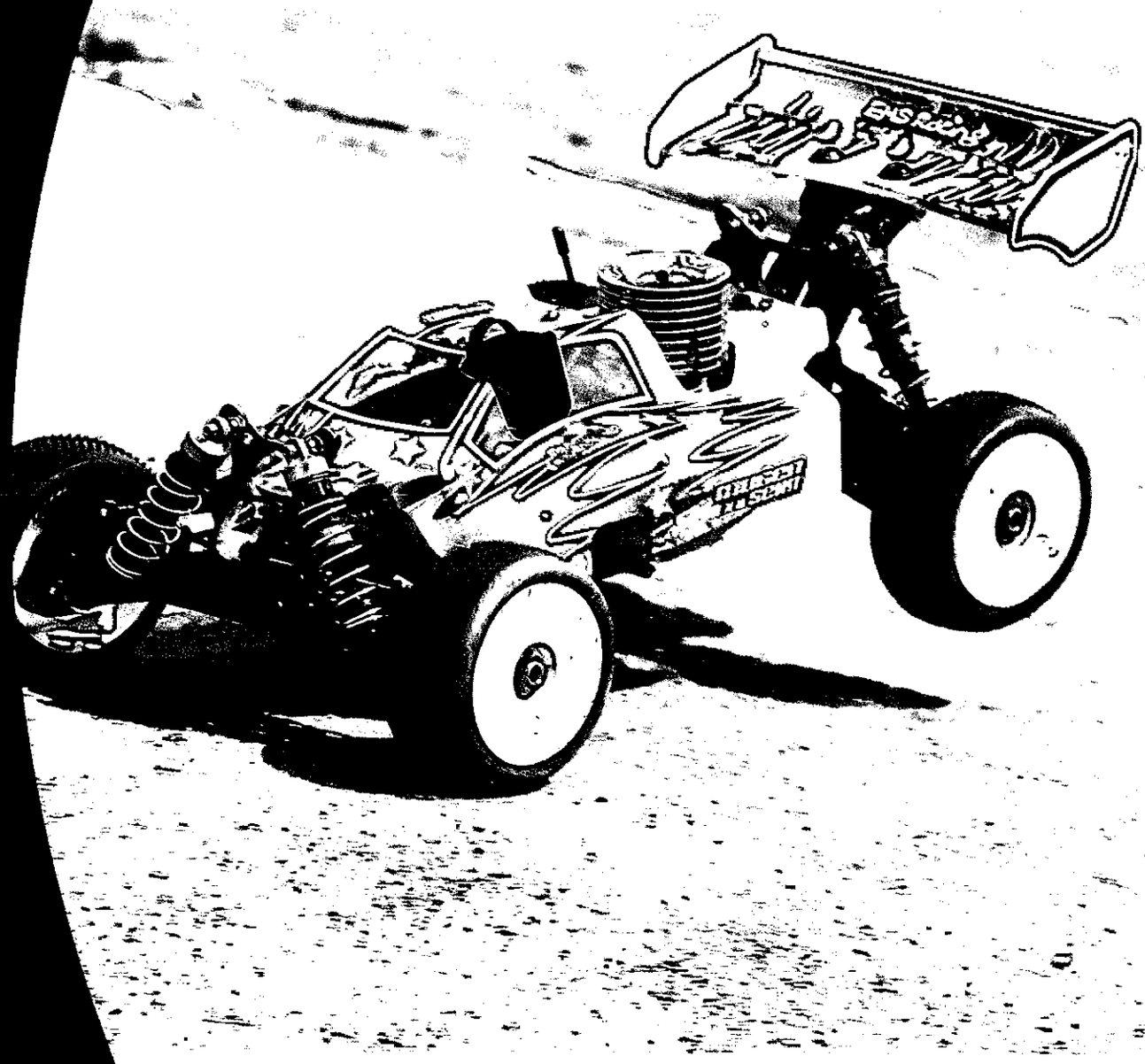
Vol 38 No 5 September/October 2013

ACOUSTICS BULLETIN



in this issue... **Noise from radio-controlled rallycross buggies**

plus... **Golden memories as ISVR celebrates its 50th anniversary**
Noise in the printing industry: then and now
Is this the world's quietest wind turbine?

Institute of Acoustics

MATRON Live – The first web-based neighbour noise nuisance monitor

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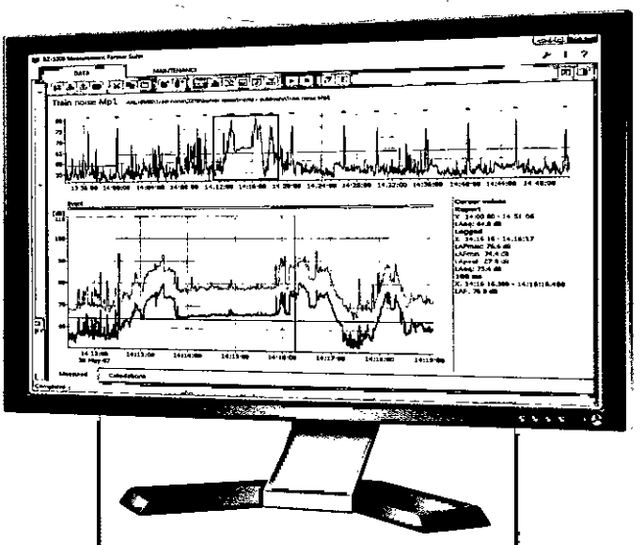

MATRON Live

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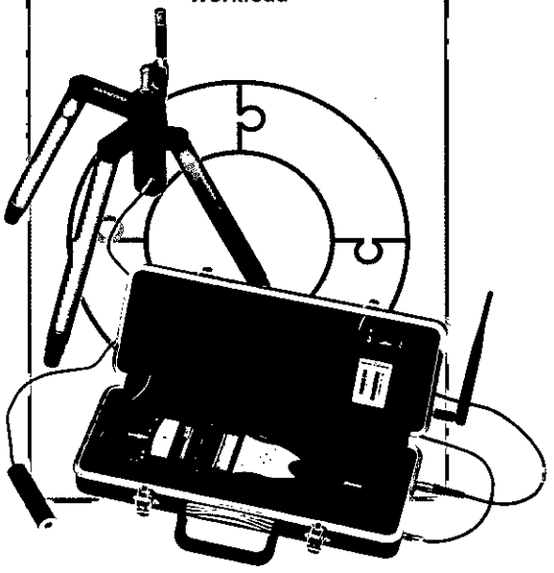

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25 September 2013
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Uncertainty in the measurement, prediction and assessment of noise
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29 October 2013
Organised by the
Environmental Noise Group
The Wilson Report – 50 years on
London

