	1,010
Acoustics Update (e-bulletin)	4.4% (44)	10.7% (107)	33.7% (337)	**39.6% (396)**	11.7% (117)	1,001
Conferences	9.1% (91)	16.7% (168)	31.0% (311)	**31.1% (312)**	12.2% (122)	1,004
One day meetings	8.6% (86)	18.2% (182)	31.0% (310)	**31.9% (319)**	10.4% (104)	1,001
Workshops	9.1% (90)	17.2% (171)	31.6% (314)	**31.9% (317)**	10.3% (102)	994
Special Interest groups	6.1% (60)	17.1% (169)	**38.9% (385)**	30.1% (298)	7.8% (77)	989
Website	4.1% (41)	14.0% (140)	**33.6% (336)**	33.1% (331)	15.1% (151)	999
Regional branch meetings	9.1% (91)	22.2% (222)	**30.8% (308)**	26.1% (261)	11.7% (117)	999
Regional branch social events	22.8% (225)	**32.6% (322)**	28.5% (282)	11.1% (110)	5.0% (49)	988
Opportunities for networking with other professionals	6.4% (64)	15.4% (154)	**32.4% (325)**	32.3% (324)	13.6% (136)	1,003
Technical reports/Code of Practice/Publications	2.9% (29)	7.6% (76)	20.2% (203)	**38.2% (384)**	31.1% (312)	1,004
Proceedings of meetings	6.6% (66)	19.3% (193)	**32.0% (320)**	31.1% (311)	10.9% (109)	999
Notices of job vacancies	17.5% (174)	20.0% (199)	22.7% (225)	**26.0% (258)**	13.8% (137)	993
Route to achieving CEng and IEng status	**24.9% (247)**	19.5% (194)	20.3% (202)	19.0% (189)	16.2% (161)	993
Free access to Acta Acustica united with Acustica	21.5% (211)	26.9% (264)	**27.4% (269)**	15.1% (148)	9.3% (91)	983
Professional development	6.5% (65)	11.0% (110)	25.0% (250)	**34.7% (347)**	22.7% (227)	999
Register of Members	6.8% (68)	16.4% (164)	30.0% (299)	**31.9% (318)**	14.9% (149)	998
Buyers' Guide	16.2% (161)	30.1% (299)	**33.5% (333)**	15.2% (151)	5.0% (50)	994
PI Insurance at reduced rates	**39.0% (386)**	24.3% (241)	20.6% (204)	10.6% (105)	5.5% (54)	990
Access to IOA library	9.6% (96)	19.4% (194)	**29.3% (293)**	26.1% (261)	15.6% (156)	1,000
					answered question	**1,019**
					skipped question	**58**

19. What restricts your attendance at paying events?

	Response Percent	Response Count
Employer unwilling to pay	29.0%	253
I cannot afford to pay/justify payment	35.1%	306
Work commitments	**63.5%**	**554**
Topic not of interest	27.2%	237
Other (please specify)		181
	answered question	**872**
	skipped question	**205**

24. Please rate the following aspects of the Institute. 1 means strongly disagree, 2 means disagree, 3 means neither agree or disagree, 4 means agree and 5 means strongly agree.

	1	2	3	4	5	Response Count
The Institute office provides a high quality of service to its members	1.1% (11)	3.5% (34)	23.0% (226)	**50.2% (494)**	22.3% (219)	984
I am kept well informed of Institute affairs and forthcoming events	0.9% (9)	2.7% (27)	10.1% (100)	**51.0% (504)**	35.3% (349)	989
The Institute is good at raising public awareness of the role of acoustics	1.6% (16)	13.4% (131)	**39.9% (391)**	36.2% (355)	9.0% (88)	981
The Institute is good at influencing politicians/decision makers	3.2% (31)	15.3% (150)	**55.8% (546)**	21.7% (212)	4.1% (40)	979
The Institute is good at promoting acoustics as a career to young people	3.1% (30)	15.1% (148)	**46.7% (457)**	29.4% (288)	5.6% (55)	978
The Institute is good at providing a route to CEng and IEng status	0.7% (7)	6.3% (61)	**45.0% (432)**	36.3% (349)	11.7% (112)	961
The Institute is good at maintaining a high professional standard for membership	1.5% (15)	4.9% (48)	22.3% (219)	**50.2% (494)**	21.1% (208)	984
The Institute is good at promoting Continuing Professional Development	0.7% (7)	6.7% (66)	31.0% (305)	**47.9% (471)**	13.6% (134)	983
I am aware that the Institute has a clear strategic direction	5.1% (50)	19.3% (188)	**45.9% (448)**	24.4% (238)	5.3% (52)	976
					answered question	**989**
					skipped question	**88**

26. Please rate the following aspects of the Acoustics Bulletin with a score between 1 and 5. 1 is very poor, 2 is poor, 3 is acceptable, 4 is good and 5 is very good.

	1	2	3	4	5	Response Count
Institute Affairs	0.3% (3)	2.9% (28)	25.7% (252)	**52.8% (517)**	18.3% (179)	979
General News	0.4% (4)	2.3% (23)	27.0% (264)	**55.9% (547)**	14.4% (141)	979
Technical Contributions	0.7% (7)	3.3% (32)	19.3% (189)	**51.6% (505)**	25.1% (245)	978
News and Product Update	0.3% (3)	4.3% (42)	29.2% (285)	**52.6% (514)**	13.6% (133)	977
Product News	0.5% (5)	4.4% (43)	33.8% (331)	**50.0% (489)**	11.2% (110)	978
					answered question	**982**
					skipped question	**95**

31. Would you prefer to receive a paper or electronic edition of the Acoustics Bulletin?

	Response Percent	Response Count
Paper	**59.0%**	**579**
Electronic	41.0%	402
	answered question	**981**
	skipped question	**96**

What are the key research challenges in acoustics?

The Engineering and Physical Sciences Research Council (EPSRC) has asked the IOA Research Coordination Committee (RCC) to identify the key research challenges in acoustics.

The RCC is therefore asking IOA members to provide it with their views on challenges on which the acoustics research community will need to focus in the next five to 10 years.

The table below offers a starting point for this discussion. It lists some current applications of acoustics and possible future developments. This table originally appeared in the *The Technological, Social and Economic Importance of Acoustics* document compiled by Professor Keith Attenborough in 2009.

IOA members are asked to email their views on the research challenges to the RCC Chairman, Professor Kirill V Horoshenkov (**k.horoshenkov@bradford.ac.uk**) before 1 October 2012.

It would be helpful if the challenges quoted in your response were accompanied with a short paragraph of text explaining the technological, social and economic reasons for addressing these challenges.

Technology	Acoustically-related applications and developments	
Sensors and Actuators	Distributed sensors, Introduction of local computing, Multi-variable MEMS-based autonomous measuring systems Acousto-optic sensors Improved sensors and actuators for active noise control Multi-sensor modality developments including data fusion	
Sonic treatments for industry	Sonic cleaning, Ultrasonic agglomeration, Ultrasonic welding Biomedical Ultrasonic therapies Acoustic sensing and diagnosis, and increased understanding of processes for scale-up	
Imaging and Diagnostics	Embedded sensors for structural health monitoring, SMART materials Acoustic target recognition, NDE Audiometric applications, Medical ultrasonic imaging Data fusion with other imaging modalities Time reversal and related methods for imaging through complex environments	
Environmental applications	Noise and Vibration Control Humanitarian Landmine Detection Test ban treaty verification	Structural Health/Condition Monitoring Acoustical monitoring in Agriculture Monitoring of biomass and environment underwater

Dozens more candidates gain success in latest IOA certificate examinations

April 2012 saw the first presentation of the Certificate of Competence in Building Acoustics Measurements (CCBAM). So far the recruitment has been poor, mainly as a result of the fact that successful candidates are not automatically qualified to carry out pre-completion testing. There were only five candidates (at Southampton Solent) but they were all successful.

The number of candidates for the Certificate of Competence in Environmental Noise Measurements (CCENM) remains buoyant: 126 (including three resits in March 2012).

The Certificate Course in the Management of Occupational Exposure to Hand Arm Vibration (CCMOEHAV) was presented for the first time in two years (18 passes out of 22 candidates).

There has been a slight upturn in recruitment for the Certificate of Competence in Workplace Noise Risk Assessment (CCWPNRA) – 21 candidates, all of whom passed.

The Certificate Course concerning the Anti-Social Behaviour Act (Scotland) ASBA has not run so far in 2012 as a result of a fire at Strathclyde University.

The pass lists for the IOA certificate courses are shown below.

Building Acoustics Measurement

Southampton Solent University
Beckingham W O
Bilton K M
Doherty D F
Lakhiani S
Ridgard S K

Environmental Noise Measurement

Bel Educational Noise Courses
Boyle M C
Byrne B
Corey J
Davies E R
Duncan R W
Elder A
Gardner A
Gourlay B F
Grierson A
Hill A
Horton C
Hunter C A
Landwehr J L
Macleod A
Maxwell M
Mcknight K J
Murray A G S
Oldroyd F J
Rogers-Bald C
Smith A M
Steven K
Stewart D
Stewart G H
Stirling N M

University of Birmingham
Green R M
Green J S
Healey D
Smith C

University of the West of England
Allard R J
Fedotov A
Ferris D
Fowler T K I
Green D
Hanks L C
Jefferies D E J
Jefferies M A J
Scotford P

Colchester Institute
Bailey S M
Barker D E
Forsyth D
Gudde P J
Heppell J P
Jones K E
Kirley C
Young N R

University of Derby
Campbell C P
Gridley D
Marshall D
Matthews G T
Spencer S
Sycamore S L
Tonkin S
Beaumont D J
Belton J
Brooks N
Burnett D
Burrows G L
Cragg B
Jeffcoat P
Periam N C
Price R J
Slee E

EEF Sheffield
Billingham N
Clarke M P
Dawson N R
Mosley A D
Sanderson R
Thomson R D

Leeds Metropolitan University
Anderson D
Audsley N J
Bispham R
Brettell J L
Coombes N
Harper J
Lane R W
Laverack R L

Liverpool University
Deane H
Dooley K E
Massey I P
Nicholson C
Rose D B
Shaw J
Turner G C
Wilson D S

NESCOT
Asghar S
Kowalewska A M
North K G
Quinlivan B

Shorcontrol Safety
Byrne J
Crowley E
Farrell K
Langan M
Luby M
Raftery S
Thornton G

Southampton Solent University
Aljahdali A M
Benstead S
Cornfield S
Hickling M W
Jeffery E M
Marshall C M H
Packham C
Walsh A L

Management of Occupational Exposure to Hand-Arm Vibration

EEF Sheffield
Ansell R G
Bimpson M
Cummins C R
Hopkinson M A
Raeburn S G
Skidmore S
Thompson M

Institute of Naval Medicine
Bell G C
Bell S A
Clarke T H
Donnelly S J
Frost J M
Johnstone G S
Shawcross J A
Tonner M

Shorcontrol Safety
Doyle L
Lane B
Lane M
Menihane G
Tubridy, F

Workplace Noise Risk Assessment

EEF Sheffield
Kelly G E
Stace G A
Strawbridge S N
Togara M
Towler D J
Wood D C
Zaman A

Leeds Metropolitan University
Mazur A

EEF Melton
Fletcher S V

Rapid Results College
Head V C
Matthews P J
Read P L
Reed P
Washer E L

Shorcontrol Safety
Bolton G
Campbell D
Digney M
Gault P
McClelland A K
McGurnaghan A
Valentine M

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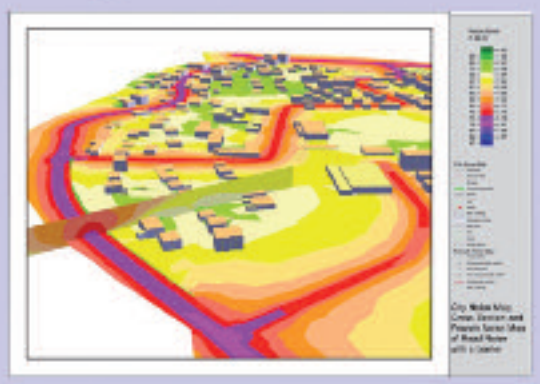

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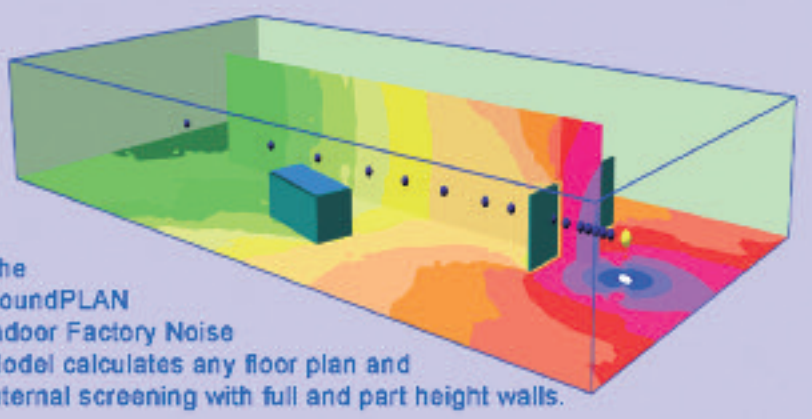

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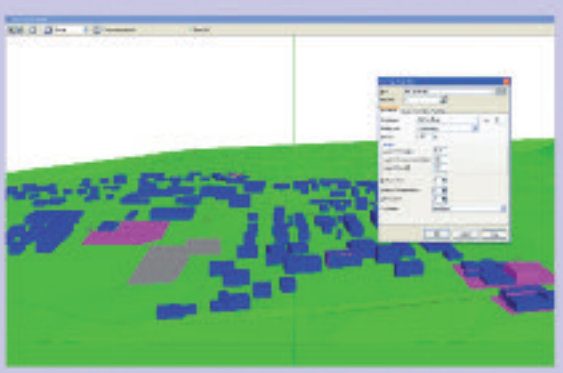

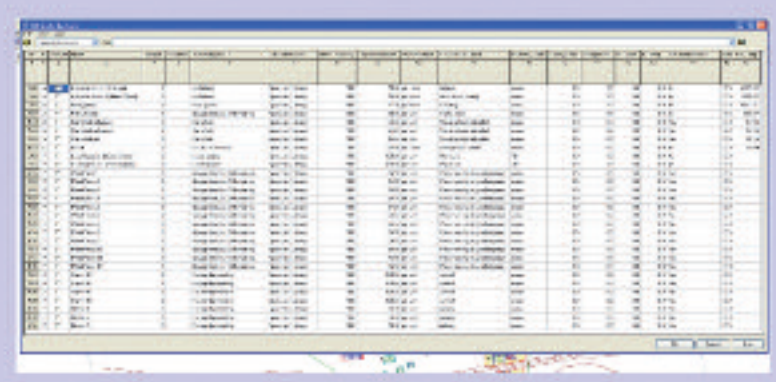

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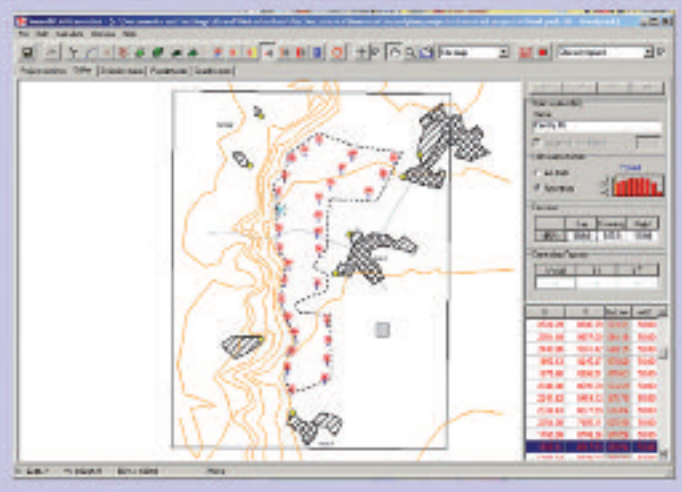

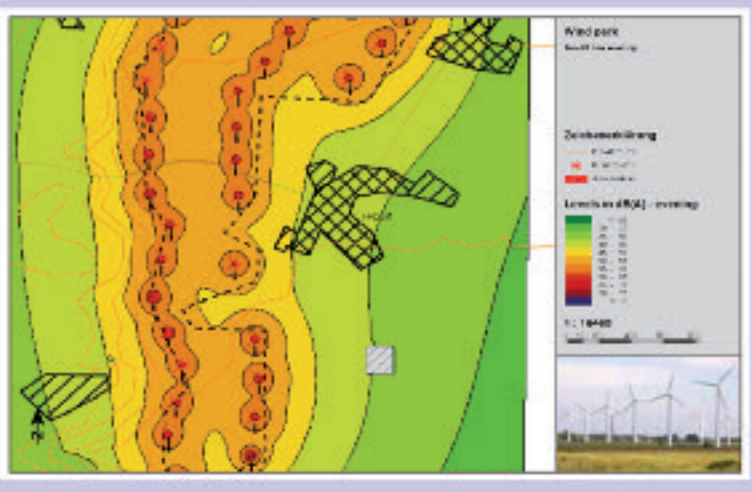

Focus on 'the key topic' of wind turbine noise assessment

Irish Branch one-day meeting

Report by Sarah Middleton

Wind turbine noise assessment is currently a key topic and the release of the IOA's *A good practice guide to the application of ETSU-R-97 for wind turbine noise assessment* (see report page 6) coincided with the Irish Branch's one-day meeting on 18 July in Dublin.