12-14 November 2013
Organised by the
Electro-acoustics Group
Reproduced Sound 2013
Manchester

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

Dear Members

There seems to be quite a lot happening in the IOA at the moment – hopefully for the good of the Institute! Those of you on standing committees will by now be aware of slight changes we are making to the way they operate. This is in response to various observations and comments by both Council and members in recent years, and is in line with priorities agreed at the strategy meeting last spring. The overall aims are to allow the IOA to operate more efficiently and to be able to plan better for its financial future. We hope to improve the communication between committees and Council, particularly where a decision by Council is required, so that any actions and decisions can be speeded up and their financial implications considered and monitored. The standing committees, groups and branches are the lifeblood of the Institute – without them the IOA would cease to function – and the time, commitment and hard work put in by committee members is very much appreciated. Hopefully, in the long term, the proposed changes will make their work easier and make them feel more involved with Council and with decision making. As usual when any changes are introduced, I would welcome feedback from members. And of course we are always keen to get new people involved in committees, so if any of you would like to join a standing, group or branch committee please let me or the committee chair know so that you can be considered at their next AGM.

Talking of groups and branches, I am delighted at the rejuvenation of the Musical Acoustics Group. After a few relatively quiet years the group organised a very enjoyable and interesting meeting in July, as reported elsewhere in this Bulletin. A new committee has been formed, which is coming up with lots of ideas for future meetings, and is also making useful links with other organisations. Many thanks go to Mike Wright and his colleagues for their enthusiasm and persistence in getting the group up and running again. The group has also launched an e-newsletter, *MAG-MAG*. If you would be interested in joining MAG and/or receiving *MAG-MAG* then contact Mike.

Plans are progressing for our 40th anniversary celebrations next year. The main event will be a large, multi-session, all group conference in the autumn. I am delighted that we have so far arranged for two "star" speakers to give plenary lectures – Leo Beranek and Herman Steeneken. The conference will take place shortly after Leo's 100th birthday so we can look forward to celebrating that with him too! In the meantime you can all start thinking about what papers you will be presenting...

Something else I would like you to start thinking about now is nominations for the 2014 IOA awards. The Medals and Awards Committee meets every February, with a closing date for nominations in mid-January, so do look at the IOA website to see what awards are to be given next year. If you think someone is worthy of an award then please submit a nomination form – it is never too early to nominate someone.

We have recently had this year's AGM, and welcome Hilary Notley as a new Council member. Again it is never too early to start thinking about putting yourself forward for Council. We are always keen to get fresh faces, and to have a good cross section of members on Council, so if you are interested have a look at what is involved in being nominated. If you want more information on the roles and responsibilities of Council members please contact me or another member of Council to discuss it.

In the meantime I look forward to meeting lots of you at the many interesting meetings and conferences taking place this autumn. ◘

Bridget

Bridget Shield, President

Acoustic challenges in quires and places where they sing

By Mike Wright, Chairman of the Musical Acoustics Group

The well-known expression "It'll be all right on the day" held its promise for the meeting held by the Musical Acoustics Group (MAG) in London in July. *Acoustic challenges in quires and places where they sing* was the first one-day meeting for five years and, with almost 30 delegates attending, it brought back to life a specialist group that had been more or less dormant. The title of the meeting, appropriately cribbed by Chris Turner, a strong supporter of the group, was taken from the beginning of a rubric found in the 1559 prayer book of Elizabeth 1. Delegates included representatives from teaching, research, consultancy and musical performance sectors. This was an encouraging start to reviving the MAG's fortunes.

As a starter, IOA President, Bridget Shield stepped in to the breach to present a paper on behalf of Stephen Dance (London South Bank University) who was unable to attend. This described how music and acoustics should be working together and was in collaboration with Stephen's research with the Royal Academy of Music and the London Philharmonic Orchestra. It dealt with the need to educate musicians on acoustical issues, taking into account such matters as noise awareness in health and safety, cultural sensitivity, theatre design and solutions etc. The presentation concluded by outlining future work that was needed with an emphasis on vocalists, stresses involved and the need for collaboration with colleges and professional musicians.

Raf Orlowski, from Ramboll Acoustics, related the interaction between music, acoustics, and architecture in renaissance churches in Venice. His study looked into how 16th and 17th century architects such as Jacopo d'Antonio Sansovino (1486 –1570) and Andrea Palladio (1508–1580) considered acoustic needs for the new churches being built in Venice. This was at the time of Flemish-born composer Adrian Willaert (c 1490 –1562, who later became maestro di cappella of St. Mark's at Venice and considered founder of the Venetian School), and Italian-born composers Giovanni Gabrieli c1554-1612), Andrea Gabrieli (c1533 –1585) and Claudio Montiverdi (1567–1643), who were pioneers of the development of large scale polyphonic choral music. He concluded that there was strong evidence of collaboration. As an example, Sansovino specified flat ceilings in naves of churches – good for speech – and vaulted ceiling for music. Palladio favoured very reverberant churches that were acoustically good for festivals.

John O'Keefe, Aercoustics Engineering, Canada, shared with the delegates a study of choral singers and perceptions of auditorium acoustics. He explained the difficulties and limitations posed in the past by limited computing power in calculating acoustics from curved forms in large buildings. He then introduced non-uniform rational basis spline (NURBS) in order to show some explanations that were often difficult to understand. NURBS is a mathematical computer modelling process using graphics for representing curves and surfaces in buildings. He cited studies undertaken in buildings with curved surfaces. This included his own local church in Canada and examples such as the Wigmore Hall and St. Paul's Cathedral in London.

Investigating singing performance in different acoustic environments in the virtual singing studio was a good follow up by Shane Sugrue. He was recently awarded the Newman medal from the Acoustical Society of America for his comparative study of singing and space, taking account of perceptions along with predictions and analysis of acoustic measurements in three different types of auditorium. His ambitious project undertook questionnaire studies at concert halls, churches and theatres in four countries.

During lunch, Bridget Shield presented the 2013 Award for Promoting Acoustics to the Public to Gianluca Memoli. See page opposite for full details.

Mike Barron, of Flemming and Barron, held a lively post lunch session discussing the well-known problems associated with concerts of unamplified music in cathedral-type spaces. He reminded delegates that the basic issues were the lack of clarity associated with long reverberation times. He took the group through the interesting case study of Bath Abbey which had a pretty generous Rt – 4.5 seconds unoccupied, 3.9 seconds occupied in a volume of over 23,000 m². This was long known to be problematic for musical festivals held there. He demonstrated various possible solutions such as covering the pews with drapes to increase absorption, raising the orchestra platform, moving the stage in various positions, electronic assistance and introducing reflectors. He concluded by suggesting that only suspended reflectors would really improve subjective clarity.