Delegates were taken through five talks by Huw Thomas (Environmental Health for the Isle of Anglesey), Chris Jordan (Environmental Health Northern Group Systems, Northern Ireland), a joint presentation by James Mangan of AWN Consulting and Dermot Blunnie of Enfonic (both based in Dublin), Andy McKenzie of the Hayes McKenzie Partnership and Chairman of the IOA Working Group, Richard Perkins of Parsons Brinckerhoff.

Huw Thomas discussed Anglesey Environmental Health's experiences of the increased number of turbine applications, most of which are concentrated in one roughly 15km by 12km area of the island. Anglesey has three major existing wind farms, two more proposed and more than 100 applications for individual or pairs of smaller turbines. Beyond the guidance principles noted in the Technical Contribution *Prediction and assessment of wind turbine noise* contained within the Institute of Acoustics' *Acoustic Bulletin March/April 2009* [IOA Document], Huw noted that particular factors that they consider to be important are that predictions should take site specific wind shear into account and the cumulative impact on background noise levels in the area.

Chris Jordan talked through the difficulties that he and his colleagues in Environmental Health have faced regarding the quality of reports submitted in support of planning applications. Several issues were highlighted by Chris, which, if implemented, he considers would improve the planning process. These include:

- Early consultation between the persons performing the assessment and environmental health to ensure that the eventual report submitted contains the necessary information including data on the measurement equipment and locations. This would help ensure that sufficient and accurate data is presented in order to properly assess the impact. In particular the report should include a sufficient range of wind speeds and the exclude all "unacceptable" data.
- The noise sensitive locations should be agreed prior to surveying and Environmental Health should be given the opportunity to attend the installation of the survey equipment so as to minimise the "refusal" of submitted measurements.

Before lunch the Irish Branch's AGM took place with the election of officers and chairman's report. An outline programme of meetings and events for the coming year was discussed and it is hoped that a number of meetings will take place throughout the country.

In the afternoon, Dermot Blunnie and James Mangan gave a presentation on the effect of a prototype "double-windscreen" on an ETSU-R-97 noise assessment. The windscreen used in their investigation was a substantial 40cm spherical type coupled with a standard commercially available outdoor microphone. They used this arrangement and a "control" outdoor microphone along with close-proximity wind speed measurements to gather significant amounts of data. Dermot explained the mechanism of windscreens in general and then discussed his data, the conclusion of which was that although there can be substantial wind-induced noise in standard outdoor microphones, when used in an ETSU-R-97 assessment, the A-weighting and statistical analysis reduces these effects to a minimum.

James then went on to assess the impact that this would have on an actual assessment and it was concluded that the maximum decrease in wind-induced noise offered by the double-windscreen for LAF90 was 1dB at 9ms-1. The presentation started a good deal of debate and the pair plan to do further research.

Andy McKenzie summarised the findings of the Hayes McKenzie Partnership's research for the Department of Energy and Climate Change on the *Analysis of How Noise Impacts are considered in the Determination of Wind Farm Planning Applications* report reference HM: 2293/R1 dated 6t April 2011. This was most useful as the basis for the reasoning behind the IOA document *A good practice guide to the application of ETSU-R-97 for wind turbine noise assessment*, which was commissioned to answer the questions raised in the conclusions of the Hayes McKenzie report. Richard Perkins then gave a summary of the basis for the different chapters in the document and how they tie with the recommendations for further investigation noted within the Hayes McKenzie report.

Three discussion groups were formed to discuss the topics of background noise measurements, prediction methodology/wind shear and cumulative impact. These groups were to spend some time debating the issue at hand and then give a short presentation to the meeting. This thus allowed for some feedback to be given to the working group on their newly released draft.

Background noise measurements

It was suggested by this group that there should be initial predictions performed in order to identify the potentially affected dwellings associated with a development, how many measurement locations should be used and further guidance on how to measure the background noise climate when there is existing wind turbine noise.

The guidance on seasonal conditions, wind speed measurements and the need for an assessment to have a minimum number of data points and/or duration were found to be useful.

There is also the need for manufactures to get "up to speed" quickly in producing double-windshield systems with data that quantifies the insertion loss of the overall windshield system (for static wind conditions) and the wind induced noise for the range of wind speeds within which measurements are normally performed.

Prediction methodology/wind shear

This group felt that the guidance in respect of the standardisation of the prediction methodology was considered to be very good. However, a standardisation of turbine manufacturer's data needs to be clearly set out. A sound power database would be very useful, giving data for hub height wind speeds (as per current proposals for standard measurement principles). More guidance on met mast location would also be welcomed.

It was felt that more guidance is needed on the effect of wind shear and the accounting for it in the prediction process. It was recognised that the data for wind turbines is still very difficult to obtain – the suggestion of a "central" library of such data was well received – although the comment was made that manufacturers appear to be constantly changing the noise level that they will "warrant" depending on the prevailing market forces.

Delegates also felt that the 2dB limit for topography would appear to be too limiting in some specific locations and the 3dB correction factor for a valley was surprisingly high.

Cumulative impact

It was felt that more guidance should be provided on prediction where the lower "fixed" limit applies and there is a significant increase in the power capabilities of all the turbines combined. More guidance is thought necessary on how to show compliance for individual/development turbines. For instance, when taking account of existing wind turbine noise, should it be measured or the planning limit (which may be significantly more) used when predicting the cumulative impact?

It was felt that when setting planning limits, conditions should not be based upon the upper levels allowable in line with ETSU-R-97 where the predicted contributions are significantly less as this could "sterilise" many areas of the country.

The general feedback from the delegates was that the document is very welcome and covers the areas of concern for clarification by both environmental health and noise consultants and gives a good basis for a consistent approach to the prediction, assessment and reviewing of noise impact assessments for wind turbine noise.

Planning appeals – theory and practice

Young Members' Group workshop

Report by David Trew

The second dedicated young members' workshop was held at the University of Salford in May. The event was well attended at an ideal venue. Many thanks go to Dr David Waddington for turning a lecture hall at Salford into a town hall ideal for the mock inquiry.

David Trew provided an introduction into the "theory" of the planning appeal procedures and the typical role of a technical witness was discussed. This was followed by a virtual drive around the case study and an overview of the technical arguments on both sides of the "fence". The case study was based on a proposed residential development close to both road traffic and industrial noise sources which had been refused consent on noise grounds.

Colin Waters, who would later assume the role of the planning inspector, provided a valuable insight into the "practice" of the planning appeal procedures. Two consultations with counsel followed to give the audience a feel for the private discussions between a technical noise expert and the advocate. Ian Bennett acted as the advocate for the property developer, with James Healy taking the role of the acoustic consultant. Andrew Raymond had taken on the task of defending the local authority's case, with David Trew as his witness. The author will of course maintain complete impartiality in the reporting of the mock inquiry.

The audience witnessed the most horrific and aggressive intimidation and verbal assault as Mr Bennett tore into Mr Trew. Attacks were made on all technical aspects of his witness statement. These were promptly followed by severe criticism of his standard of grammar, spelling and choice of tie. On a more serious note, the advocates and inspector made an excellent job of exposing the various technical strengths and flaws in both sides of the case. This included discussions of the applicability of BS4142, the role of the superseded PPG24, and the reliability and details of technical information.

The Young Members' Group is looking forward to the one-day conference organised with the Measurement and Instrumentation Group on 27 November at BRE, Watford. The YMG is keen to set up similar events. Any feedback on the recent events or suggestions for future events would be welcome.
Please e-mail **youngmembers@ioa.org.uk**

Hospital noise – is it really a problem?

Midlands Branch meetings

Reports by Kevin Howell

In June, the Midlands Branch returned to the URS offices in Nottingham where a large audience enjoyed this presentation by Dr Nicola Shiers. Over a period of three years Nicky had conducted an extensive study into noise levels and the subjective perceptions of staff and patients at three major UK hospitals. Previous studies had mainly been undertaken by healthcare staff with limited knowledge of acoustics and generally concentrated on hospital areas perceived to be noisy. This study evaluated noise levels in the wards where most patients spend most time, and where rest and recuperation should take place. It considered the effects of noise on patients' comfort and wellbeing and on the nursing process, with particular reference to the building design and layout, and the ward systems and equipment in use.

The study incorporated continuous noise measurement at nurse stations and in multi-bed and single room accommodation, and included identification of significant noise sources (above 70dB L_{Amax}) and measurement or estimation of reverberation time. Alongside the measurement study a survey by questionnaire was carried out to investigate staff and patient perceptions of noise. The questionnaire asked for feedback on some 18 types of noise event including, for example, door banging and noise from trolleys as well as people generated noises such as talking, phone conversations and other patients crying out. A pilot study was conducted at Great Ormond Street Hospital and the main study was then conducted at Bedford Hospital and Addenbrooke's in Cambridge.

Nicky presented detailed findings of the noise and perception surveys, too many to mention in this brief report. However, these included that 21% of patients are annoyed by noise during the day and 52% are disturbed by noise at night. Ward layout was sometimes found to have a detrimental effect on noise levels for patients, and single rooms were found to be noisier overall than multi-bed bays. There was a correlation between building age and daytime noise levels, suggesting that newer buildings are quieter. Nicky identified a number of areas where noise levels could be reduced including by building layout and design, by reducing the noise levels of ward systems and medical equipment which were often set far louder than was necessary, and by the design, location and maintenance of general ward equipment. An important consideration was the potential conflict between design for improved acoustic comfort and design for infection control, but it was found that this need not necessarily be an issue.

The main findings of the study are therefore that average daytime noise levels exceed the WHO guideline of 30 dB L_{Aeq} by more than 20dB and the night time L_{Amax} limit of 40dB is exceeded by more than 40dB. More than 50% of patients are disturbed by noise at night. Noise levels are not related to the number of beds in a bay but are affected by the "open door nursing policy" in UK hospitals. More realistic guidelines are needed for noise levels in occupied wards with a more suitable division between day, evening and night. The noise from ward equipment and systems could be reduced by improvements to design and technology. There is a need to raise awareness among patients, staff and visitors of the effect of their behaviour on noise levels and the need to enforce policies relating to visiting hours and mobile phone and headphone use. The presentation provoked a good debate with a number of questions coming from some NHS staff who were present. Many thanks go to Nicky for her excellent presentation and to URS for once again providing the venue.

Ground borne noise and vibration: prediction and mitigation for the Thameslink Canal Tunnels Project

This was a joint meeting between the Midlands Branch and the Permanent Way Institute and was held in May at the Aston Court Hotel, Derby. The presentation was shared by Steve Cawser of URS and Barnaby Temple of LB Foster (formerly of Balfour Beatty). Steve and Barnaby presented an overview of the ground borne noise and vibration prediction and mitigation work for the Canal Tunnels Project, part of the Network Rail Thameslink programme. They described the project and the particular points of interest of the location at Kings Cross, and highlighted the requirements for environmental vibration control. They explained the technical work involved in the prediction of ground borne noise and vibration from the new line and the associated changes. They also described the proposed track system and explained how it was implemented at the junction with the existing line into St Pancras. Thanks go to Steve and Barnaby for an excellent presentation.

Good vibrations as Salford roadshow draws near record attendance

Central Branch meetings

Report by Richard Collman

In May David Waddington and the remainder of the team from the University of Salford brought the *Human Response to Vibration in Residential Environments* roadshow to the Central Branch at Milton Keynes. This was one of the best attended meetings for a considerable time although, unlike the London Branch presentation, it didn't quite break records. David has previously written about this talk in *Acoustics Bulletin* so there is little point in repeating his expert summary here. As would be expected, the talk raised numerous questions and led to a good discussion both during the meeting and a short while later at the local Indian restaurant with, probably for the first time, the majority of those who had attended the meeting.

June provided a chance for a limited number of visitors to enjoy a guided tour of the acoustics laboratories at the National Physical Laboratory (NPL). The wide range of topics included underwater acoustics, where they can simulate working conditions for transducers submerged at depth, or, for testing at lower frequencies, they use their local outdoor facility (reservoir), although it seems that the current "drought" could have raised the cut off frequency if the water level fell significantly below the usual depth because this is the smallest dimension of the outdoor 'test tank'. In the ultrasonics laboratories we learnt a little about methods for delivering medicine to very specific points in the body using micro bubbles that are then burst at the target location by resonance from a highly focused ultrasonic signal. Another development is the use of similarly highly focused high intensity ultrasonic sound to target small groups of cells, using the energy to raise the temperature of the targeted cells sufficiently to destroy them while minimising damage to the surrounding tissue. On a more "conventional" note we also learnt how groups of three microphones are used to calibrate each other without using a reference microphone; why it can be useful to measure interference effects between two laser beams; and how free field microphones may be calibrated in a reverberation chamber.

Our thanks go to all of the personnel involved both from Salford and at NPL for the effort they put into providing two very enjoyable and interesting meetings and also to NHBC for hosting the first of these meetings.

Institute welcomes aboard another large new influx of members

Membership Committee recommends more than 70 applications

More than 70 applications for IOA membership were accepted by the Council in July as a result of recommendations from the Membership Committee.

Of the 36 successful applications for corporate membership (MIOA), 26 were from existing members and the remainder were from people new to the IOA.

And of the 21 people who successfully applied for associate membership (AMIOA), 17 had not been previously been members of the Institute.

The Council approved two applications for technician grade, three for affiliate and three for student membership. It also approved three applications for sponsor membership.

Fellow

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Paddan G S

Member

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Backus B C
Barber N J
Betts D J
Borak C
Bromilow I D
Chatzipanagiotis T
Clinton F J
Coleman M T
Cooper C E
Di Lauro F
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Mountings of transducers and its effects on environmental vibration measurements

Report by Dr Yuyou Liu, Bureau Veritas

The last few years have seen a sharp increase in vibration measurements and surveys, thanks to the large infrastructure projects such as Crossrail and Thameslink, and increased awareness and concern of vibration effects on both human and non-human receptors. Previous Instrumentation Corner articles have provided insights on how to choose vibration transducers. This short article aims to provide some general knowledge on mounting of transducers and its effects on measurements.

Placement of transducers and how the transducers would be best mounted will be determined by the purpose of the vibration measurements. In general, "Transducers should be mounted so as to reflect faithfully the motion of the object or surface being measured. There should be no loss-of-contact or resonance to affect the measurement over the relevant frequency range." (BS 6472-1: 2008). "The aim should be to reproduce faithfully the motion of the element or substrate without introducing additional response." (BS ISO 4866:2010).

Accelerometers fundamentals

The majority of the accelerometers can be modelled as a simple mass-spring system. The fundamental frequency of the system is determined by its mass and the stiffness. The frequency response of the system below the fundamental frequency is virtually flat, which defines the usable range of the accelerometer as shown in the Figure 1.

Anything that modifies these characteristics during the mounting of the accelerometer will shift its natural frequency. Unfortunately, this shift in resonance always reduces the usable range of the accelerometer. The accelerometer is not broken, or any less worthy than when it was designed, it is just that the dynamic characteristics were altered during the mounting process. Figure 2 shows typical frequency responses for various mounting options.

Mounting of vibration transducers to structural elements

The mounting of vibration transducers to vibrating elements or substrates should comply with ISO 5348:1998. Care should be taken with triaxial assemblies to avoid rocking or bending.
In order to achieve these ideal conditions, it is necessary to ensure that:

- the accelerometer and its mounting are as rigid and firm as possible and the mounting surfaces shall be as clean and flat as possible
- the mounting introduces minimum distorting motions of its own, simple symmetrical mountings are best
- the mass of the accelerometer and mounting are small in comparison with that of the dynamic mass of the structure under test.

Poor coupling can cause friction and slippage of the transducer, resulting in distortion, alteration of the amplitude and phase of the signal, and often yielding higher measured vibration levels. The table on page 26 compares some typical mounting techniques for piezoelectric accelerometers with regard to different criteria as in ISO 5348.

As the mass of the transducer and monitoring unit (if any) compared with that of the structure element on which it is mounted can lead to significant changes in its modal behaviour, the mass of the measuring equipment should not be greater than 1 % of that of the structure. Vibration transducer requirements for human response to vibration are listed in Annex E of BS EN ISO

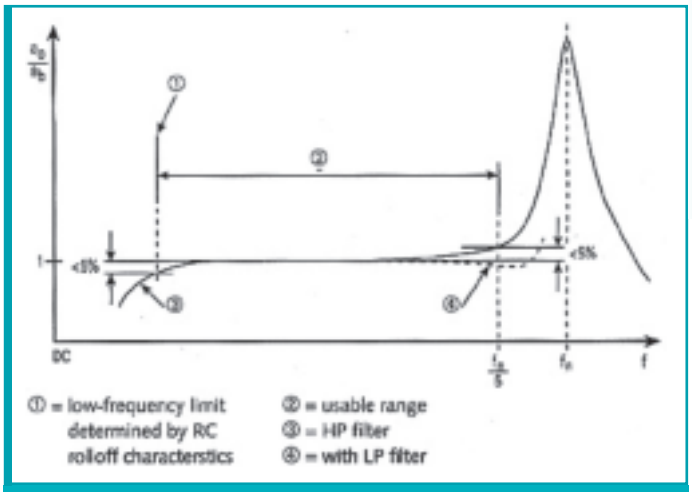


Figure 1 Typical accelerometer frequency response curve (Source: Kistler Instrument)

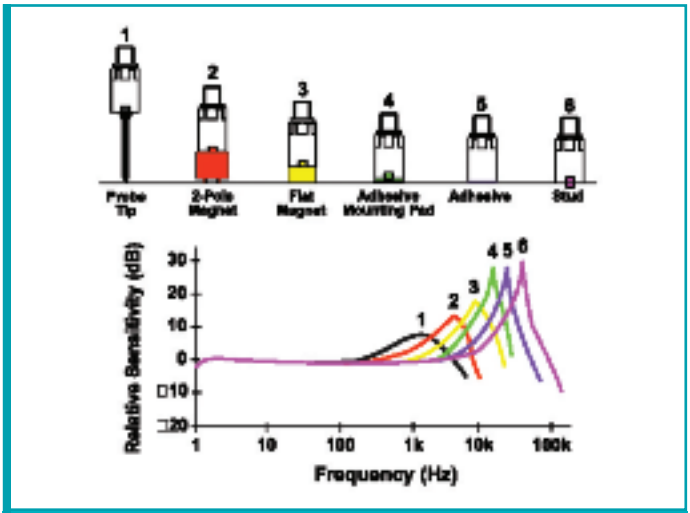


Figure 2 Typical frequency response curves for different mountings (Source SIRF Rt)

8041. Of interest for buildings is the recommended distance of less than 25mm, from the measurement surface to the transducer axis.

The transducer mounting can be secured to the frame of the structure by expansion bolts. Gypsum joints are preferred when taking measurements on lightweight concrete elements. When this is not possible, the transducer should be adhesive mounted with rigid glues such as cement glue or epoxy filler. Beeswax is also widely used. It is interesting to note that recent research suggested that "Blu-tack" (kept to a practicable minimum) performs very similarly to beeswax although not referred in standards.

Measurements on floors having compliant coverings tend to give distorted results and should be avoided. Transducers may be mounted using heavy steel plates with support legs that can be pushed through carpets so that they are attached firmly or special adaptors should be used.

Mounting of vibration transducers to the ground

BS ISO 4866:2010 provides some guidance on typical methods of mounting transducers to the ground, which include the P26

P25 buried transducer method; rigid plate and spike method.

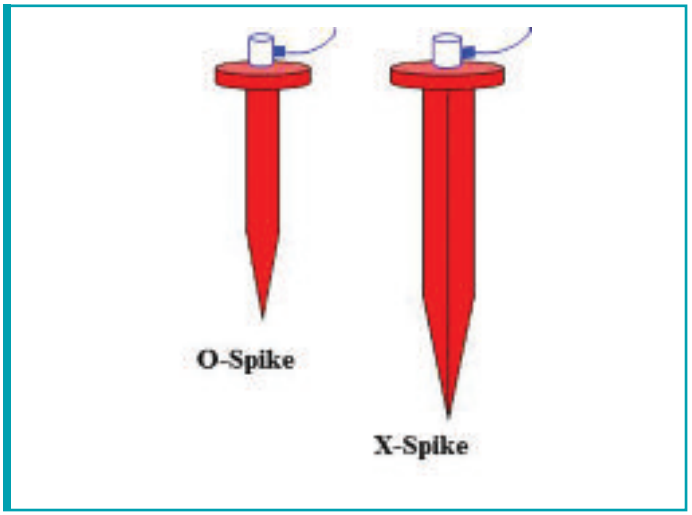
The buried transducer method is considered by a vast number of experts as the method that minimises ground coupling distortion. Where transducers have to be mounted in the ground, in order to minimise coupling distortion, they should be buried to a depth at least three times the main dimension of the transducer/mounting unit. In order to minimise the risk of disturbance and also ensure good coupling with the ground, the pit should be refilled with the excavation soil and then hand-tapped around the sensor. Where the material has large particle size, extreme care is required to avoid poor repeatability.

Alternatively, transducers can be fixed to a rigid surface plate with a mass ratio ($m/\rho r3$) not more than 2, where m is the mass of the transducer and rigid plate, ρ is the bulk density, in kilograms per cubic metre, of the soil, and r is the equivalent radius of the plate. The rigid surface plate may, for example, be a well-bedded paving slab.

The spike method consists of a small transducer mounting disc welded to a steel spike. The spike is to be driven fully into the ground vertically through a loose surface layer. There are different recommendations for the shape and size of the spike. BS ISO 4866 recommends a round spike (O-spike) while DIN 45669:2005 recommends a cross spike (X-spike). For good practice the O-spike should be:

- less than 400mm in length to avoid natural frequencies within the frequency range of interest;
- greater than 200mm in length to ensure adequate coupling between transducer and ground;
- greater than 10mm in diameter to ensure good contact and resist rotation; and
- no more than a few millimetres above the ground surface.

The resonant frequency of the spike is directly proportional to the length. This is attributed to an increasing surface area in contact with the ground. For a spike of 250mm in length, the resonant frequency is about 200Hz.



Concluding remarks

Careful planning and professional judgement are required when conducting vibration measurements to obtain reliable vibration levels. The decision on the mounting system alone can influence measurements by as much as 20 dB within a 100 Hz bandwidth. However, most environmental vibration measurements only deal with low frequencies up to 250 Hz where the coupling system performance yields relatively limited impact. For example BS 6472-1:2008 states that "This part of BS 6472 provides guidance on predicting human response to vibration in buildings over the frequency range 0.5 Hz to 80 Hz.", and BS 7385-2:1993 states that "however a more limited range of 4 Hz to 250 Hz is usually encountered in buildings." For further reading, refer to BS ISO 4866:2010, BS ISO 5348, BS EN ISO 8041:2005, DIN 45669 and the 2nd Edition of the ANC Red Book.

	Resonance frequency	Temperature	Mass of transducer and stiffness of mounting	Resonance magnification factor Q	Importance of surface preparation
Stud	●	●	●	●	●
Methylcyano acrylate cement	●	●	●	●	◑
Beeswax	◑	○	◑	●	●
Double-sided tape	○	◑	○	○	●
Quick mount	◑	●	◑	◑	◑
Vacuum mounted	◑	●	●	◑	◑
Magnet	◑	●	○	○	●
Hand held	○	○*)	○	○	○

*) Depends entirely on distance between hand and measured surface.
Key: ● high ◑ average ○ poor

Statutory nuisance – public regulation of noise

By Mervyn Rundle, of Solicitors Title, Exeter, an Affiliate member of the IOA

Statutory (or public) nuisance as laid down by the Environmental Protection Act is one of the types of nuisance of the overall law of nuisance discussed in my last article (*Acoustics Bulletin* July-August 2012). Usually instigated by a local authority in response to resident complaints, statutory nuisance is used quite frequently to try to remedy excess noise. As many as 10,000 noise abatement notices are served every year.

The concept of statutory nuisance is quite simple. The Environmental Protection Act places a legal duty on local authorities to monitor noise levels and to reduce excess noise by serving a noise abatement notice. The powers given to local authorities are wide; in effect, the act allows a local authority to create an individual criminal offence. Breach of the terms of a noise abatement notice carries some quite severe penalties: £5,000 plus continuing penalties for private persons and up to a £20,000 fine for businesses. There is also a right to seizure of noise making equipment in some cases. In view of this, there are rights for scrutiny by the courts by way of appeal against a noise abatement notice.

Statutory nuisance is defined in the act as noise which is "injurious to health or otherwise a nuisance". ("Injurious to health" is aimed at noise levels which are physically damaging and outside the scope of this article). However, the rest of the definition in the act is somewhat circular – statutory nuisance is defined as something which is a nuisance! As a result, the parties are left to fall back on the common law notions and tests for nuisance (i e a material interference with a person's lifestyle or property) which have proven so problematic. The law does not grant a right to silence, rather it supposes that there is a threshold (I have deliberately not used the word "level" to avoid technical confusion) at which legitimate noise changes to being illegitimate. However, identifying this "legitimacy threshold" and then expressing it in a way which is understandable and enforceable can be very difficult. As practitioners will be aware, it is relatively easy to assess and define continuous daytime noise such as industrial machinery or road noise but far more difficult with intermittent variable noise such as motorsport. (That may turn as much on the dosage and or character of the noise to which the recipient is subjected, rather than the volume of the noise).

Once a noise abate notice has been issued the noise maker has only 21 days to request court scrutiny by way of an appeal. Initially this will be before the magistrates' court. Grounds of appeal range from serving the notice on the wrong person (ie not the person responsible for the noise as required by the act) to arguing that the noise does not constitute a nuisance. Other grounds are that the notice is unreasonable in some other way – its drafting may go beyond that which is required to abate the nuisance, for instance. Businesses can offer the defence of "best practical means" in certain circumstances. (This is a curious but very strong defence in that it has the effect of permitting a business to go on making the noise even though it is a statutory nuisance. Discussion of this topic could merit an article on its own). P28

P27 In reviewing a noise abatement notice, the court has three options open to it: to uphold the notice, reject it or vary its terms. However, the court can only vary the notice in favour of the noise maker, not the local authority. Tactically this can be difficult for a local authority when drafting a notice – should it go for a strongly worded notice on the basis that the court cannot improve on it (from the local authority's point of view) or should it go for a more moderate approach on the basis that the notice is more likely to be upheld? Attempts by magistrates to redraft noise abatement notices can lead to some very strange results – there have been redrafted notices which have inadvertently made the situation worse. Appeals are possible from the magistrates' court. Curiously either party can ask for a complete rerun of the case in the Crown Court without needing any grounds for appeal. Alternatively, points of law can be appealed to the High Court. Injunctions are possible although only rarely used. Private individuals can ask the court to find a statutory nuisance but cannot themselves issue a noise abatement notice.

There is real skill in drafting a successful notice – too little detail and it may not withstand scrutiny and be unenforceable, too complex and it may be expensive to draft and then be too specific to deal with a deeper underlying problem. In principle however, the more specific the notice, the easier it will be to enforce. The act provides for two types of notice – a simple "You are required to make less noise" version and an alternative where "steps" or "works" are required. The simple notice is intended for blatant but straightforward situations of unreasonable noise e.g. night time party noise. The "steps" type notice is intended for more complex situations, but has been the subject of intense litigation to determine whether a local authority must actually specify the "steps" it requires to be taken, as opposed to just saying that "steps" are required. The recent case of Elvington (a former airfield near York used for Formula One car testing which became the subject of a long-running legal battle) has confirmed that if a local authority drafts a "steps" type notice then it must specify the steps required. This fits with the basic principle of law that a person must know not only what he is accused of but also what he must do to be compliant.

If a notice is upheld or not challenged then the local authority can prosecute for breach. To found a successful prosecution a local authority will have to prove beyond reasonable doubt that the notice has not been complied with. In theory at prosecution time it does not have to prove that there is a statutory nuisance because this will be assumed by the fact that the notice is by now valid. However, proving non-compliance may pose a problem if the drafting of the notice did not give any guidance as to what compliance would look like. This fits with the Elvington approach and the legitimacy threshold concept. Without this the court may well ask how it can know whether the notice has been complied with and if there is doubt then the prosecution will fail. It should be noted that to succeed in establishing a noise nuisance the local authority only has to work to the balance of probabilities standard of proof whereas to prosecute the criminal standard of "beyond reasonable doubt" will apply.

In all but the most straightforward cases statutory nuisance can be problematic. For a local authority which is receiving resident complaints there are the issues (and the cost) of determining whether a statutory nuisance exists and then framing a notice which can withstand scrutiny. Many noise abatement notices are issued which are not robust enough to stand a determined appeal by the noise maker. The decision to issue a noise abatement notice is a crucial decision point in the process; it is the drawing of the line in the sand. Once issued it may be impossible for a local authority to concede or drop an appeal for to do so would raise the question of the justification for the notice in the first place. This can sometimes compromise negotiations to settle the matter. Failure to see a case through might lead to a complaint to the Local Authority Ombudsman from aggrieved residents. For the noisemaker the position can be equally confusing. If the notice is not clear there are some who just ask "what do I have to do in order to comply?" particularly if the simple form of notice is used. For others a legal struggle with a local authority lies ahead. In such case the penalties for breach of the notice make a court appeal and associated costs for both parties inevitable.

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Motorsport noise is difficult to assess and define

Top ASA award for Steve Dance

IOA member Dr Steve Dance was awarded the Acoustical Society of America Mentoring Award as decided by the ASA Student Council in Hong Kong. It is the first time the award has gone to a non-American.

Masters students from the class of 2009/10 at London South Bank University, where he is an Acoustics Lecturer, each wrote highly complimentary letters to the Student Council.

An eloquent citation was prepared by John Zeman, now of Veneklasen, and read by Matthew Guild, representing the ASA Student President, to the great embarrassment of Steve (pictured left).

Paul 'all at sea' with unique artistic venture

IOA member Paul Malpas returned to a remote English nature reserve this summer – to put his acoustical skills to use on another unique artistic venture.

He was invited to work on Untrue Island, a project involving a combination of sculpture, narration and the real time sounds of Orford Ness, a wild shingle spit on the Suffolk coast once used for weapons testing.

In 2006 Paul, Chairman of the IOA Electro-Acoustics Group, who runs Engineered Acoustic Designs, worked with artist Louise K Wilson, collaborating on the sound of and installing the audio for a series of pieces for her artwork, called A Record of Fear.

This year he was asked to assist Turner Prize-nominated twins Jane and Louise Wilson (no relation to Louise K Wilson), writer and poet Robert Macfarlane and jazz musician Arni Somogyi.

Jane and Louise's piece, named Blind Landings, could be viewed (and heard) amongst the debris of the ageing atomic weapons testing facilities that once occupied the buildings that form the skyline on the Ness.

Paul worked with the sisters on the preparation of the audio environments to accompany the installations, spending time on location with them exploring, auditioning and gathering recordings of the spaces in and around the buildings.

These recordings were sifted, selected, worked and compiled into atmospheres that were heard playing gently amongst the natural sounds of the gulls, the North Sea and the groaning and creaking of the buildings themselves.

To ensure the right aural experience was effected, he installed and set F55 loudspeakers (loaned from John Newsham at Funktion One), along with a bespoke arrangement of remotely powered audio sources designed to operate continuously throughout the three-week event in locations more than a mile from either shelter or mains electricity.

IOA experts on a mission to improve cinema sound

Two senior IOA members have been drafted in to help with an ambitious project aimed at delivering "great and consistent" sound in cinemas.

Glen Leembruggen and Philip Newell were invited earlier this year to join the B-Chain Study Group, which has been formed by the US-based Society of Motion Picture and Television Engineers' Standards Committee.

The group's aim is to examine and investigate possible design, set-up and performance issues with cinema theatre sound systems (generally known as the B-Chain) and suggest areas where they could be improved.

It is currently compiling recommendations, which are due to be considered by SMPTE later this year. If agreed, they would result in new B-chain measurement techniques, leading, it is hoped, to more consistent and better sounding cinema theatres.

Brian Vessa, Group Chairman, who is also Executive Director, Digital Audio Mastering at Sony Pictures Entertainment, said: "There is a definite lack of sound consistency in movie theatres. You can see the same movie at two different theatres and the sound in the second will be completely different to that in the first.

"However, standards do exist, but these were created 40 years ago and since then there have been major advances in audio production. Measurement technology has improved significantly, so too has sound reproduction equipment and today movie soundtracks are more detailed and dynamic

"At present B-Chain quality is much too dependent on the skill, talent and training and hearing acuity of the adjusting technician using current standards

"We believe new standards should be created for B-Chain electro-acoustics measurements and calibration using modern equipment and techniques. We want to produce a step-by-step repeatable method for calibrating the B-Chain in a cinema room that can be performed by a trained technician with minimal reliance on aural evaluation and subjective adjustment.