Delegates tune in to a session

Jude Brereton, University of York, investigated singing performance in different acoustic environments using the Virtual Singing Studio (VSS). She considered the problems and solutions of auralisation and investigated conditions by detaching performance from room acoustics. She found that VSS gives good results in terms of matching real and VSS venues where T30 values were generally acceptable across seven octave bands with some errors explained. She concluded with a listener performance test comparing real and VSS, and the audience noted the difference, despite the limitations of the acoustics in Friends House (the meeting venue) and the sound system which seemed to be interacting with the hearing loop in the building!

The Musical Acoustics Group held its first AGM since 2008 during afternoon tea.

That well-known problem of intonation drift frequently encountered in a cappella choral music was explained by David M Howard, University of York. He noted that when an SATB quartet sings a capella, it is not tied to fixed pitched instruments and performs in non-equal temperament. As a result, its pitch centre can drift. When the music modulates away from the starting key and back again later in the piece, the starting and ending keys (usually the same) will not be in tune with each other if the overall pitch has shifted. The fundamental frequencies for each singer were derived from the results of analysis of data from electrolaryngographs attached to each performer. These are a cumbersome looking device for the non-invasive measurement of the time variation of the degree of contact between the vibrating vocal folds during voice production. Surprisingly, he found that conductors and choral leaders were rather unaware of this effect or its reasons. This was a clear case for acousticians to enlighten others about this common age old problem.

To round off the session and further test the sound system, Christopher Stanbury, University of West London, illustrated 21st Century organ technology, investigating the growth in popularity of "hybrid" instruments. These are traditional pipe organs incorporating an enlarged, digital system into their specification. These are termed a "virtual organ" and have become increasingly common over the last decade. This is due to significant cost savings over more traditionally built organs and because they offer greater flexibility in tonal design. He showed that a virtual organ can offer similar artistic and aesthetic qualities as a traditional pipe organ and possibilities that the two technologies be successfully amalgamated. He outlined the process of augmenting the specification of a pre-existing pipe organ with a Hauptwerk computer-based virtual organ, referring to case studies of recent installations in Sussex. ◘

Gianluca Memoli wins 2013 Promotion of Acoustics to the Public award

Dr Gianluca Memoli has won this year's IOA award for the Promotion of Acoustics to the Public for his extensive efforts and activities in communicating science, in particular acoustics, to the public.

Bridget Shield, IOA President, writes: "Gianluca, who is with the Acoustics Group at the National Physical Laboratory, came to the UK from Italy in 2006. He studied physics at the University of Pisa for his first degree, following which he did a PhD in bubble dynamics and a diploma in acoustics. He then worked with Tuscany's Environmental Protection Agency (ARPAT), before taking up a postdoctoral position at Imperial College. Gianluca joined NPL (and the IOA) in 2008. It was while he was at Imperial College that he first became involved in outreach activities, using aspects of his own research in soundscapes and ultrasound to enthuse and inform school children, students and the general public.

"Between 2007 and 2010 he communicated ideas in sound and acoustics to more than 800 UK students a year, through lectures, school demonstrations, science festivals and work experiences. He presented to the House of Commons in 2009 as part of SET for Britain and contributed to programmes on Swiss Radio and BBC Radio Scotland.

"In addition to lectures at NPL and the Cambridge Physics Centre, Gianluca has given Christmas lectures at the Open University and the Kent Physics Centre. He is also a STEM ambassador and contributes to school careers fairs and teacher training sessions, explaining what it means to be a scientist and an acoustician.

"In 2012 Gianluca led a team of scientists from NPL, UCL and Oxford University in designing and presenting a stand ("POP! The Sound of Bubbles") at the Royal Society Summer Exhibition, which attracted around 8,000 visitors of all ages and experience, who voted the stand as one of the best in the exhibition. Gianluca produced an associated blog (bubble-sounds.tumblr.com) and was interviewed by video for the TES teachers' network. Gianluca's work also featured on Radio 4's *Material World* and on BBC-online, and has an increasing presence on YouTube.


Gianluca Memoli receives his award from Bridget Shield

"Recent and current activities include two TEDx lectures, a Café Scientifique in Salisbury and participation in the Big Bang fair, which attracted more than 60,000 visitors in March this year.

"Gianluca is a passionate and enthusiastic scientist and acoustician. He is fascinated by all applications of sound and claimed in his TES interview that being a scientist is 'being in love all the time'. His infectious enthusiasm and his ability to tell a story that allows a listener to easily relate every day experience to science, enhance his public communication skills. The Institute thanks him for all his efforts in communicating acoustics to the public and is delighted to present him with the 2013 award." ◘

Jacques Guigné wins the IOA's Rayleigh Medal for 2013

Jacques Guigné is the winner of this year's Rayleigh Medal, the Institute's premier award, which is given to "people of undoubted renown for outstanding contributions to acoustics". Jacques was presented with the award by Bridget Shield, IOA President, at the 1st International Conference on Underwater Acoustics, which was held in Corfu in June. Below is her citation.

Jacques Guigné's interests and accomplishments in acoustics are remarkable in that they span from the deep seismic, to the shallow ocean and out into space. His approach has always been driven by application and underpinned at all stages by his many peer-reviewed publications.

From concepts and science, Jacques has created the necessary R&D company base structure to take forward the supporting technology necessary for the realisation of his ideas. The approach of underpinning by peer review has been the foundation for his success in establishing credibility and reputation for the funding support needed. The finance required for the projects outlined below is very considerable and is measured in many tens of millions of dollars. This has made acoustics visible to the society far outside the narrow world of university laboratories and will inspire younger generations to consider acoustics as a basis of their future employment. For example, the acoustic levitation and control device now operational on the International Space Station, shows that acoustics can be at the cutting edge of science.


Jacques Guigné receives his award from Bridget Shield

Following graduation from the University of Winnipeg in 1975 Jacques took several advanced courses at the Universities of Idaho, Birmingham and Wales, specialising in geophysics with emphasis on acoustics. In 1986 he was awarded a PhD from the University of Bath. He worked in the geophysics industry in Newfoundland and in 1989 he created the Guigné Group of companies. Currently he is President of Intelligent Sciences, and of Acoustic Zoom, and also holds the post of Chief Scientific Officer at Pan Geo.

Out of a rich career in acoustics, four major achievements will be outlined here. Each one is major in its impact on science, in its foundation in peer review and not least in the significant technological base required to deliver practical realisations. In all, PB1

P7 acoustics is at the heart of cutting edge science.