"It would be a field guide that would codify best practice – and if we can produce it, we will definitely raise the bar overall.

"We have 60 people involved in the group – a real 'who's who' of audio professionals from all aspects of the industry. The one thing they all share is a great passion for audio – it's something they really care about – so I am trying to channel this passion so we can move forward."

As well as regular meetings, the group has been comparing sound at different cinemas in the Los Angeles areas, which range from Academy (of Motion Picture Arts and Sciences) theatres to commercial cinemas. "It's very revealing going to commercial theatres because we can see real world problems," said Mr Vessa.

In order to achieve the quicker adoption of attainable standards, the group is seeking to demonstrate the benefits of its objectives to key industry players, such as mixers, sound designers, studios, manufacturers and exhibitors, so that a transition plan is developed with a timeline that works for all concerned.

Mr Vessa said he envisaged that once the group's detailed report and recommendations had been taken on board by SMPTE the B-Chain group it would "morph" into part of the society's standards group.

Noise survey reveals that Cockneys are becoming 'a disappearing breed'

Motor vehicles and buildings mean Bow Bells are harder to hear

According to tradition, in order to qualify as a true Cockney, you must be born with earshot of the bells from St. Mary-Le-Bow Church in London.

One hundred and fifty years ago the bells could be heard across the City of London as far away as Hackney and Leyton in the north, Southwark in the south, Stratford in the east and Bloomsbury in the west.

But an analysis carried out by consultants 24 Acoustics for the *Times Atlas of London* has revealed that in 2012 it is almost impossible to be born a Cockney because the area within earshot of the bells has shrunk to a small area of the City and Shoreditch in which no maternity wards are located.

The exercise involved extensive noise surveys whilst the bells were tolling and detailed propagation modelling and consideration of background noise throughout north-east London to determine the level of audibility.

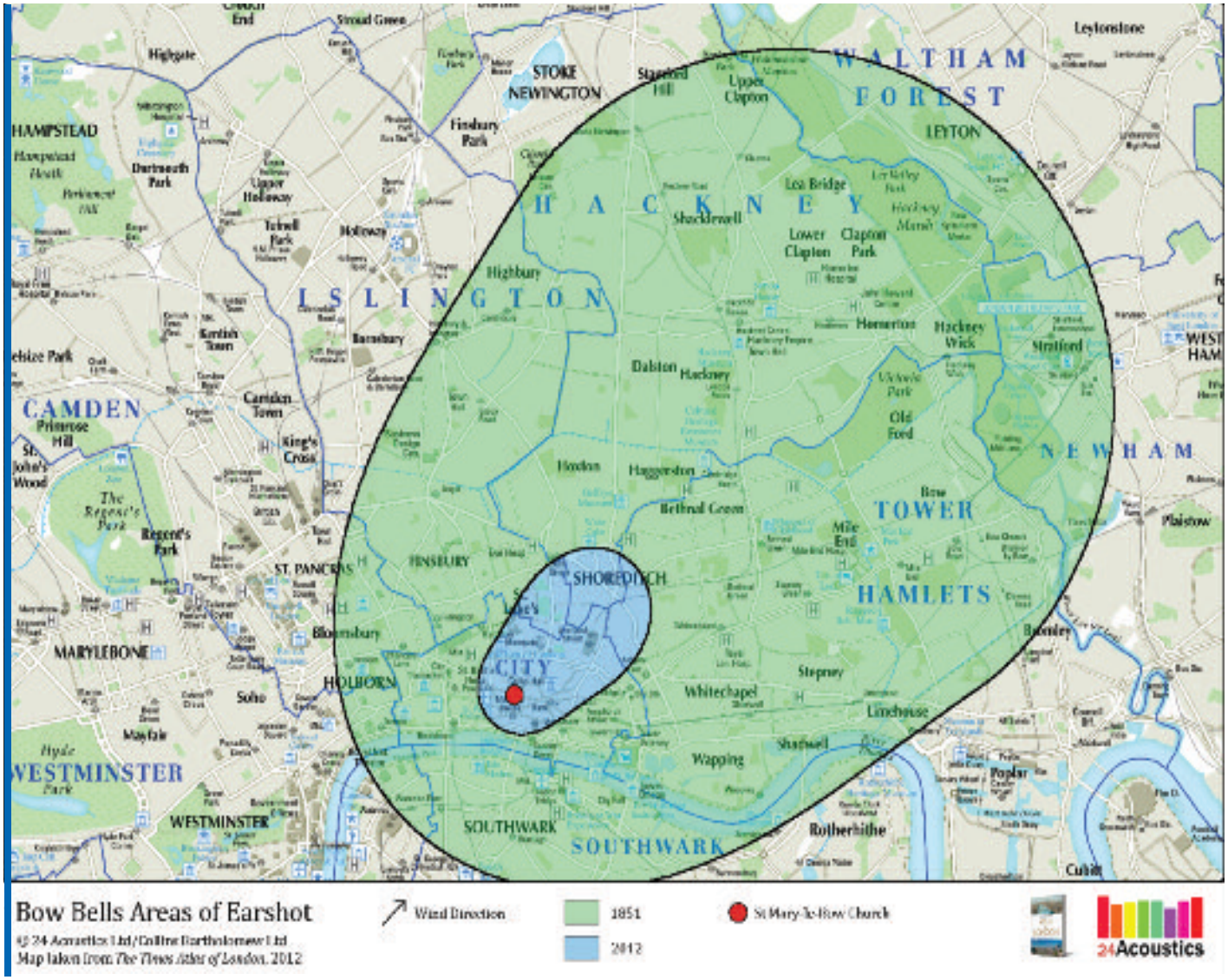
24 Acoustics determined the current zones of earshot for the Bow Bells using precision sound level measurements taken while the bells were tolling and calculations according to the effects of the UK's prevailing wind, which comes from the south west.

The output from the bells is equal in all directions from the church tower, but the wind direction is the reason that the sound of the bells travels eastwards. Most of the Cockneys living in the City of London close to St Mary-le-Bow Church moved east in the 19th century, but they took their devotion to the church and its bells with them – hence St Mary-le-Bow, its bells and the Cockneys all being associated with the east end of London.

The reach of the Bow Bells is affected by the ambient noise level which was significantly lower 150 years ago before the widespread use of motor vehicles (and building developments which further curtail the noise carrying).

This explains why the bells could be heard over a much larger area. Without roads or aircraft, the ambient noise levels in London in 1851 would have been similar to those in a rural location today (20 to 25 dBA in the evening).

In 2012, the ambient noise levels in London vary across the city, but are typically not less than 55dBA, owing to a combination of road, aircraft and noise from air conditioning plants, all of which was absent 150 years ago.



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Head of Music at Lancaster and Morecambe College, Pete French, was delighted with the new sound-isolating practice rooms installed by Black Cat Music: "The facility used to be a lecture theatre. It was just one space we could use; now we've got three spaces. The modules are being used every day with all three year groups time tabled in, so they are getting maximum use."

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"The music practice rooms have changed the whole nature of the course, because they are so sound-proofed. The students love them and yes, they work very effectively."

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Pete French - Head of Music, Lancaster and Morecambe College

"The Music Practice Rooms have changed the whole nature of the course, because they are so sound-proofed. The students love them and yes, they work very effectively."

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Views sought in EU noise consultation exercise

IOA members' views are being sought on the implementation report of the Environmental Noise Directive and on the EU Noise Policy.

The aim of the consultation exercise is to gather views and additional information on the effectiveness, strength and weaknesses of EU environmental noise legislation, in particular as regards Directive 2002/49/EC (END) relating to the assessment and management of environmental noise.

This consultation is part of a follow-up process to the first Implementation Report on the END published in June 2011. It serves to gather views also on the data and information published in the report focussing on the issues for further consideration.

The IOA's Environmental Noise Group will be formulating responses to noise policy and strategy issues. IOA members are encouraged to respond in their own right, stating their individual view, or the views of the organisations they represent. To help coordinate the group's response, please let Steve Mitchell (**Steve.Mitchell@erm.com**) know if you plan to respond directly to the Commission.

Views must be submitted by 25 September.

For full details go to **http://ec.europa.eu/environment/consultations/noise_en.htm**

Solar barriers will tackle M40 noise

A group of Oxfordshire residents proposing to tackle noise pollution with solar-powered barriers has won a competition to help make it a reality.

The Co-operative and the Centre for Sustainable Energy has awarded the M40 Chilterns Environmental Group and six others £200,000.

Dr Ken Edwards, chair of the group, said: "Now we believe we can begin to tackle this needless noise."

They plan to install the photovoltaic-enabled barriers along a 20 mile (32km) stretch of the M40.

Dr Edwards added: "This is a major step on a journey we started eight years ago. Noise pollution from the M40 has affected the lives of local communities since 1990.

"Our proposal stemmed from addressing the question of how to make noise reduction barriers self-financing and we believe that our solution is win, win, win.

"It will improve the quality of life for local communities, will offset installation costs, and benefit the environment."

The group formed in 2004 when neighbouring communities came together to find solutions to the noise heard from the M40 between junction 3 at Loudwater and junction 8 at Wheatley.

Its award includes "specialist mentoring, enterprise development and technical advice".

Paul Monaghan, the Co-operative's head of social goals, said: "Ambitious community-led projects can contribute to a step-change in people's thinking about energy and inspire others to take action, providing a catalyst for a clean energy revolution across the UK."

Photovoltaic panels which double up as noise barriers can be found in a number of countries including Austria, Germany and the USA

Martin Preston / Shutterstock.com

Leo Beranek updates his 1954 'classic'

IOA Honorary Fellow Dr Leo Beranek has produced a new version of his 1954 book *Acoustics*, widely regarded by many as an acoustics "classic".

Acoustics: Sound Fields and Transducers (Elsevier 2012), co-written with Tim Mellow, aims to incorporate recent developments, practical formulas and methods of effective simulation.

This text is dedicated to the student who anticipates doing the engineering design of audio equipment. The particular vocabulary of electro-acoustics is treated early on in the book.

Next follows the very basis for the subject, the laws governing sound generation, radiation, and propagation, which are expressed both mathematically and graphically. Then follow chapters dealing with microphones, loudspeakers, earphones and horns. Following the performance of loudspeakers either in baffles or attached to waveguides is treated. Directed toward the design of miniature systems, i-pods and cell phones for example, the next sections deal with squeezing the most sound out of tiny radiating surfaces.

Throughout the text, numerical examples and summary charts are given to facilitate application of the material to the audio designer.

The expected release date is 12 September.

Residents win airport noise pay out

Nearly 600 homeowners and six schools are to get compensation for the building of Manchester Airport's second runway.

The householders, who claimed their properties were devalued due to the noise from the planes since the runway opened in 2001, will get £1,500 each.

Six local schools will also receive £1,300 each from the airport's owner, The Manchester Airports Group.

Five hundred and eighty-three households are to receive payments under the deal brokered by local MP and Chancellor of the Exchequer George Osborne and Jeff Gazzard, from the Manchester Airport Environment Network.

"It is a very acceptable final line to draw under second runway compensation," said Mr Gazzard.

Roisin Moores, head teacher of St Vincent de Paul Primary in Knutsford, who speaks on behalf of the six schools affected, said the runway had had a marked impact on teaching.

"You can always guarantee that there will be a certain time in the day when you have to stop talking in the classroom," she said.

A Manchester Airports Group statement said: "The legal process for runway two claims formally concluded in 2010.

"However, since then, George Osborne MP and Jeff Gazzard have presented us with a convincing case which showed inequity in the legal process.

"We've now agreed with them a final package of benefits as a goodwill payment.

"We hope that this demonstrates our commitment to work with our local communities and finally draws a line under this process."

Residents win payouts for noise nuisance

MEPs could be voting to make vehicles louder

Research carried out for Transport & Environment suggests there is a danger that new rules aimed at making vehicles quieter will in fact make them louder for the next 15 years.

Last December, the Commission presented a package of new noise limits for private and commercial vehicles. They were criticised by T&E and other environmental groups as lacking ambition, but draft changes by the Parliament's environment committee would weaken the Commission's proposals even further.

T&E commissioned M+P Consulting Engineers to provide an expert analysis of the draft changes.They say noise emissions from certain types of vehicles such as large buses and large lorries would take 16 years to get back to today's levels, which effectively means these vehicles would be louder than they are now for the next 15 years. Other vehicles will also get louder, albeit for shorter timespans.

T&E clean vehicles manager Greg Archer said: "The committee could end up making the new rules even weaker than the existing 20-year-old standards. That would be a slap in the face for the millions of Europeans that live next to noisy roads. In times of economic hardship, local authorities will be left to pick up the bill to install expensive noise barriers. That makes no sense as it would be 100 times cheaper to cut the noise from vehicles."

Environmental groups have been highly critical of the EU's approach to noise. Over the past 40 years, traffic noise has become a major impact on human health, causing an estimated 50,000 premature deaths a year and 250,000 cases of heart disease. Yet legislation has barely been updated in those four decades, and any updates have not set standards that would give the automotive industry an incentive to develop quieter vehicles.

"It's clear the car industry is lobbying fiercely to weaken even the modest proposals the Commission has put forward," Archer added. "It's vital that MEPs see this in context, resist the noisy demands of the car companies, and support a regulation which contains at least a mild tightening of noise standards for all types of vehicles, as well as a much-needed improvement in testing methods to mirror real-world conditions."

The European Parliament's environment committee has postponed a vote on the proposed changes from July to September.This reflects the difficulty in reaching a compromise and gives evidence of the complexity of the proposals.The regulation has also yet to be considered by the member states, which will provide further justification for delay.

A leading official from the German sports car maker Porsche has called for noise barriers to be the preferred solution to cutting vehicle noise to prevent car makers having to develop quieter technology. Hanns-Martin Gerhard, Porsche's head of vehicle noise, says cities should be redesigned with huge concrete barriers to separate cars and residents.

Programme to improve UK aviation environmental performance

The UK Civil Aviation Authority (CAA) has launched a four-year programme to help improve aviation's environmental performance and allow the sector to grow sustainably.

CAA and the Environment sets out the CAA's activities over the next four years to facilitate, advise, influence and regulate the aviation sector so its environmental impacts can be reduced.

The strategy was developed following a public consultation earlier this year that attracted responses from across the aviation industry and follows the CAA's 'insight note' on the environmental impacts of aviation, which was released in December last year.

Andrew Haines, Chief Executive of the CAA said: "The significance of the environment to the aviation sector continues to grow, and there is every indication that this will continue. In addition, aviation produces local impacts, primarily noise and air quality effects. Set against this background, the CAA, as aviation's regulator, has a potentially key role to play in helping the sector improve its environmental performance.

"We already undertake a wide range of activities that have a direct impact on the environment in areas such as safety, airspace, noise and economic regulation. We have produced this programme aimed at helping facilitate the sector's environmental performance and generating benefits to consumers, the environment and the sector itself."

The strategy focuses on key areas including – airspace; safety and standards; incentives and metrics; and noise modelling and local impacts. Its development is in line with the CAA's strategic objective to: "improve environmental performance through more efficient use of airspace and make an efficient contribution to reducing the aviation industry's environmental impacts".

Matching an organ to its acoustic space

John Norman, Organ Consultant and Past Chairman, British Institute of Organ Studies

Introduction

Although the organ has the widest dynamic range of any musical instrument, it is the only instrument whose design is varied according to the acoustic of the building in which it is housed. Other instruments either have some method of adjusting their sound, such as the raising of the lid of a grand piano, or are present in greater or less numbers, as in the contrast between a string quartet and a full 80-piece orchestra. Not for nothing does the large St Paul's Cathedral, London, have more boy treble singers than any other English cathedral. Before the acoustic of the Royal Festival Hall was altered, the leading orchestras often had twelve double bass players sawing away in an effort to make themselves heard.

This paper looks at the musical requirements for the acoustic power of an organ, the effect that the acoustic space has on the fulfilment of those requirements, and at the tools that organ designers have at their disposal for coping with varying circumstances.

Musical requirements

House organs

In the late eighteenth century, a small organ, generally with a single manual, was a standard fitting in the music rooms of the wealthy. We have a magnificent example here in Cardiff, in the organ made by John Snetzler in 1775 for Sir Watkin Williams Wynn's private house in St James's Square, London. (Figure 1) Organs like this were typically intended for either solo performance or with a small group of stringed instruments. Only a modest power output was required so Robert Adam's rather heavy casework was not a problem.