First is the ambitious project which has placed a highly sophisticated acoustic levitation capability aboard the International Space Station. The acceptance of the system by NASA as a payload for the Shuttle is extraordinary by any standard and in itself points to a remarkable "one man mission" over several years. The so-called Space-DRUMS is currently in place on the International Space Station and its operation is controlled by Jacques through a ground station in St Johns, Newfoundland

Second is an acoustic system placed on the seabed for the production of what is termed an acoustic core. Its prime focus is on providing for a rapid, high resolution look into the seabed for geo-hazards in a limited area to a depth of 50m, for the placement of foundations of rigs and wind generators. The methodology is now providing the missing spatial geotechnical information that fuses conventional geophysical data sets with traditional borehole and geotechnical investigations.

Third is an acoustic approach to quantify the health of the seabed, initiated in response to the catastrophic collapse around 1993 of the Northern Cod stocks, which for centuries was the most plentiful fish stock in the world. The significance of the approach is that it does not attempt to count the fauna and flora living in the seabed as evidence of health, but rather it quantifies statistically through the use of very high resolution acoustic sensing of the internal ratio of fabric to structure of the seabed that constitutes a healthy sediment. The publications of this work are regarded as seminal and are heavily referenced.

Fourth is a transformative departure to current seismic surveying protocols using a new method, called the Acoustic Zoom, adapted from sonar applications, that enables high resolution imaging of geological structures using beam-formed and beam-steered seismic signals. The value proposition is that it can deliver very high resolution seismic images at targeted unconventional reservoir zones through the strategic and localised placement of a specially designed, stationary star-array receiver pattern that can beam-form and steer at reservoir depths to deliver high-frequency subsurface imagery. This has never been done before and is deemed to be a scientific first and a game changer in the field of seismic acquisition and processing.

It is with pleasure that the Institute of Acoustics presents Jacques Guigné with the Rayleigh Medal for his significant and outstanding contributions to the application of acoustics over such a disparate range of fields. ◘

Trials and tribulations of overcoming acoustic challenges – 'It should never happen to an acoustician!'

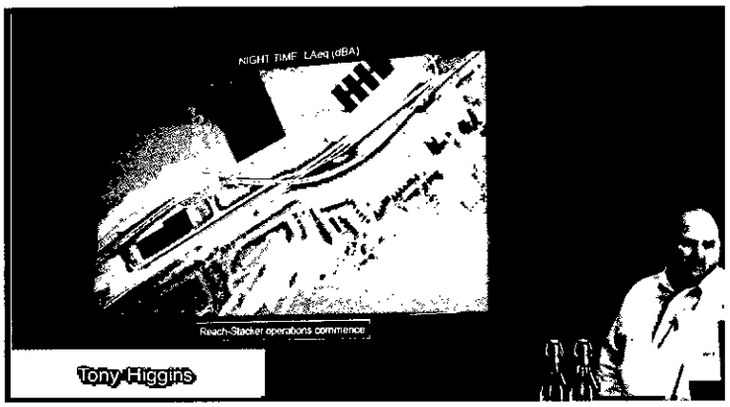
Report by Richard Tyler

A beautiful sunny day heralded the start of a varied meeting at the Royal Society, London, covering acoustic challenges from more than 50 years ago to the present day and ongoing. Organised by the Measurement and Instrumentation Group, it was chaired by IOA President-Elect William Egan.

The first speaker was Joe Bear (Adrian James Acoustics), whose presentation entitled Moveable goalposts was a review of on-site performance of operable walls and folding partitions. Joe identified common technical problems, such as sealing, incorrect installation and manufacturer's specifications not being accurate, but also that the real requirements of customers were often significantly different from the stated requirements prior to installation. As so often, earlier involvement of acousticians in the building design was found lacking, and expectations of sound reduction unrealistically high. He concluded by suggesting that a $D_{nT,w}$ >40 dB was in most cases unrealistic.

David Watts (AIRO) then described four cases where making any meaningful measurements was a challenge. Testing a jet engine at 2.6m and a temperature of 44°C, with levels >150 dB was solved with special attenuators over the microphone capsule and a cool cloth over the sound level meter display, whilst measuring the noise of a significant quantity of stage lighting required attendance at 3am in a reverberation chamber to get background levels low enough, and verifying correct measurements, especially where the extremes of the audio spectrum and beyond were involved, were all described with "one-off" solutions.

Jon Tofts (Environment Agency) expanded on The *Trials and tribulations of environmental noise monitoring.* The agency is mainly interested in large industrial sites, e.g. refineries, landfills and scrap yards, and often monitors for lengthy periods. Jon cited problems from animals (chickens near microphone site startled by noise being measured, dogs peeing over the equipment left on "their territory"), as well as the difficulties in getting equipment to suitable measurement positions e.g. chimney stacks, exhaust outlets, and the problems of weather, especially heavy rain at the



end of the measuring interval (he recommends keeping the equipment running in its enclosure until it can be opened up in a sheltered location for the final calibration check to avoid getting it wet in the field).

Geoff Kerry (University of Salford) took a much longer-term look at the testing he had been involved in during *50 years of acoustic field trials and their tribulations,* including trying to measure the effects of sonic booms from Concorde on historic buildings when pilots didn't make their trial runs when expected and long-range sound propagation tests with much varied equipment outdoors, needing many people to co-ordinate the measuring process in unpredictable weather.

Continuing the longer-term aspect, Graham Parry (ACCON UK) asked *40 years on – so has anything changed for the good?* Examples of the type of equipment in use 40 years ago were compared with today's offerings, showing how much smaller and lighter equipment had become. He thought this trend was now starting to reverse, and how software had become an important factor, especially when longer-term requirements exist, as it was often tied in with specific personnel who were not always available for this longer term. Predictions and validation P10

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P8 attempts were discussed, with tips like: do not measure ground vibration when the soil is frozen and heaters on microphones to prevent condensation.

The final presentation from Tony Higgins (Borough of Telford and Wrekin), co-authored by Giles Parker of Sound Barrier Solutions, was much more up to date in that the *Rail Freight Blues* of the title had yet to materialise. A planned rail freight terminal was proposed and remedial action in the form of sound barriers of various sorts were installed prior to the development of the site, making the noise climate quieter than what had previously existed. As the terminal is now on hold, should it ever start operating fully, the expected noise levels will be similar to those before the barriers were erected. But in the intervening time, people will have got used to the quieter environment, and noise complaints are being anticipated should it start operating.

A presentation from Anne Budd was missing, as she was unable to attend at the last minute, but during the day the Measurement and Instrumentation Group held its AGM and Bridget Shield presented the IOA Prize for the best Diploma student 2011-2012 to Gary Wickens (see page 12)

Delegates enjoy the impressive surroundings of the Royal Society

It was a varied day of useful information and anecdotes that made for interesting listening. ◘

Notes from the ICA/ASA/CAA meeting in Montreal

By Keith Attenborough

The 21st International Congress on Acoustics, 165th meeting of the Acoustical Society of America and 52nd meeting of the Canadian Acoustical Association was held at the Palais des Congrès de Montreal in June. Many IOA members were among the 2,300 delegates, including Keith Attenborough, Murray Campbell, Trevor Cox, Steve Dance, Tim Leighton, Yui Lam and Olga Umnova.

Murray Campbell gave an excellent plenary lecture, *Objective evaluation of musical instrument quality: A grand challenge in Musical Acoustics*, which he illustrated by a few blasts on a plastic trombone which would certainly have wakened any "sleeping" listeners soon after 8 a.m. on the fourth day.

Tim Leighton received the Helmholtz-Rayleigh Interdisciplinary Silver Medal of the Acoustical Society of America "for contributions to physical acoustics, biomedical ultrasound, sonochemistry and acoustical oceanography". In keeping with this multi-disciplinarity, Tim gave two papers *A new approach to ultrasonic cleaning* [see *Acoustics Bulletin* January/February 2013 p.10] and *Use of dolphin-like pulses to enhance target discrimination and reduce clutter*. The first of these presentations consisted of a series of spectacular video-demonstrations of the efficacy of the technique until the audience demanded to know how it worked!

At the medal awards ceremony, another British acoustician, Eleanor Stride from the University of Oxford, received the R Bruce Lindsay award "for contributions to biomedical applications of bubbles". The award is given annually to a member of the society who is under 35 years "who, during a period of two or more years immediately preceding the award, has been active in the affairs of the Society [ASA] and has contributed substantially through published papers, to the advancement of theoretical or applied acoustics, or both".

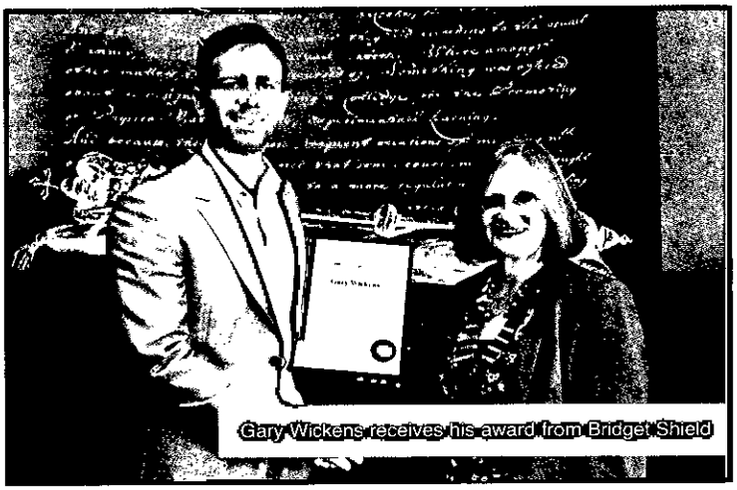
According to the conference programme [J. Acoust. Soc. Am. 133 May 2013], two IOA members (Keith Attenborough and Paul Darlington) will be receiving 'Twenty-Five Year Awards' from the Acoustical Society of America in the form of "Silver" certificates "in recognition of the mutual advantages derived from their long term association with the Society".

A session organised jointly by the ASA Architectural Acoustics and Noise Technical Committees was entitled *Dah-You Maa – His Contributions and Life in Acoustics*" and included 12 invited papers. Dah-You Maa (better known in the UK as Maa Dah-You) is often considered the "father of acoustics" in China and had a long association with the Acoustical Society of America stemming from periods at UCLA and Harvard (where he received his PhD in 1940). It featured presentations from Leo Beranek (his friend for 65 years), Jing Tian (the current director of research at the Institute of Acoustics of the Chinese Academy of Sciences – founded by Dah-You Maa), David Blackstock, Richard Lyon (this had to be presented *in loco* by the Co-Chair Ning Xiang since Richard was unable to attend on medical advice), Jiqing Wang, Christian Nocke, Keith Attenborough, Jie Pan, Jiancheng Tao, Jiri Tichy and Buye Xu. In his presentation Keith Attenborough admitted that he had never had the good fortune to meet Dah-You Maa but had chosen to talk about a link between his own research and that of Dah-You Maa viz. surface waves over slitted (micro-perforated) surfaces.

Many of the more noise-conscious delegates will have been relieved to exit Montreal before the Formula One Grand Prix shenanigans began the day after the conference closed. ◘

The speakers who paid tribute to Dah-You Maa

Model student Gary receives IOA Diploma prize


Gary Wickens receives his award from Bridget Shield

Gary Wickens, the winner of the 2012 IOA Diploma in Acoustics and Noise Control prize, was presented with his award by President Bridget Shield at the Institute's *Trials and tribulations of overcoming acoustic challenges* conference in London in June (see page 8).

In achieving merits in all three written papers, laboratory module and project (measurement and analysis of noise and vibration impacts of speed humps), he achieved the highest average mark of all students.

After graduating from the University of Plymouth with a first class honours degree in geography, he obtained an MSc with a distinction from the university in sustainable environmental management.

Since 2011 Gary, aged 27, has been working as a consultant for Southdowns Environment through its Lewes and London offices on the prediction, monitoring and management of acoustic and air quality impacts for various major projects. These include City tower blocks, Crossrail and a major international airport in the Middle East.

His associated interests include the on-going development and management of integrated monitoring systems for environmental noise, vibration and dust monitoring. ◘

Reverberation time measurements in performance spaces

South West Branch event

Report by David O'Neill

On a sunny Wednesday afternoon a group of IOA members representing the fields of consultancy, local authority, instrumentation and the audio system world roamed the streets of Bristol brandishing sound level meters and ear defenders. Their task? To perform reverberation time measurements in a series of very different performance venues. First was St George's, Bristol, a former church seating 562 with a reputation for an excellent natural acoustic. We were treated to a couple of short pieces by Grieg and Schumann performed by Gavin Irvine on the shiny big black Steinway Grand to give us a feel for the acoustic of the space before carrying out the traditional acoustician's hand clap estimate of the RT. Measurements using the impulse response method from BS EN ISO 3382: 2009 were made using a 0.22 blank firing gun dog training target launcher (target not included!) as well as some balloon bursts for a comparison. There was a good cross-section of meter types, along with a couple of smart phone apps being used in parallel. We are awaiting collation of all the results, but the mid-frequency mean rev time (500/1kHz) from initial findings was around 2.0 sec.