Not all the organs were as grand as the Williams Wynn instrument but many survive, sometimes, as here, enlarged to suit a later use in a larger venue. However, even without enlargement, some such organs found new usefulness in rooms with low acoustic absorption, as, for example in the Holywell Music Room at Oxford. (Figure 2)

The modern equivalent is the box organ, used as a portable continuo instrument with small orchestras. They are limited in size by the need for the player to look over the organ to see the conductor, limiting the bass (low frequency) output below that of their eighteenth century forbears. (Figure 3)

Concert hall organs

There is music in the concert repertoire, such as Saint-Saens' third symphony, that calls for a Concert Hall organ to be able to come through the sound of a full orchestra. Symphony orchestras have become steadily larger and louder over the last 200 years (indeed even in the last 50) and this can cause a real problem for the organ designer. Even the famous Henry "Father" Willlis got it wrong in 1871 at the Royal Albert Hall, London, where the instrument was criticised for being under-powered (more than rectified later when the organ was rebuilt in the 1920s), More recently the 1996 organ in the Bridgewater Hall, Manchester, has proved to be seriously underpowered and the 2001 organ in Symphony Hall, Birmingham, has little to spare. (Figure 4)

Church organs

The requirements of church organs differ by country and by denomination, and have changed over time. In most churches in Britain, however, the present-day limiting requirement is the ability to lead congregational singing. This can vary from half-hearted in crematoria to lusty unison voices in the chapels of the leading independent schools.

Factors external to the instrument

Placement of the instrument

As the largest piece of furniture in the building, the placement of an organ is subject to both liturgical and architectural fashion. In most non-conformist chapels the organ is placed at the front on the major axis of the building and in Anglican churches the standard position up to the middle of the 19th century was on the major axis at the back (the 'west' end). Liturgical changes then led to most organs being placed sideways, often in separate 'organ chambers' with poor acoustical projection. A major difficulty is that visual issues usually receive priority attention. This is at least partly caused by a general ignorance of acoustic principles, not only in the general public but also amongst many architects. P38

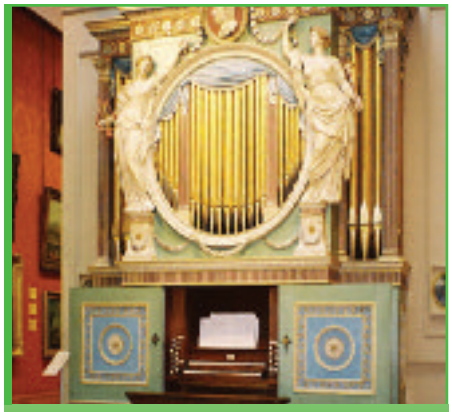

Fig. 1 John Snetzler 1775, for Sir Watkin Williams Wynn.

Fig. 2 John Donaldson 1790. Made for Belvedere House, Dublin.

Fig. 3 Box organ. St John's College, Oxford. Bernard Aubertin 2011

P37 A classic consequence of this attitude can be found in the Colston Hall, Bristol, where the hidden organ speaks largely into the roof space. In the Royal Festival Hall, London, the organ consultant Ralph Downes[1] fought a long battle over the location of the organ, where a similar roof-space position was originally proposed.

To some extent, the problem lies in the very wide frequency range of the organ. Large organs typically go down to 16 Hz and nearly all organs go up to at least 8 kHz (the fundamental pitch of the smallest pipe). 16 Hz (wavelength 64 ft - c.20 m) will go round most obstacles in the interior of a building without significant attenuation, but the musically-important higher frequencies will be seriously attenuated unless redirected by a reflective surface. That is why organ position is least important in a very reverberant building, where much sound is heard by reflection anyway, but is vital in any venue where most sound has to be direct.

Placement of the player

Although the location of the player has no direct effect on the sound of an organ, it may well affect the way in which it is played. From the point of view of practical performance, it is desirable to have the player located close to any other musicians - in a church context close to the choir. This can give rise to a conflict between visual/architectural considerations in the location of an organs, on the one hand, and practical musical requirements on the other. The development of low-voltage electrical organ action mechanisms towards the end of the nineteenth century gave rise to the possibility of separating the player from the body of the instrument. (Figure 5) This led to situations where the organ was physically located at the opposite end of the building from the player. This arrangement proved highly unsatisfactory. This is partly because of the acoustic delay affecting the player's timing (approximately 100 millisec. for a distance of 34 m, plus the delay in the electric or electro-pneumatic action, typically 20-50 millisec.). The other problem is that, by having the congregation/audience between the organ and the player, the power of the instrument, as perceived by the player, is less that that perceived by the listeners. This invariably leads to complaints that the organist is playing too loudly.

Fig. 4 Birrmingham Symphony Hall. Johannes Klais 2001

The problem is less acute in a reverberant building where the perceived sound level diminishes less with distance. It has also been found that a 12 m separation of pipes and keyboard (35 millisec. delay) is acceptable when combined with a fast (20 millisec.) electric action (Figure 6).

Fig. 5 Robert Hope-Jones. Electric action movable console demonstration in porch of St John's Church, Birkenhead 1887

Building reverberation and absorption

It may have been the nineteenth-century organ builder "Father" Willis who coined the phrase "The most important stop on the organ is the sound of the building". Certainly he is known to have exhibited a marked lack of enthusiasm when asked to build an organ in a non-reverberant church. As noted above, the reflections that make up reverberation do ameliorate problems of positioning, both of the instrument and of the player. Quite apart from scientific considerations, it is obviously more satisfactory to perform music in the same acoustic ambience that was expected by its creator. Listening to a Bach Cantata in St Thomas's Church, Leipzig, is an unforgettable experience. For no very obvious reason other than expectation borne out of past experience, we prefer the reverberation of a big building to be longer than that of a smaller one. Stephens & Bate[2] expressed this as a mathematical formula which I have put into a graph (Figure 7).

In any given building, acoustic absorption is the other side of the coin of reverberation. The greater the absorption the louder the organ will have to be to create the same musical effect, since the direct sound will have less reflected sound to back it up. This has caused widespread problems. In the case of new buildings, late changes in the specifications of surfaces can upset the design of organs already under construction. This caused problems at the Royal Festival Hall, where a number of surfaces proved to be more absorbent than the acoustician Hope Bagenal had originally planned[3]. At the Bridgewater Hall in Manchester, mentioned above, there was poor liaison between the hall authorities and the organ builder in Denmark. The reverse problem occurred at St Alban's Church, Holborn, in 1960. Here the Compton organ company had the opportunity to build an organ in an open position on the elevated west gallery of a church with long reverberation and low absorption. However, the Compton speciality had been in overcoming the problems of voicing organs buried in chambers. Not realising the change in acoustic circumstances, Comptons kept to their usual style of voicing and, as first built, the instrument was easily the loudest organ in London

Treble and bass (high and low frequencies)

Organ builders have long known that large leaded windows absorb bass (low frequencies); the better organ builders have allowed for this in their calculations. The problems with the bass in the Royal Festival Hall have already been mentioned, due to a particular theory of Hope Bagenal[4]. Until the recent alterations there the fundamental note of organ pipes sounding 16 Hz was almost inaudible. A more difficult problem is that caused by the recent tendency to cover tiled or wooden church floors with carpet, particularly if this is placed immediately in front of the organ. With typical absorption coefficients of 0.6 at 2 kHz and 0.7 at 4 kHz for Wilton carpet laid on underfelt[5], not only does this substantially reduce reinforcement of sound by reflection, but also introduces a substantial skew to the treble to bass balance. Since this is normally encountered as a retrofit, affecting already installed organs, there is virtually no corrective action that can be applied to the organ itself.

Fig. 6 Worcester Cathedral. Kenneth Tickell 2008.

There is a more subtle effect on the tone of an organ which results from the absorption of sound by the atmosphere at high frequencies. This varies somewhat with the relative humidity of the air, being higher at low humidity, but is shown in Figure 8, which is based on a table by Evans & Bazley[6]. The effect of this is a high frequency filter, virtually absent from venues with low reverberation but very significant in buildings with relatively long reverberation times. The musical result is that a style of voicing appropriate to

a reverberant Gothic abbey will sound hard and aggressive in a more intimate environment. This occurred in the 1972 organ by Grant Degens & Bradbeer in the chapel of St Mary Undercroft in the Palace of Westminster. The replacement organ of 1999 by William Drake (consultant John Norman) was designed to have a deliberately less aggressive sound than its predecessor.

Tools available to the organ designer

Design of the organ case

Sound transmission: The design of the organ case can affect the transmission of sound to the listeners. Unlike architects, organ builders design cases with the minimum of panelling in order to maximise sound transmission. Front pipes do, however, act as a high filter, reducing transmission of sound with a wavelength less than 0.1 m (i.e. from about 3 kHz up). In America, the organ builder Walter Holtkamp (1894-1962) always placed the bass pipes at the back with the smallest pipes on show at the front. This arrangement was used (more by accident than design)[7] in the Royal Festival Hall, London.

Organs located under a low roof or in a chamber usually have a minimum of woodwork above the lower panelling in order to maximise sound transmission.

Effect of a case roof: Up to about 1820, it was usual for organ cases to be roofed in. Although originally provided more to keep out the dust than for acoustic reasons, roofs have been found to have important acoustical effects when an organ is free-standing, i.e. not within an enclosure. For this reason some present-day organ builders now provide case roofs whenever possible and replace them on old organs where they have been removed. Some have theorised that vibrations in the case panelling can have a beneficial effect (unproven). Others have suggested that a complete enclosing case can constitute a Helmholz resonator, although calculation shows that the resonant frequency of such a resonator is well below the audible range.

The real effect of a case roof is not as yet widely P40

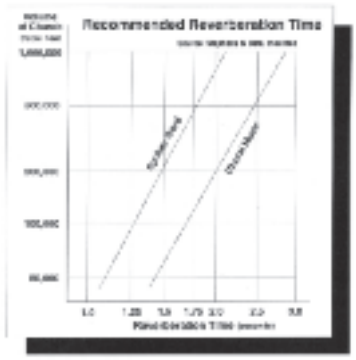

Fig. 7 Recommended Reverberation Time

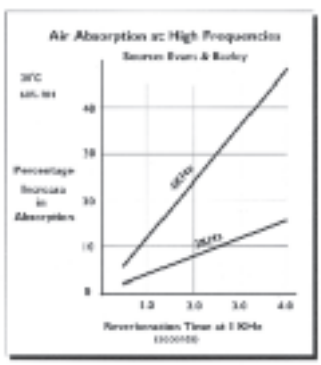

Fig. 8 Air Absorption at High Frequencies

P39 understood. It provides early reflection of sound emitted vertically from the tops of the pipes. This reflection increases the precision of the sound of an organ standing below a roof that is some way above the instrument. It does this by eliminating the time delay of sound travelling up to the structure above and then down again, relative to that emitted directly forwards. For example the new organ in Keble College Chapel, Oxford, (Figure 9) retains the Victorian appearance of its predecessor and thus has no case roof. Sound travelling up nearly 10 m to be reflected from the arch above will arrive at the ears of the listeners on the floor below about 60 milliseconds after sound coming directly through the front pipes. This considerably reduces precision in a building with a long reverberation time so that the ratio of direct to reflected sound is quite low.

Wind Pressure: Most organs are voiced on a wind pressure of between 55 mm and 100 mm of water. In the past the upper limit was set by both the manpower required to pump the wind and by the fact that the pallet valves controlling the wind supply to the pipes require more effort to move if the wind pressure is increased. Engineering developments in the 19th and early 20th centuries eased these restrictions; electrically-powered fan blowers are now virtually universal and electric or electro-pneumatic actions isolate the effort required to operate the keys from that required to open the pallet valves that admit air to the pipes.

The facilities were utilised in the design of the organs made to accompany silent films in the 1920s. Cinemas have padded seats and a low volume per seat, yielding high acoustic absorption and short reverberation times. Commercial considerations meant that the organs had relatively few pipes but utilised relatively high wind pressures (typically 250 mm of water) to generate a powerful sound. They also used more reed pipes (using woodwind technology) relative to the number of flue pipes (using a technology related to the orchestral recorder), as reed pipes tend to have a more aggressive tone.

The use of mechanical key action has undergone a revival in the last 50 years, as giving the player a more intimate connection to the instrument. Despite 1970s design improvements in the key action, church and concert instruments tend to be limited to a maximum of 100 mm pressure. Indeed this has now led to a move back to electric action for the very largest organs, especially in concert halls.

Pipe scales: The diameter of the body of an organ pipe (the 'scale') is the most important factor in controlling the tone quality. This is because the higher resonances of the air in a pipe are not perfectly in tune with the harmonics of the fundamental, and are therefore not excited. For a given pitch, the greater the diameter of the pipe, the more pronounced the effect, and the flutier the resulting tone. But, all else being equal, a wider scale also allows the pipe to be voiced somewhat louder, especially if the height of the pipe mouth is increased. (The height of the pipe mouth governs the edge tone, the basic vibration that is amplified and controlled by the pipe resonator). Overdoing this change coarsens the tone, however, losing higher harmonics. The converse is the smaller pipe scales used 200 years ago for house organs. The chorus of the 1818 Thomas Elliot chamber organ now in the crypt of Lancing College Chapel is seven notes smaller than the basic scale that Elliot used for his Open Diapasons in normal church instruments. Present-day organ builders use similar scales for organists' practice instruments.

We have seen, in 3.4 above, that in a reverberant building the acoustic absorption of the air itself starts to become significant in the treble, so an instrument needs to put out extra energy in the upper range, whereas in an acoustically 'dead' building one needs to hold back the upper harmonics of the treble pipes or they will 'scream'. At Norman & Beard my grandfather[8] evolved two basic scaling methods, one with the diameter halving on the 16th note in the bass and the 18th note in the treble - used for large reverberant buildings. The other scale halved on the 17th in the bass, the 18th from 4 ft to 1 ft and on the 20th in the treble, giving flutier and less edgy treble pipes. (Figure 10)

Number of stops: When John Goss (later Sir John) was appointed organist of St. Paul's Cathedral, London, in 1838, he had the temerity to enquire about the possibility of adding another stop to the 1697 Father Smith organ. Sir Sydney Smith, a very grand Canon, was determined to put down the young upstart: "What a strange set of creatures you organists are. First you want the bull stop, then you want the tom-tit stop; in fact you are like a jaded cab-horse, always asking for another stop."

The plain fact is that the more stops there are the more fun the instrument is to play. But, in practice, we also need to relate the size of the organ stop list to the acoustic power needed. One might have thought that this need not apply in the case of electronic imitations. The power of such an instrument depends on the power of the amplifiers and loudspeakers, not on the stop-list, and the cost and space requirements of extra stops are relatively small. Exploiting this situation to supply a large stop-list in a small building can lead to a very considerable mismatch between the

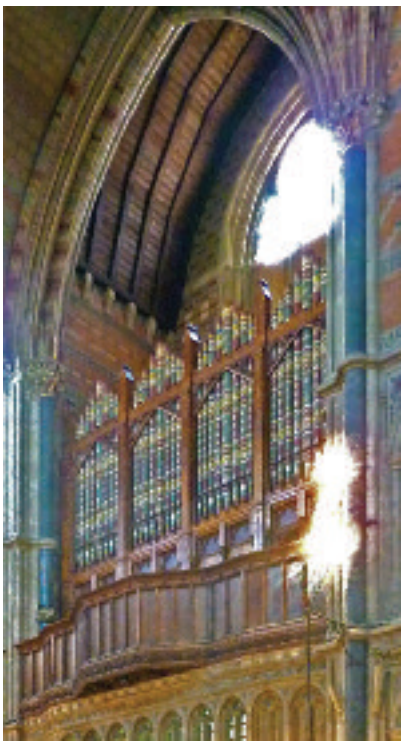

Fig. 9 Keble College Chapel, Oxford. Kenneth Tickell 2012

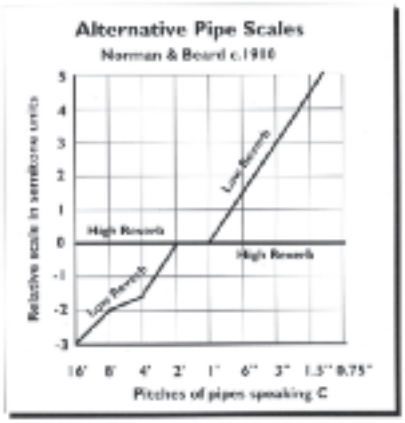

Fig.10 Norman & Beard pipe scales

stop-list and the actual power of the instrument, with each stop sounding only a tiny fraction of itself in order to prevent the 'full organ' sound becoming overwhelming. The result invariably sounds artificial.