Next was the O2 Academy, a former cinema below a former ice rink, now used as a touring band amplified music venue as well as night club. The 1,600 capacity venue has a large volume with a deceptively low rev time which foiled the attendees' initial hand clap estimates; everyone over-estimated the rev time, some by up to 0.8sec. Balloon bursts could not generate enough energy in this space, so measurements were all made with the target launcher. The mid frequency mean was around 1.1 sec. Clear differences between the two spaces in speech clarity from the stage were observed, with some minor difficulties in intelligibility at the livelier St George's. By the same token the speech effort required to project to the room in St George's was noticeably less than at the O2 Academy, where plenty of vocal effort was required to reach the rear of the upper balcony.


Branch members prepare for testing at St George's

Then we moved to a far smaller and more intimate, but well regarded, venue at St Bonaventure's Parish Club in Bishopston (capacity 150-200). This room is essentially the local Roman Catholic club bar, but hosts regular gig nights, mainly from highly respected Americana touring acts. In this much smaller space the 0.22 blanks generated too many overloads and balloons were used as the main source. The rev time estimates were much closer to the measured mid-frequency mean of 0.5 sec. Further analysis of the results will be carried out once the data is in.

The branch AGM and social was then held in the Bristol Flyer, where Dan Pope of WS Atkins was elected the new chairman, David O'Neill of Ion Acoustics the secretary and Andrew Rickard of Mach Acoustics the young person's representative.

Thanks are due to Louise Orchard and her team at St George's, Matt Royston-Bishop at the O2 Academy and Stu and Cherie from Touch PA for giving us access to these venues. ◘

Midlands Branch meetings

Reports by Kevin Howell

Sounds familiar? English accents and dialects at the British Library

The Midlands Branch Committee's continuing commitment to provide its members with presentations across a wide range of topics was epitomised by that on offer at their June and July meetings.

In June at the Arup Campus in Solihull, Jonnie Robinson, Lead Curator of Sociolinguistics and Education at the British Library, gave a fascinating talk entitled *Sounds familiar? English accents and dialects at the British Library.* He began by describing the huge extent of the library's collections which include 150 million items stored on 625 km of shelving, which grows by 12km/year (3 million new items), covering everything from books and newspapers to photographs and paintings, and includes sound and vision recordings in various formats from wax cylinders onwards. Jonnie's talk focussed on accents and dialects and was illustrated using recordings dating back to 1916. He described the concept of "received pronunciation" (RP) and illustrated this with an example of a document published by the BBC in 1928 describing the correct pronunciation for "Broadcast English", and with recordings showing examples of BBC English, conservative RP and mainstream RP. He then described various linguistic surveys that were conducted in the 20th century and played recordings of different accents and dialects and also examples of how these were carried over into popular culture with examples of Cockney, London, Patwa and Sheffield accents, with current examples including Lily Allen and the Arctic Monkeys. Jonnie had gone to some trouble to include a section in his talk looking at the variety of local Midland accents, and this was much appreciated. He made reference to the various BL collections including Voices of the UK which includes examples of lexical, phonological and grammatical variations and is available to all at the library. Further collections are in development including some through partnerships and collaborative research with other bodies. Thanks go to Jonnie for this excellent, amusing presentation enhanced by his expert mimicry of some of the accents he discussed. Thank you also to Arup once again for providing their excellent facilities.

Groundborne noise and vibration from tunnel boring

In July at Atkins in Birmingham, Colin Cobbing and Andrew Bird, of ARM Acoustics, gave a presentation on behalf of Crossrail entitled *Groundborne noise and vibration from tunnel boring.* The presentation began with a fine example of ad-libbing by Colin as the laptop suddenly decided to do its own thing. When order was restored we were treated to a fine presentation which began with a comprehensive description of the Crossrail project itself. Europe's largest infrastructure project, costing £15 billion, it will create 42km of new 6.2m diameter tunnels and 37 new stations, of which eight are sub-surface. The route goes below some of central London's most sensitive receptors including recording studios, theatres, auditoria and schools and weaves between underground lines, sewers, utility tunnels and building foundations at depths between 15m and 40m.The immense scale and complexity of the project was clearly demonstrated, as well as that of the tunnel boring machines (TBMs) themselves which are each some 148m long and weigh 980 tonnes. Colin then described the stringent environmental commitments made in the Crossrail Act 2008, and its associated codes and memoranda, in relation to groundborne noise and vibration. The main vibration sources of concern are the TBM themselves with both the cutter forces and the thrusting forces (which push the TBM forward), and also the narrow gauge (900mm) temporary construction railway which carries supplies to the TBMs, which was itself the subject of very demanding P14

◀P13 design analysis. Noise and vibration monitoring has been carried out at three surface locations and two in-tunnel locations to assess the impact of these sources, and some very interesting data were presented. For the TBM operation there was no perceptible vibration on the surface. Cutter operations were not audible but the 'thrusting' operation was just audible when the operation was directly below the listening position, and only when backgrounds were low. If audible at all then this would only be the case for less than one day. For construction train movements monitoring was carried out inside two residential premises. These movements were audible at levels in the range 30-35dB $L_{Amax,s}$. However, this was 5-10 dB below that for the passage of trains on the Central Line. Vibration levels were significantly lower than for the Central Line trains. The presentation concluded that Crossrail and its contractors have acted with determination and fully met all of the assurances, agreements and commitments. The designs and operational practices ensured that construction trains are barely noticeable. There has been very little, if not negligible, adverse comment relative to the scale of the operations and the work completed to date. Many thanks go to Colin and Andrew for this excellent presentation and to Atkins for once again providing our venue.

Replacement of BB93

Eastern Branch meeting

Report by Martin Jones

In this well attended talk at Hemingford Abbots golf complex, Andy Parkin of Cundall Acoustics set out the history of the guidance on schools and outlined the key factors which have led to the amendments to a document we in consultancies know all too well.

Moving through PFI, BSF, Academies and Free Schools, we arrived at the main topic of the talk which was the new guidance written collaboratively by the ANC and IOA for the Priority Schools Building Programme (PSBP), which is "the next big thing" for education development. The PSBP output specification is the biggest shake up in the way school buildings are designed since the launch of BB93 as part of the Building Regulations in 2003.

The new PSBP output spec has gone through a number of incarnations and version 1.7 is due out for consultation later this year. The new document has learnt the lessons that we've all come up against using BB93 over the years, sets straight some of the foibles of the old document and gives an important shot of common sense to school design, while retaining the importance of the acoustician in the process. One key addition is the introduction of the "exceptions" to the project criteria, which overcome the most common needs for alternative performance standards in the school projects we all handle currently. The definition of SEN use in schools was also significantly widened to include learning and communication difficulties, which is an undoubtedly positive change.

The designs promote the use of thermal mass providing coolth in the warmer months; therefore exposed concrete soffits are expected to be the system of choice in new schemes. This, in turn, promotes a raft reverberation time solution, removing ceilings and ceiling baffles to allow clean air flow across the classrooms.

The meeting benefited from a keen Q and A session as so many of the attendees deal with the intricacies of BB93 on a daily basis. The discussion threw up some interesting points and also challenged the baseline designs, which, at first glance, appear to be addressing many common issues to avoid reinventing the wheel. But, on closer inspection, they make quite significant assumptions as to a site's suitability. These question marks particularly apply to the external ambient noise level. The baseline designs were found to be unable to achieve the target cost of £1,100 per m2 set out by the Education Funding Agency, even in conditions where external noise and ground conditions are perfect. Therefore this price can only go one way where anything other than silent external noise conditions, contaminated land or unstable foundation conditions exist. It's fair to conclude that the baseline designs definitely do not rule out site specific acoustics advice, which is good to see.

In August Kieran Gayler of Sharps Redmore addressed branch members on noise from nitro-fuelled radio-controlled buggies. Full details of his talk can be found on page 30.

We have a varied and full diary of meetings for the rest of the year and it would be great to see more of the many local organisations sporting many IOA members represented at future meetings; the talks are highly rewarding and often give expert opinion on matters from a different viewpoint to your own.

Designing voice alarm systems for underground stations

London Branch meeting

Report by Alan Bloomfield

This year marks the 150th anniversary of the opening of the world's first underground railway, a section of the London Underground Metropolitan line. So it was appropriate that at the June meeting of the London Branch, Luis Gomez-Agustina of London South Bank University gave a talk on *Designing voice alarm systems for underground stations* to about 40 attendees.

Voice Alarm systems (VAs) are a crucial part of the communication and emergency network in underground stations. But according to Luis, fully adequate speech intelligibility from VAs in those spaces is often not attained. From recent research it appears that the relevant literature is scarce and that the vital role of these systems is underrated. Luis outlined the factors involved in VA design and performance, the measurement and prediction methodologies, performance specifications and the research carried out to date. He concluded by suggesting design solutions and recommendations for improving the intelligibility of VAs on deep tube platforms, where the acoustic challenges are greatest.

VAs are similar to public address systems in that they involve a distributed sound system, but VAs are linked to the fire alarm and emergency systems and so can be activated automatically. They give announcements (automated or live) to aid safe evacuation in emergencies, crowd management and safety warnings (such as the famous "mind the gap please") and can also be used to provide travel information. They are more effective in emergencies than simple warning tones because they can convey complex messages. The obvious key point is that to be effective, VAs must be clearly intelligible under all circumstances.

Key factors affecting intelligibility are the shape of the space and its volume (which cannot be changed); the reverberation time (difficult to alter in practice); background noise (also difficult to

reduce); the signal to noise ratio (where improvements may be possible); the loudspeaker configuration (which is easiest to change in principle) and surfaces (where it may be possible to make changes). There are considerable constraints on changes to some factors due to other requirements, such as placement of speakers to avoid vandalism, fire and water resistance, aesthetic/heritage considerations and the positioning of other electrical equipment within the confined spaces of the platforms. London Underground is also said to be averse to acoustic treatments of surfaces. Luis's talk focused on the acoustics of the listening space as the final link in the chain from the announcer to the passengers.

Acoustically the spaces are unusual in that the volumes are large – around 3000 m^3 – but very long compared with their other dimensions and with hard concave surfaces. The low power, directional loudspeakers are evenly distributed along the platforms, but the listeners are in the reverberant field which has its highest levels in the 125 and 250 Hz bands. Delayed sound from speakers further along the platform effectively adds to the reverberation. Measurements have been taken on 74 deep platforms. Currently, the values for intelligibility average 0.45 STI, and in fact, almost no deep platform achieved the aim of at least 0.5 STI. Luis considers that given the vital nature of emergency announcements and the vulnerability of the Underground, it would be better to aim for values of at least 0.55 and ideally 0.6.

After discussing the many difficulties in addressing the acoustic problems while meeting all the other complex requirements and restrictions, Luis offered some suggestions for practical steps to improve intelligibility using the existing loudspeakers. These included using features such as benches to scatter sound and obstruct propagation along the platforms; textured or corrugated walls; micro-perforated surfaces on equipment and cable panels; using ventilation openings and cross passages for absorption and designing billboards to act as diaphragmatic absorbers. Other possibilities include reducing low frequencies in the announcements where reverberation is greatest (125 and 250 Hz), although this might result in an unnatural sound – and automatically shutting off loudspeakers when no passengers are nearby. If London Underground were willing to allow surface treatments, already approved types of mineral wool fitted over just 6% of the surfaces (especially the end walls) could give an STI of 0.5, while 12% could give 0.55, resulting in dramatic subjective improvements at modest cost.

Luis commented that a blurred CCTV picture would be considered unacceptable and anything less than the best quality sound from VAs should be too. A packed platform can have 800 to 1,000 passengers and the Underground is highly vulnerable to terrorist attacks and other potential disasters. The Underground system cannot afford ineffective VAs that could lead to perceptions of a poor quality service and could be counterproductive in emergencies.

Nearly 90 more membership applications approved by IOA Council

Eighty-seven applications for Institute membership were approved by Council in June following the recommendations of the Membership Committee.

Of the total, 67 applications were for new memberships and the remainder were for upgrades.

Fellow
Brown G

Member
Anthony S
Bowden D M
Burrell R
Davies R A
Day M L
Dixon N J
Edwards M
Gontcharov V
Harrison E L
Liddell S A
Mahon J
McConnell C J
Minier J
Moore A
Nicholson S L
Owen P A
Pantziarides A
Percival G
Ponsford C M W
Priddle N
Rawlings C
Rirsch C M
Sarton B S
Simona J
Vaughan N D
Walsh J
Wilson M J
Wright P
Yelland J V

Associate Member
Alexander B W
Andreu Medina J I
Argence T
Barling P
Barry P
Blakeley J D
Bryant S A H
Colgan D
Gilbert D R
Groves B
Hackett P E
Heather S
Heppleston R R
Higgins C
Higham C J
Jones J
Krok T P
Laws S R
Liston K I
Liston S J
Mart J
Newman R J
Rigby M
Roche P
Rodriguez Perez L A
Thomas A
Whydle S
Winman A
Woods O F

Affiliate
Freneat C
Kambourellis M L
Norman T
Simmons T P
Williams C

Technician
Burchell J
Collins S P
Elder A J M
Faulkner L A
Forster P J
Gerard D J
Meneguz K
Selkirk C J A
Serrao K M
Walsh R

Student
Edwards R L
Gregory N D
Herd L
John R
Lu A
Nikolova L S
Okten G
Reed B
Tomlinson A D
Wood J M L

Sponsor
Deveci M
Trzcinski-Clement F
Winter I

Environmental noise measurement remains most popular course

By Keith Attenborough, IOA Education Manager

Spring 2013 has seen the third presentation of the Certificate of Competence in Building Acoustics Measurements at Southampton Solent University. Of the 12 candidates, 10 passed. Southampton Solent seems to be the only centre (out of eight originally accredited) able to recruit for this course and future IOA publicity for this course will list only Southampton Solent and Acoustical Associates (Peterborough) as centres.