In calculating the ideal size of an organ for a given acoustic, one must disregard the number of manuals. Additional manuals add tone possibilities and flexibility in performance but relatively few decibels. The calculation should be based on the size of the Great organ (the lower manual of a two-manual organ or the middle one of a three-manual instrument). For an organ in a roofed case and a prominent open position on the main axis of the building, experience has shown that one stop on the Great organ for every 1000 square foot absorption units is a most useful rule of thumb. Thus a church 120 feet long, 50 feet wide and an average 30 feet high, with a midrange reverberation period of 1.5 seconds (with congregation) will have 6,000 square foot units of absorption and would need an organ of around 16 stops as a two manual (6 Great, 6 Swell, 4 Pedal), perhaps 21 stops as a three-manual, or even as few as 7 stops (6 manual plus one Pedal) as a one-manual. The additional manuals add variety of tone and convenience for the player, but not much power. If the instrument is in a chamber it may need to be up to double the size, however, to produce a comparable effect, On the other hand, if for musical reasons the organ needs to be slightly larger than the calculation indicates, pre-knowledge enables some adjustment of pipe scales to compensate.

Summary

The acoustic space inhabited by an organ can vary within very wide parameters and these variations will have a major effect on the musical result. Some effects can be taken into account in the design of the instrument but some adverse external factors are difficult to mitigate, especially if poorly placed absorbent surfaces are added after the organ has been made. Organ designers have not always understood the effect of the reverberation time on atmospheric sound absorption at high frequencies, the mechanism by which a case roof affects the sound, or the calculation of the optimum size for an organ. Hopefully, with this knowledge, we can help to avoid future mistakes.

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Development of methodology for documentation of key action properties and haptic sensation of pipe organ playing

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Abstract

Musical instruments provide auditory, visual and tactile feedback to the performer. The organist hears the pipes sounding as well as the contribution of room acoustics, sees the console, smells the air of the room, and feels the key action properties through his or her fingers and feet. Thus just as perception of most objects and events is multisensory, the sensation and perception of instrument playing are also multisensory. Within the project, "The Organ as Memory Bank", we investigate the underlying dimensions of haptics in pipe organ playing, focusing on the mechanical manual-key action. This research involves both objective and subjective characterisation of the key action. Objective characterisation focuses on mechanical construction of the key and trackers and how it shapes the tactile feedback. The dynamic behaviour of the keys is measured as a function of key-fall and velocity as keys are pressed using a controllable linear actuator and characterized by objective parameters. The subjective characterisation of the haptics of organ playing is initially surveyed online. Semantic differential scales, which are devised based on the results of the survey, will be used in subjective experiments to reveal the underlying dimensions. Finally the objective (physical) and subjective (perceptual) characteristics will be linked to reveal the salient sensorial key action properties.

Introduction

Within the research project, The Organ as Memory Bank, we aim to investigate the underlying dimensions of haptic sensation in pipe organ playing, focusing on mechanical manual-key action. This paper presents the development of a methodology for describing the dynamic behaviour of the key action. Further, it proposes a methodology for the subjective characterisation of the key action with the aim of revealing the sensory-salient key action properties.

Research on key action involves both objective and subjective characterisation of the key action properties. Objective characterization is done by focusing on mechanical construction of the keys and how different components affect the physical force feedback that is perceived by the organ player. In order to study the dynamic behaviour of the keys, force-feedback at the key tip is measured as a function of key-fall and velocity, while keys are pressed using a controllable linear actuator. From the measurements, we extract a number of objective parameters, which can be used for comparison of different keys within an instrument as well as overall comparison of different instruments.

Apart from the objective characterisation, subjective characterisation of key action is required. For this purpose, based on an online survey on haptic sensation of organ playing, semantic differential scales are devised. They will be used in subjective experiments, whose aim is to reveal underlying dimensions of haptic perception of the instrument. Finally, the above mentioned objective (physical) and subjective (perceptual) characteristics will be linked to reveal sensory-salient key action properties.

In the most general sense haptics refers to perception and manipulation of objects through the senses of touch and proprioception [1, 2]. The sense of touch refers to the cutaneous system which relies on the information from the mechanoreceptors in the skin that responds to mere deformation of the skin. On the other hand, proprioception relates to stimuli that are produced and perceived simultaneously within the body of an organism, and that is primarily connected to the position and movement of the body. Therefore, due to simultaneous existence of both perception and manipulation, information flow is in two-directions in haptic modality, i.e. both inwards and outwards with respect to the perceiving and manipulating body. This definition is especially important here because an organ player, while playing a pipe organ, simultaneously manipulates and perceives the instrument. In more general terms, the haptic channel is central to interaction with physical objects. Thus, a characterisation of a physical system like the key action of a pipe organ, where perception and manipulation occur simultaneously, would be incomplete without involving haptic characteristics.

Characterisation of mechanical key action properties

Research on key action properties takes place in two main parts: characterisation of (1) the objective (physical) and (2) the subjective (haptic) properties of the keys as perceived by the organ player at the keyboard. Since the organ player is the user of the instrument, the key action properties are chosen to be investigated from the perspective of the organ player. Also, this kind of investigation, we believe, would be much more informative to other organ players and organ builders.

Objective characterisation of dynamic properties

There are a number of components in the mechanical key action that contributes to the force feedback that is received by the organ player: force from the spring to keep the pallet closed, force needed to accelerate the key, force due to friction in the key action and force due to the pressurized wind chest acting on the pallet. All these components contribute to key action characteristics, which are perceived by the organ player. Therefore, in order to reveal the dynamic behaviour of the keys, force feedback as a function of key-fall and velocity is chosen to be measured. In order to have objective measurements and to be able to control for the key velocity, a controllable linear actuator is used for pressing the keys. During the movement of the key, position of the key and force feedback at the key tip are measured simultaneously.

The development of the methodology was done at the North German Baroque Organ at Örgryte Nya Kyrka, Gothenburg, Sweden [3]. Then it was tested in a number of different instruments. Following, we describe the methodology using a small sample of the measurements that were carried out at the Cornell Baroque Organ, Cornell University, Ithaca, NY [4].

Measurements

Measurements were done on 22 keys in each manual (five keys in each

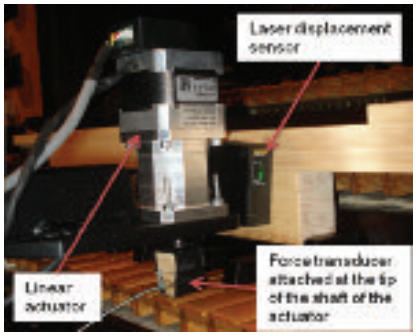

Figure 1 Measurement set-up. Linear actuator is used to press the keys with controlled speed. Force at the key tip and displacement of the key are measured by a piezoelectric force transducer and a laser displacement sensor, respectively.

full octave were measured) of the Cornell Baroque Organ. For each key, force and displacement were measured when the blower was off and on, while depressing the keys using a linear actuator. For each of the two wind conditions, keys were pressed in three different ways: (1) with constant speed of 100 mm/s, (2) with constant speed of 125 mm/s, and (3) with slow jolt-free acceleration. The last condition was selected in order to be able to study the spring and friction forces separated from the inertia of the keys when the blower was off.

Measurement of the force was done via a piezoelectric force transducer placed in between the shaft of the actuator and the key; while a laser displacement sensor was used for the measurement of the key position (figure 1). We used a National Instruments CompactDAQ (NI cDAQ-9178) system in order to collect data. Force and displacement measurements were repeated three times for each condition, and then they were averaged.

Extraction and comparison of objective parameters

A number of objective parameters were extracted from the measurements in order to characterise the dynamic system. Moreover, these parameters can be used to compare different keys within the same instrument, as well as between instruments which have similar key action. In order to illustrate these comparisons we picked two keys (tenor c of each manual) to compare from the Cornell Baroque Organ.

First, we studied the force at the key tip as a function of the key position when the blower was off and the key was pressed with slow jolt-free acceleration (figure 2). Since the effect of inertia could be eliminated due to the use of the jolt-free acceleration, the slope of the attack in this particular condition was taken as a measure of the equivalent stiffness in the system (i.e. the steeper the slope the stiffer the system), which is mainly due to the spring that keeps the pallet closed. Further, the area that lies in between the attack and the release of each key in figure 2 indicates the energy that was lost due to friction. Judging from figure 2, c in Haupt Werck (HW) had more stiffness and friction compared to c in Ruck Positiv (RP) (see table 1 for a summary of the extracted parameters).

The effect of the mass in the system could be seen by studying the force feedback measured with different ways of pressing the key when the blower was off (figure 3). The oscillation in the constant speed condition arises from the inertia of the key components and the stiffness of the spring. The frequency of the oscillation depends on the stiffness and the mass in the system. Thus, since we have a measure of the equivalent stiffness, one can estimate the equivalent mass in the system from the oscillation frequency according to the equation below.

$$F0 = \frac{1}{2\pi}\sqrt{\frac{k_{eq}}{m_{eq}}} \qquad \text{Eq.1}$$

where, k_{eq} is the equivalent stiffness in the system and m_{eq} is the equivalent mass in the system (see table 1 for the values).

From the measurements when the blower was on two parameters were extracted: force needed to overcome the pressure in the wind chest to open the pallet (i.e. pluck) and the position of the key when the pallet opens. From figure 4, which shows the attack and release while the keys were pressed with slow jolt-free acceleration, one can deduce that the force that is needed to open the pallet is higher for c in HW compared to c in RP. Further, pluck point occurred earlier for c in RP compared to HW.

The extracted parameters are aimed to characterise the dynamic system; and they can be used to compare different keys within the same instrument as well as between instruments which have similar key action. Further, these parameters need to be combined with the subjective measures in order to reveal the sensory-salient key action properties.

Characterisation of haptic properties

In order to measure haptic sensation, the first task is to devise measurement scales, which are based on words and/or phrases that describe haptic sensation of organ playing. Obviously, these words have to be relevant to organ players and instrument properties. Therefore, an online survey was carried out with the aim of compiling a list of words that are used by organ players describing haptic sensation of organ playing.

Ten participants (four females) took part in the survey. They were organists and organ students with at least five years' experience in organ playing. In the survey participants were asked to describe the physical experience of playing a pipe organ with good and bad key action P44

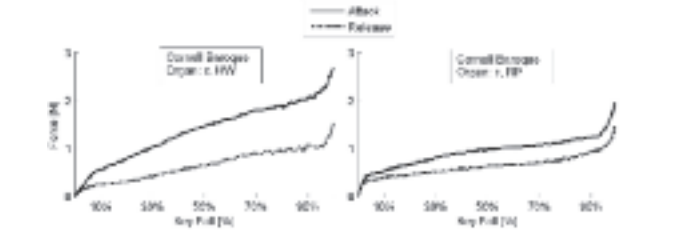

Figure 2 Force at the key-tip as a function key fall for tenor c's in HauptWerk (HW) and RuckPositiv (RP) for attack and release of the keys. Keys were pressed and released using jolt-free acceleration while the blower was off. The slope of the attack is taken as a measure of the equivalent stiffness in the system; and the area between attack and release is taken as a measure of friction.

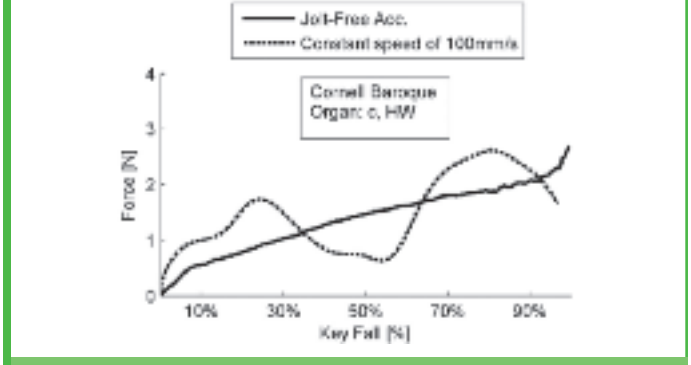

Figure 3 Sample measurement. Force feedback during the attack of the tenor c of HauptWerk with different playing conditions, while the blower was off. The oscillation during the constant speed condition arises from the inertia of key components.

P43 according to their preferences. From their responses a list of descriptive words was generated. Words or phrases that were used in the survey to describe the physical experience of pipe organ playing could be divided into a number of central topics or categories: (1) controllability of the instrument (e.g. feeling of being in control, fast response from the instrument), (2) mechanical or physical aspects (e.g. heaviness of the action, balance between the keys, viscous feeling), (3) connectedness (e.g. feeling in contact with the wind, feeling disconnected from the instrument), and (4) ergonomics. These four main topics seemed to shape the sensation of organ playing.

The next step is to design subjective experiments in order to measure the haptic sensation of pipe organ playing as applicable to key action characterisation. For this purpose, semantic measurement scales are developed based on the aforementioned list of descriptive words. For example the sensation of heaviness of an action could be measured using a scale that ranges from "not at all heavy" on one end, to "very much heavy" on the other.

In the first planned experiment, a number of instruments, whose objective parameters were already collected, will be picked. Organ players will rate, using the semantic scales that are provided, the instruments that they are familiar with among the selection. They will rate the instruments based on their previous encounters with them. Data collection in this manner can be done rather fast and this experiment could serve as initial testing of the semantic scales and the relevance of the objective parameters.

Conclusion

Following the methodology explained above, key action properties can be characterised both objectively and subjectively. The natural way to finalise this research would be to link these objective (physical) and subjective (perceptual) characteristics in order to reveal sensorial salient key action properties.

In conclusion, one of the aims of The Organ as Memory Bank is to improve the current understanding of the key action properties and their influence on the overall perception of the instrument. Within the scope of the project, research is being done in order to develop a methodology for describing dynamic key action properties both subjectively and objectively.

Acknowledgements

The Organ as Memory Bank is a research project at Göteborg Organ Art Center (GOArt), University of Gothenburg, financed by the Swedish Research Council, and carried out in collaboration with the Division of Applied Acoustics, Chalmers University of Technology.

	Tenor c (HW)	Tenor c (RP)
Key depth [mm]	8	8
Eq. Stiffness [N/m]	275	127
Energy lost to friction [mJ]	4.5	1.9
F0 [Hz]	18	16
Eq. Mass [gr]	22	13
Pluck [N]	2	1.3
Pluck point [%]	21% of key depth from top	12% of key depth from top

Table 1. The summary of the extracted parameters from the measurements for the tenor c's in manuals HauptWerk (HW) and RuckPositiv (RP)

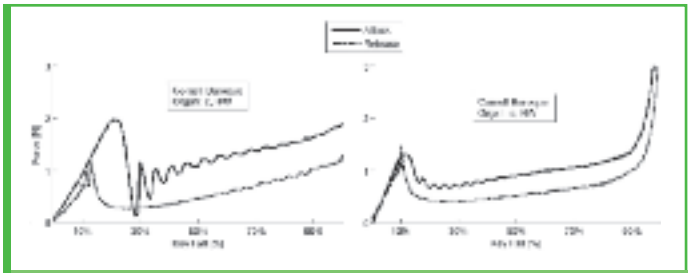

Figure 4 Force at the key-tip as a function key fall for tenor c's in HauptWerk (HW) and RuckPositiv (RP) for attack and release of the keys. Measurements were taken with the Principal 8f registration for both manuals.

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The misapplication of BS8233 1999 to offices in heavy industrial areas

Report by Mike Stigwood MIOA of MAS Environmental

Summary

Disproportionate weight appears to be given to the protection of office workers where the offices are insufficiently designed for the nature and character of the area in which they are located. Offices in areas designated for major industry or commercial activity cannot expect the same freedom from noise as offices located in residential areas. They should be designed to protect against potential noise impact. BS8233 1999 is being erroneously applied as a control mechanism preventing noisy activities, regardless of the nature of the area where the offices are located, and whether they are suitably designed for noisy areas. They should not rely on window opening or other measures that are more appropriate to the provision of amenity to residential premises.

Introduction

Offices are generally treated as reasonably noise sensitive due to the nature of operations including telephone use, discussions, meetings and work requiring high levels of concentration.

The guidance in the BS is of a design standard directed at those providing new buildings and protecting the users of those buildings. Its title is *Sound insulation and noise reduction for buildings - Code of practice*. It provides design criteria for many building uses including offices. The criteria of the BS may be applied wherever the offices are located.

The foreword to the BS clearly describes it as a document primarily directed at providing new buildings and includes some advice on refurbishment of existing buildings. In the scope it states: "These criteria and limits are primarily intended to guide the design of new or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise level."

It is not directed at the introduction of new noise sources into an existing noisy area. It is clear that expectations for freedom from noise will vary from area to area depending on the character of the area being considered. Anyone constructing offices ancillary to industry in a heavy industrial area should design those P46

Criterion	Typical situations	Design range L_{AeqT}	
Reasonable conditions for study and work requiring concentration	Cellular office,	40	50
	Staff room	35	45
	Meeting room & Executive office	35	40

P44 offices to be able to function with high levels of external noise and not rely on their absence. Where offices are constructed primarily in a residential area then there can be a higher expectation of freedom from loud external sources as this is dictated by residential amenity needs. As a consequence there is less need to design the office building to resist the passage of sound when in use.

There is clearly a need for offices in a range of localities which need to be designed to function having regard to the potential impacts likely in such areas. In summary, their design would need to vary to reflect the nature and character of the area in which they are constructed. It follows logically:

- offices adjacent to major transport sources (airports and railways) need to be designed to mitigate the noise from those sources
- offices in a major shopping area / town centre will be affected by noise from people and advertising methods such as amplified music
- offices in an area used primarily for entertainment such as pubs and clubs will be subject to patron and music / entertainment noise. These are less likely to conflict during the daytime but issues can arise
- offices in rural localities may be subject to agricultural noise and more odour and flies etc while the latter two are not noise issues, they do impact upon design
- offices in a heavy industrialised area will be subject to a range of pollutions including noise.

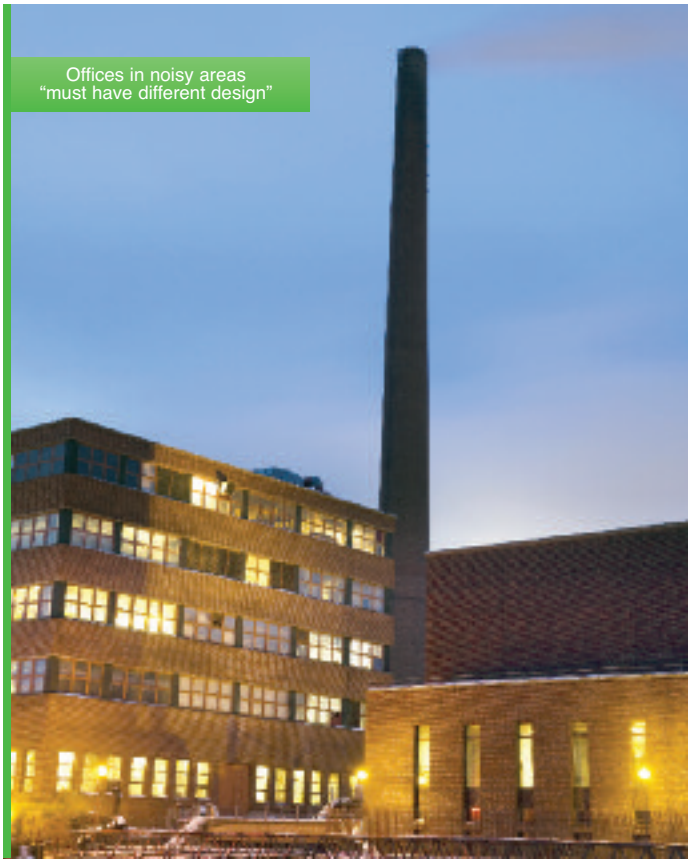
Increasingly office activity has been used as a reason to argue some industrial or polluting use is unsuitable in a particular locality despite the area being so designated. As a consequence noisy and polluting industry and entertainment activities are increasingly objected to as unacceptable because of their impact upon an office user, despite their location in a suitably designated area. In at least one case this has led to nuisance action. The industrial user chose to undertake noise mitigation measures rather than fight the matter as the costs were ultimately lower than the potential legal costs, win or lose.

BS8233 1999 is the benchmark most commonly used for arguing the unsuitability of a new noisy or polluting activity affecting offices. This is clearly a misuse of the standard and there cannot be a "one size fits all" standard of acceptability in different areas. When BS8233 1999 is read carefully it is clear it is not promoting a single external criteria for all areas on which offices can be designed, it is merely identifying the criteria to be achieved internally to avoid communication and study issues.

The primary issue is therefore whether offices have been suitably designed and located for the nature and character of the area where they are situated. If they have been constructed on the basis of the existing noise environment but that did not reflect the noise producing potential from an area, arguably the design is inadequate, rather than the new noisy activity being considered unsuitable.

This approach fits with nuisance law where people in towns and urban areas cannot expect the same freedom from pollution (e.g. odour, dust, smoke and noise etc) as those in rural locations[1]. The acceptability of any impact must relate to the character of the area within which it arises. This also follows human expectation. An office worker located in the middle of a heavy industrialised or major transport area would not expect the same freedom from noise compared to offices in the middle of a residential area. In turn the former would require design which adequately mitigates the noise but the latter could rely on openable windows for ventilation etc.

In attempting to impose control over internal office noise by restricting external noise and other pollutants, without adjusting for the character of the area is to ignore the needs of industry and commerce and to treat all areas the same way as you do a case of mixed industrial and residential conflict. There is no basis for such an approach and there must be expectation that in industrialised areas or those subject to other types of commercially based noise, more noise must be tolerated. In turn that means any office use in noisy and polluted areas should be designed to resist a higher passage of noise and pollution. In practice this means offices located in noisier areas need to be designed to operate with windows closed and include alternative means of ventilation.


Offices in noisy areas "must have different design"

It is difficult to address a location which may be subject to more noise in the future, depending on the neighbouring uses. The easiest way to address these differences is to rate areas according to typical character with the caveat there are always exceptions. This was originally done in ISO1996 and in the original BS4142 1967.

It is suggested an approach where the criteria to meet is adjusted for the character of the area is appropriate with use of +5dB in an urban area with some industry or commercial activity and +10dB in an area of heavy industry or solely entertainment / commercial (no residential). These are adjustments for expectation on the operator of an office to have to attenuate more noise than experienced in residential or mixed residential areas and follow the adjustments previously applied in former criteria such as ISO1996 which adjusted for the locality. In other words,where a proposal does not meet BS8233 1999 with the windows of the office open, an adjustment of 5-10dB is provided to account for the character of the area and the office operator needs to design their office to provide a higher standard of attenuation as necessary.

1. There are situations where the reverse is true. Consider the presence of agricultural smells or flies in a rural locality compared to the same smell and flies in a heavily populated urban town. An expectation exists of rural smells and flies in agricultural areas which may not be tolerated and 'out of character' in towns and cities.

Bond heads Center for Nondestructive Evaluation

Leonard Bond has become the new Director of the Center for Nondestructive Evaluation (CNDE) and a Professor in the Department of Aerospace Engineering at Iowa State University, USA.

He comes to Iowa State from the Pacific Northwest National Laboratory where he served as a Laboratory Fellow since 2000. Bond has focused his career on nondestructive evaluation and related topics and has worked in academia, as a consultant, and in government laboratories.

Professor Bond was a Research Professor at the University of Colorado, Boulder from 1997-1998, a Chief Scientist at the University of Denver Research Institute and Research Professor in the Department of Engineering at the University of Denver from 1994-1998. He also served as a Lecturer and Reader in ultrasonics at the University College London from 1979-1992.

He earned his Ph.D. in physics from The City University in London in 1978.

New Chief Scientific Adviser at Defra

Professor Ian Boyd has been appointed by Defra to be its new Chief Scientific Adviser. Professor Boyd, who is the current Director of the Scottish Oceans Institute at the University of St Andrews and the Sea Mammal Research Unit, joins in September on a three year contract. He will replace Professor Sir Bob Watson, who is leaving Defra after five years in the post.

Environment Secretary Caroline Spelman said: "Scientific evidence is absolutely crucial at Defra and helps us make the right decisions on how to protect and improve the environment. I have been immensely grateful for the scientific advice and oversight of all our research by Sir Bob, and I look forward to working with Professor Boyd to continue the Department's reputation for scientific excellence."

Professor Boyd has been Director of the Scottish Oceans Institute at the University of St Andrews and the Sea Mammal Research Unit, a partner institute of the Natural Environment Research Council, from 2001-2012.

He was responsible for the creation of the Marine Alliance for Science and Technology for Scotland in 2009, a partnership of nine institutions conducting marine science across Scotland. He is a member of the Scottish Science Advisory Council, chairman of a scientific advisory board on decommissioning for Oil and Gas UK and he also chairs the committee that monitors the environmental compliance around Europe's largest oil terminal at Sullom Voe in Shetland.

Much of his career was spent in polar science when he worked for the British Antarctic Survey from 1987- 2001 where his interests were focussed on the behavioural and physiological ecology of Antarctic seals and the ecology and management of the Southern Ocean.

More recently, he was Chief Scientist for a US Navy study examining the behavioural responses of whales to military sonar and he was a co-developer of environmental risk management procedures used by the Royal Navy.

Much of his recent research has focussed upon the effects of sound on marine life and this led to his role as co-chair of the International Quiet Oceans Experiment, a joint initiative of the Scientific Committee for Ocean Research and the Partnership for Observation of the Global.

Jim Smith joins AECOM as an Associate Director


Jim Smith

Jim Smith has joined AECOM from Arup as an Associate Director in its Manchester office. He is a Chartered Engineer with over 15 years' experience in acoustic consultancy. Over the past 10 years he has specialised in sound systems design and will draw on and continue to develop AECOM's expertise in this field.

He sits on the Institute of Acoustics' Electroacoustics Group Committee and the Institute of Sound & Communication Engineers Council. AECOM's Global, Acoustics Lead Bernadette McKell said: "Jim's skills are a fantastic addition to the growth of our global team."

Two more recruits at Vanguardia

Nicky Shiers (left) and Anne Unwin

Vanguardia has announced the appointment of two more consultants to its Oxted team.

Dr Nicky Shiers is a PhD graduate from London South Bank University. One of her first tasks was to work on sound management at this summer's big music festivals in London's Hyde Park. She will also be involved in environmental acoustics projects and business development.

Anne Unwin has joined the environmental team and is currently writing an environmental statement for a development in North Wales. She has more than three years' experience and has worked with numerous other members of Vanguardia staff in her career.

Death of Dah-You Maa, 'founding father of modern acoustics in China

Prof Dah-You Maa (Ma Dayou), a renowned acoustician and one of the two founders of modern acoustics in China, died on 17 July, 2012, aged 97. Below is an obituary that was published shortly after his death.

Professor Maa was born in Beijing on 1 March 1915 and obtained his BSc from Peking University in 1936. In 1937, he went to the University of California, Los Angeles (UCLA) and began his graduate studies with Professor Vern O. Knudsen. The following year, when Professor Knudsen was on sabbatical leave, Maa continued his research with Professor Frederick V. Hunt at Harvard University. Within his first two years in the US, his research resulted in two journal publications: *Distribution of Eigentones in a Rectangular Chamber at Low Frequency Range* as a result of his research with Professor Knudsen, and *Analysis of Sound Decay in Rectangular Rooms*, which he co-authored with Professor Hunt and his fellow classmate, Leo Beranek. Those two publications, published in the *Journal of the Acoustical Society of America* (JASA) in 1939, established a new chapter in the development of fundamental theories of room acoustics.

Professor Maa got his Master's degree in 1939 and then his Ph.D. degree in 1940 at Harvard University. He was awarded the fellowship of Acoustical Society of America (ASA) in 1943. In 2012, Maa was awarded the 19th Honorary Fellow of ASA.

After obtaining his Ph.D. from Harvard University, Maa returned to China to teach at National Southwest Associated University in Kunming in those very difficult days during World War II. In 1946, he went back to Peking, and at the age of 31, he founded the Engineering College at Peking University and served as its first Dean. In 1956, he took part in the formulation of "The national visionary plan for science and technology development between 1956 and 1967" and put forward strong recommendations for an acoustics research centre to be established within the Institute of Electronics, Chinese Academy of Sciences (IECAS). He then served as a director for the centre for a number of years. Between 1956 and 1958, Professor Maa established the first ever comprehensive acoustic research centre in China which consisted of a number of large-scaled acoustic laboratories including an anechoic chamber, two reverberation rooms, a set of sound insulation measurement chambers and some underwater acoustical laboratories. In 1978, he was appointed the Head of the Physics Department and the Deputy Acting Dean of Graduate School of the Chinese Academy of Sciences, where he worked for seven years. During his lifelong career in education he had taught courses in physics, electronics, electrical engineering, and acoustics.

Campbell extend sound calibration range

Campbell Associates have extended their range of UKAS-accredited calibrations for sound calibrators, with the inclusion of multi-frequency/multi-level devices. They can also provide statements of conformance to BS EN IEC 60942.

For the first time, fully accredited calibrations can be provided at all frequencies and levels of these reference devices, along with a legal metrology statement of conformance to the standards

For legal metrology applications sound calibrators are required to meet BS EN IEC 60942:2003. This standard specifies that the devices should be independently pattern evaluated by their manufacturer and submitted annually to an accredited laboratory for periodic verification by the user.

Campbell Associates now have UKAS accreditation for calibration at frequencies over the range 31 to 16k Hz. The he most popular calibration frequencies are 250 and 1k Hz

Statement of conformance to the standard for those using a single frequency calibrator will ensure that all aspects of the calibrators performance has been verified during the periodic verification (commonly called annual calibration in the trade) rather than just receiving a statement of the devices output level.

Multi-frequency multi-level sound calibrators are used mostly in universities and larger consultancy organisations that have a number of sound level meters and more demanding applications for the instrumentation. Campbell Associates are now able to offer calibration at ten frequencies and four levels produced by these calibrators.

For more information ring **01371 871030** or visit **www.campbell-associates.co.uk**

Two year extension for Spanish noise contract

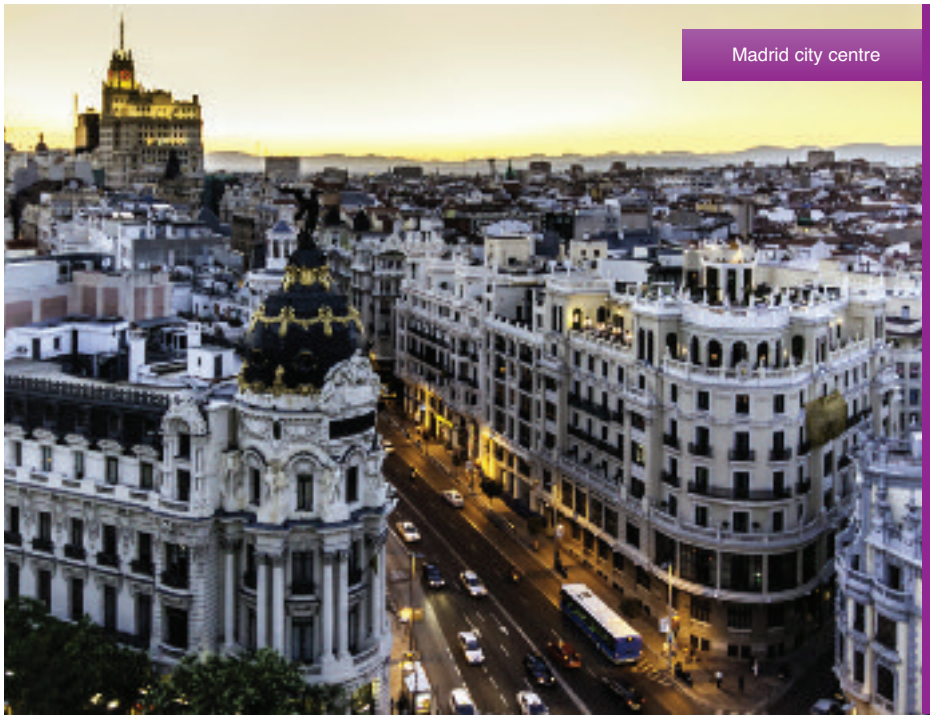
Madrid City Council has granted Brüel & Kjær a two-year extension to its contract to continue tackling noise pollution and meet national and European standards for environmental noise

Brüel & Kjær supplies a multidisciplinary team to the Environmental Noise Control Department which is based on site, allowing direct communication and interaction with the council's municipal officers and decision makers.

Its services include acoustic mapping, noise monitoring network management, environmental noise measurements management, noise assessment, environmental noise consultancy, RD1367 implementation and application, and assisting metrological tasks at the Acoustic Municipal Centre (CMA).

Among the projects currently under development are the Development of Strategic Noise Map 2012 (MER2012) and declaration of the Central District ZPAE.

For more information go to **www.bksv.com**



Madrid city centre

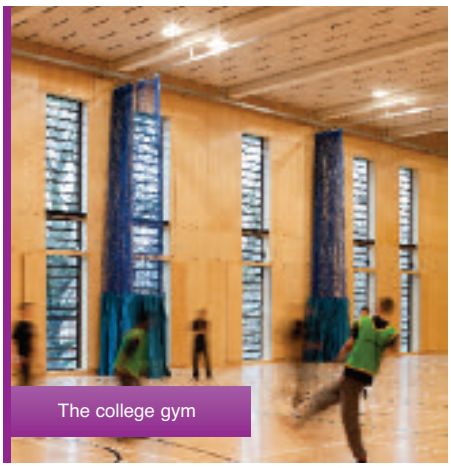
City college goes for Troldtekt tiles

Troldtekt acoustic ceiling tiles have been specified for the City of Westminster College. This 24,000 sq m project was designed by architects Schmidt Hammer Lassen as the result of winning an international competition.

To address sound absorption issues in the leisure and sports facilities and workshops, Troldtekt tiles made of 100% natural wood fibres mixed with cement were used.

The tiles are available in various sizes and in three grades, from ultrafine to coarse, They can be left untreated or, more commonly, are factory painted white, while virtually any other RAL colour is available to order.

For more information ring **0844 8114877** or visit **www@troldtekt.co.uk**



The college gym

SRS products at the heart of Samsung showcase centre

Sonata Acoustics and Floorscan Acoustics have designed Samsung's new Dolby-accredited audio visual "Sound Room" at its training centre at Brentford, west London, using SRS products

The two key requirements of the brief were:

- complete sound separation of the room, which is used to showcase Samsung's latest audio and Home Theatre products, from surrounding offices – no extraneous sound entering or leaving the room
- excellent interior acoustics enabling faithful rendition of sound to complement the audio and visual experience of the Samsung product range.

Sound separation was achieved by combining the design standard model of "a room within a room" – maximum isolation of the floor, walls and ceiling forming the inner lining of the room form the existing structure.

The whole of the inner lining was formed using a bespoke acoustic board manufactured by SRS; a lobby with a double door arrangement was created to isolate the room from the communal corridor.

The interior acoustics requirement was achieved by a combination of computer modelling of the space as a listening room, experience of sound absorption treatment and placement necessary to achieve this, and the use of Sonata Studio panels.

For more details ring **01204 380074** or visit **www.soundreduction.co.uk**

The new "Sound Room"

Accreditation for Castle

Castle Group has attained accreditation for its human vibration Competent Person Course from the Institution of Diagnostic Engineers (IDiagE).

Dianne Hamblin, Castle Training Manager, said, "This represents years of hard work. It's great to have independent verification of the programme."

The course is available in-house to companies with multiple employees and residential courses are run in Scarborough at the Crown Spa Hotel,

For further information go to **www.castle-trainingacademy.com**

Castle has also been appointed as a UK official distributor for Kimo measuring and monitoring products, including the new DBM610 thermo-anemo-manomometer for temperature, airflow/velocity and humidity.

The range of equipment includes air-flow and velocity measurement, light and illuminance meters, air quality, humidity, temperature, sound, pressure and tachometry.

Sound and Signals by Mikio Tohyama

Review by Frank Fahy et al

When I opened this book I was immediately disconcerted by the author's use of the term "signal theoretic signature" of sound waves, which is stated to be the central concept of the book and which is not explained for the benefit of those readers not familiar with the subject. I was surprised by the author's contention that it is a research monograph, which it is not. It is not at all clear who constitutes the intended target readership.

Much of the material presented in the first 10 chapters is already covered, in many cases more comprehensively and effectively, by other acoustic text books, very few of which are cited or recommended by the author. The treatment is principally theoretical with few examples of practical applications and empirical data. Chapters 11 and 12 present interesting models and analysis of sound fields in enclosures, but, most surprisingly, cite no references to the definitive book on the subject, *Room Acoustics* by H Kuttruff, or to the substantial body of research papers on the subject, especially by Michael Vorländer and Finn Jacobsen.

The final three chapters concentrate on the analysis and processing of sound signals at a fairly advanced level with which the principal reviewer is not familiar. The following comments were kindly supplied by a colleague who is an expert in this field. Chapter 13 looks like a fairly standard treatment of room responses, with a brief review of active control and pole-zero statistics, which is Tohyama's speciality. Chapter 14 is concerned with time-frequency representations, particularly for speech. This is not easy to understand, even for the parts with which this reviewer is familiar. It suffers from an unfortunate profusion of acronyms. Little motivation is given for the work, or commentary on its relevance, which gives the impression of a rather disjointed set of results. Chapter 15 deals with some fairly standard material on pole-zero representations of sampled data transfer functions, with relevance to room modelling, virtual acoustics and acoustic feedback.

The book contains a substantial number of misleading statements and explanations which cannot be attributed to errors in the use of English. Sadly, I cannot opine that this book makes an effective addition to the literature on signal analysis and modelling of sound and sound fields.

Sound and Signals is published by Springer. Price £117.

IOA 'must tell the Government to review ETSU properly'

The IOA was asked to do an assessment of ETSU but was not allowed to comment on actual noise levels as the government felt it could not commission a report that it could not recommend. Why bother then?

This just shows the government's reluctance to investigate properly the effects of noise from wind turbines and wind farms.

Some acoustic consultants have gone on record as saying that wind farms do not pose health risks because of noise even though they are not qualified medical practitioners. And the government accepted this advice without any consultation with the medical profession. Astounding.

This about sums up the whole IOA noise thing. I find it incredible that an organisation such as the Institute has not got the strength to tell the government it is wrong and that it should review ETSU properly.

You've some consultants who are interested in making the world a better and quieter place and many others who work for wind farm companies and just want the cash.

The acoustic consultant Hayes Mackenzie Partnership recommended to the government a few years ago levels should be reduced, but the government covered it up then denied it etc. But the Freedom of Information Act revealed the truth.

I wrote to the energy minister at the time and he obviously didn't read my letter as it was some fob off about not being in the terms of reference for the report. But the industry still uses the out of date guidance, which isn't even a recognised standard and is, in fact, older than the latest revision of BS4142 (though some consultants don't get this). And wind turbines are three times bigger than they were in the 80s. Then it was gearbox noise from badly made gearboxes, but now it's aerodynamic noise from poorly designed blades.

Anyway, the whole industry is messed up. The Department of Energy and Climate Change is desperate to meet the targets that Tony Blair set when he mistook electricity generation for all energy generation so massively increased UK CO2 targets, and Renewable UK is so desperate to make loads of money for its trade members it continues to tell people that wind turbines are no noisier than a fridge.

There is no mention on the REUK website about how much it cares for the planet it is looking to help by reducing noise from wind farms. It refers to sessions in Parliament from 1998, and reports from 2005. Clearly out of date. It is a lobbying group so information supplied by it must be treated with caution.

It also must not be forgotten that Renewable UK is a trade association – some people refer to it as the "body" for renewable energy in the UK, but it is not a government body.

However, the Institute of Acoustics is an institute and should be more influential in government policy than a commercial organisation.

Chas Edgington MIOA

The changing sound of tennis

Reading the recent article The Sound of Sport : what is 'real' ? (*Acoustics Bulletin*, July/August 2012) reminded me of some work I did, with my colleague Ahmed Shihab and our PhD student Krzysztof Zienowicz about four years ago, and a subsequent enquiry by the BBC during the 2011 Wimbledon tennis championships.

The research had involved performing spectrographic analysis of various sounds – particularly those associated with various strokes – occurring during tennis matches. Some of this had been published (K. Zienowicz, A. Shihab & G. Hunter (2008) "The Use of Spectrographic Template Matching to Identify and Classify Salient Sound Events in Tennis Matches" , P*roceedings of the Institute of Acoustics, Vol. 30, Part 2,* pp. 171 - 179. ISBN/ISSN 1 901656 91 8 / 1478-6095, April 2008; K. Zienowicz, A. Shihab & G. Hunter (2008) "The Use of Mel Cepstral Coefficients and Markov Models for the Automatic Identification, Classification and Sequence Modelling of Salient Sound Events Occurring During Tennis Matches", *Journal of the Acoustical Society of America* (JASA) Vol. 123 (5), pp 3431 and Proceedings of International Conference on Acoustics (Acoustics '08), Paris, France, June 2008), and we had found that, whilst it was possible to distinguish the sounds of tennis strokes from "ambient noises" (including footsteps, speech, players' grunts and audience noise), and to discriminate between high power (serves, smashes and drives) and low power (e.g. lobs and drop shots) strokes, it was not straightforward to identify particular strokes within those categories.

During the 2011 Wimbledon championships, I received a telephone call from someone at the BBC regarding that work. Apparently, former Wimbledon champion turned commentator John McEnroe had remarked how different the sound of the racket hitting the ball was when the roof on the Centre Court was closed. He claimed that, as a player, he had used the sound of this impact as one cue (in conjunction with what he saw) to predict how the ball would move. The BBC employee said that they were planning to run a piece on this topic in the *Broadcasting House* programme on Radio 4 the following Sunday, which was the day of the Men's Final. He discussed my views on this phenomenon at some length, and asked if he could contact me again the following day. That follow-up call never came, although the BBC did run a piece on that topic during *Broadcasting House* on the Sunday morning. However, instead of citing my opinions on the topic, they instead interviewed veteran commentator (but not, to my knowledge, acoustics expert) John Inverdale. Nevertheless, to his credit, he DID correctly classify three out of the five recordings of stroke sounds they played him as coming from drives, serves, lobs or smashes ! Perhaps there had been quite a bit of truth in John McEnroe's original remark?

Gordon Hunter MIOA,
Kingston University

Testing the next generation of 4G phones

A new system for testing the next generation of 4G phones that use Voice-over-LTE has been developed by Agilent Technologies and Brüel & Kjær.

Andy Botka,Vice President and General Manager of Agilent's Microwave and Communications Division, said "This solution enables operators and smartphone developers to make highly reliable and integrated Voice-over-LTE audio quality measurements."

The system uses Brüel & Kjær's PULSE analyser platform coupled with a Brüel & Kjær Head and Torso Simulator (HATS), and interfaces it with Agilent's PXT wireless communications test set.

Transporting voice over a packet-based LTE cellular infrastructure poses challenges that make voice-quality testing essential. The Agilent and Brüel & Kjær solution combines standards-based test methods with real-world base station emulation, RF testing and functional testing into one unit, to ensure that the next generation of Voice-over-LTE phones meet users' expectations.

For more information go to **www.agilent.com/find/LTE** and **http://bksv.com/Markets/TelecomAudio.aspx**

Accelerometer is 'hot off the press'

Brüel & Kjær's new type 8347-C accelerometer can withstand temperatures ranging from 196°C (-321°F) to +482°C (+900°F) and has high resistance to radiation.

The housing of the piezoelectric charge accelerometer is made of INCONEL® alloy and has been hermetically sealed, making it robust and ideal for harsh industrial environment usage.

Its 20 millimetre height also makes it suitable for testing in confined spaces for many different applications, including gas turbines, aircraft engines, turbo pumps and health and usage monitoring systems (HUMS).

Each 8347-C transducer is individually calibrated using random excitation and 1600-line Fast Fourier Transformation (FFT), which guarantees its measurement accuracy.

For more information go to **http://www.bksv.com/products/transducersconditioning/vibration-transducers/accelerometers/xaccelerometers/8347c.aspx**

The new type 8347-C accelerometer

INTA acquires array-based noise source identification system

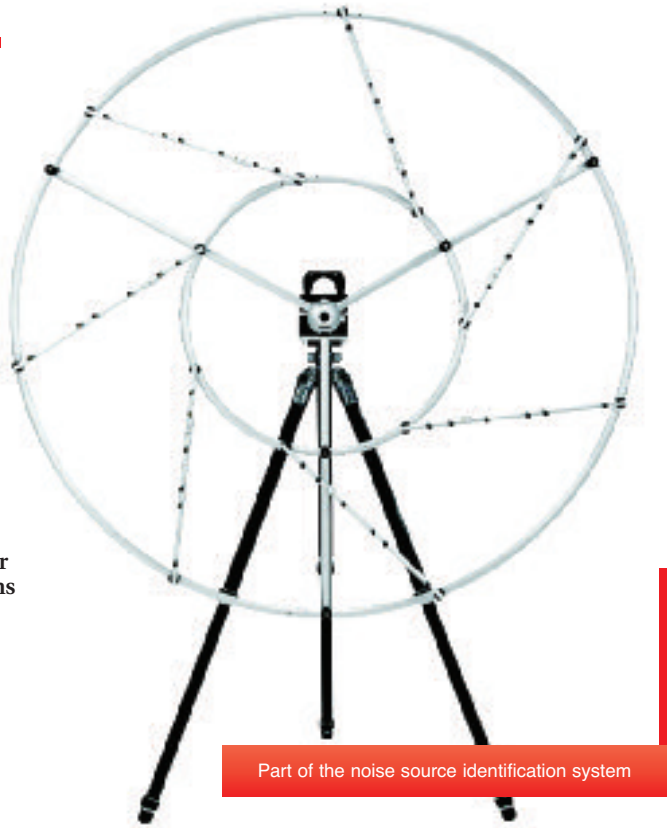
Spain's National Institute for Aerospace Technology (INTA) has acquired an array-based noise source identification system from Brüel & Kjær.

The Institute's environmental impact laboratory has been developing in recent years its own microphone array system. But due to the large number of channels needed for expanding the aero-acoustics laboratory with wind-tunnel noise measurements, its working acoustic group decided it required additional equipment for noise localisation.

The system consists of an array with 42 precision microphones, several PULSE LAN-XI modules and the PULSE Acoustic Test Consultant and Beamforming applications.

The microphones are capable of measuring up to 20 kHz and the Dyn-X input modules provide an extra-large dynamic range to avoid overloads. Using this system INTA can locate and identify noise sources of vehicle and aircraft components obtaining noise colour maps for each frequency of interest. This information helps the engineers to modify the structure in order to improve its aerodynamics and noise emission.

More information go to **http://www.bksv.com/Products/PULSEAnalyzerPlatform/PULSESolutionsOverview/AcousticApplications/NSIArrayBased.aspx**



Part of the noise source identification system

Armstrong goes full circle

Armstrong Ceilings has added curved and circular canopy systems to its Axiom Classic range as a standard offering.

The systems, previously available only as "specials", comprise an aluminium grid with a choice of highly light reflective mineral or soft fibre tiles in up to five and two standard kit options for the curved and circular canopies with Tegular and MicroLook edging respectively.

With tiles manufactured from up to 82% recycled content, the system is designed to create ceiling "clouds" for acoustically-challenged or exposed structure spaces, such as reception areas, work stations and meeting areas within open spaces in office, retail, education and healthcare applications.

Specified either at initial design stage or as a quick-fix refurbishment solution, the Axiom canopies help to reduce reverberation time and noise levels and increase speech intelligibility. They also allow specifiers to play with different planes and levels to conceal and co-ordinate with services.

For more details go to **www.armstrong.co.uk**

The latest addition to the Axiom Classic range

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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. Members are reminded that only Sponsor Members are entitled to use the IOA logo in their publications, whether paper or electronic (including web pages).

Committee meetings 2012

DAY	DATE	TIME	MEETING
Wednesday	12 September	10.30	Membership
Thursday	13 September	11.00	Executive
Thursday	27 September	11.00	Council
Monday	1 October	11.00	Research Co-ordination
Thursday	4 October	10.30	Diploma Tutors and Examiners
Thursday	4 October	1.30	Education
Thursday	11 October	10.30	Engineering Division
Thursday	18 October	11.00	Publications
Tuesday	23 October	10.30	Membership
Tuesday	6 November	10.30	ASBA Examiners
Tuesday	6 November	1.30	ASBA Committee
Thursday	8 November	11.30	Meetings
Thursday	15 November	11.00	Executive
Wednesday	21 November	10.30	CCENM Examiners
Wednesday	21 November	1.30	CCENM Committee
Tuesday	4 December	10.30	CCWPNRA Examiners
Tuesday	4 December	1.30	CCWPNRA Committee
Thursday	6 December	11.00	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.

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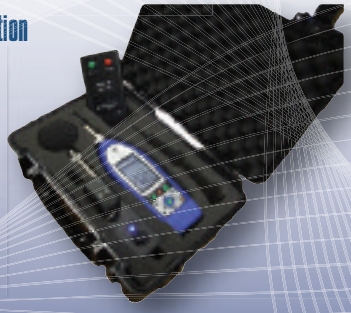
- Very easy and intuitive to use

RION NL-52 A Complete Solution for Environmental Noise Measurement

- L_{Aeq}, L_{Amax}, L_{Amin}, SEL & 5 Statistical Indices
- 100 msec data logged simultaneously with processed values
- Uncompressed audio recording NX-42WR (option)
  - Continuous
  - Manual start /stop
  - Triggered by up to 4 user selected levels (different triggers for different times)
  - Periodic samples (including 2 minutes – perfect for windfarm compliance)
- Real time octaves/third octaves NX-42RT (option)
  - Full logging functionality maintained but in octaves or third octaves
- Narrow band FFT analysis NX-42FT (option)
  - 8000 line FFT up to 20 kHz (2.5 Hz resolution)

NNR-03 Noise Nuisance Recorder Quicker, Better and Easier – A More Professional Solution



- Uncompressed WAV files - superb audio quality
- Up to 1 minute pre-trigger
- Simply drag and drop data into the new and intuitive Rion AS-60 software
- Extremely easy to use
- Outer pilot case for discrete deployment
- Handset with illuminated buttons clearly shows when audio is recording
- Wireless remote (up to 50 metres) included as standard

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