The Certificate of Competence in Environmental Noise Measurement continues to be the most popular IOA short course; 116 candidates were registered at 10 centres. Of these, only 10 failed, resulting in a pass rate of more than 90%. Discussions are continuing about the extent to which the course content should be modified to include more on aspects of wind turbine noise and wind farm noise measurements which are current hot topics.

Recruitment for the Certificate in Management of Occupational Exposure to Hand Arm Vibration remains low and the course is offered only once a year. In spring 2013, the six candidates all passed.

Recruitment to the Certificate of Competence in Workplace Noise Risk Assessment is also lower than in the past. Of the 22 candidates in spring 2013, 16 passed. The management committee no longer includes direct representation from HSE.

Building Acoustics Measurements

Southampton Solent University
Crockford J V
Hopkinson M A
McIlwain P J
Megeney L J
Millward A R
Nikolova L
Price J D A
Swiejkowski K M
Taylor I
Wilkinson G J

Environmental Noise Assessment

Bel Educational Noise Courses
Downie C H
Garnett M
Harkness M J
Kain L S F
Keenan K
Kelly S
Mungall H A
Rice P W B
Sim N A
Taylor D R
Vernon A
Wilson C
Wood A

University of the West of England
Alexander M R
Aston E
Claxton A
Clayton J P
Gaylard C R
Gowan J L
Horton A C
Jenner A
Jones M
Pittaway A J
Price T O
Sohal T

Colchester Institute
Bueser G H
Bullock M
Davis D M
Dornan N
Dunlop E J M
Holden A J
Inglis C P
Jones J
Sutcliffe A T
Whatling T
Wilson K C A

University of Derby
Clews J
Elliott M
England D
Fairweather R A
Hilton A D
Jenkins C M
Moseley A N
Otobo I
Thorpe S

EEF Sheffield
Albaya de Gago J
Close G D
Fryer J
Jackson S
Judd S A

Leeds Metropolitan University
Bloomfield N
Bridge S
George M J
Glenville S
Holdridge J
Newman R F
Parker R A
Saul E

Liverpool University
Billingham A J
Candlin J F
Crowther J S C
Deery K
Fletcher B M
Fletcher R M R
Gibson G B
Livesey J H T
McGlone G
Morley J S
Oakes I L
Sonko-Nassunje G N N
Taylor S L
Warrington B
Williams L S

NESCOT
Brewer S L
Cregeen L M
Storey M J
Shorcontrol
Flood E
Gallagher S
Goulding J
McAuley N
McFarland L
McLaughlin C
Mulvihill P
O'Dwyer R
Sharpson G

Shorcontrol Safety Ltd
Beattie S
Breen P
Downey A
Dunlop C
McCullough L
McKeever S
Murtagh S
Swift P
Thompson G
Trainor S

Southampton Solent University
Deighton G T
Giblett K S
Johnston D N
Martin P
Monckton R
Morse P M
Reilly J D
Riddel A
Tayler S
Tidridge P L
Tough J Z
Turp S

Management of Occupational Exposure to Hand-Arm Vibration

Leeds Metropolitan University
Cawthorne I
Edwards G
McGarry S

Institute of Naval Medicine
Curtis P

Shorcontrol Safety
Campbell D
Loy S A

Workplace Noise Risk Assessment

EEF Sheffield
Cameron S
Howson D
Humpage S J
Lewis S E
Mason K
Moorhouse G R
Parris K M
Ramsay G

Moloney & Associates
Brosnan D
Gallagher P
Leonard C
Ni Labhradha D

Shorcontrol Safety
Conway B
Gough S
Kelly M D
Kelly M E

Sound level meters – revised international specification standard

By Sue Dowson

International specification standards for acoustical instruments are produced by the IEC (International Electrotechnical Commission) committee IEC/TC29 'Electroacoustics'. This committee, in common with other IEC committees, has global membership, currently having 24 participating countries and 13 observing countries. IEC/TC29 has various Working Group (WGs) and Maintenance Teams (MTs) covering specific instruments and areas – sound level meters, sound calibrators, microphones, hearing aids, audiometric equipment, filters, audio-frequency induction loop systems, head and ear simulators, EMC, and instruments for the measurement of aircraft noise. National Committees provide expert members for these WGs and MTs. In the UK the National Committee is the British Standards Institution (BSI) and experts are nominated from the parallel BSI committee on Electroacoustics, EPL29.

The Maintenance Team responsible for sound level meters, MT4, has recently been revising the IEC 61672 series of standards on sound level meters. The series currently consists of 3 parts – Part 1 'Specifications' published 2002 [1], Part 2 'Pattern evaluation tests' published 2003 [2] and Part 3 'Periodic tests' published 2006 [3]. These standards were also adopted in the UK as BS EN standards with the same number ie. BS EN 61672-1 etc. Pattern evaluation is a wide ranging full test against all the specifications of the standard for a model of instrument. It is mandatory in some countries, so is important for manufacturers who are exporting, and is usually performed by National Metrology Institutes, with one of the main centres being at PTB, Germany. Periodic testing, often known as periodic verification, is limited testing of an *individual specimen* of sound level meter on a regular basis, and assures the user that the performance of an instrument still conforms to the applicable specifications for a limited set of key tests, for the environmental conditions under which the tests were performed. Periodic testing is normally performed by accredited laboratories – in the UK the accrediting body is the United Kingdom Accreditation Service (UKAS). Use of a sound level meter proven to meet a particular class is often required by method standards such as those produced by ISO TC43 – 'Acoustics'.

The standardisation process itself is well defined by IEC, and documents must progress through various stages from preliminary stage to publication stage. These 3 revised sound level meter documents are currently at the last stage of the process, the Final Draft International Standard or FDIS stage, having completed the earlier stages with discussions within the MT and approval via National Committees of the necessary drafts along the way. The National Committees will now vote for the final time on these FDIS documents. At this stage it is a simple 'vote in favour/ vote against/ abstain' process with comments only required for any 'against 'votes. The IEC closing date for voting is 16 August 2013, and if, as is strongly expected, these documents receive a positive vote under the IEC acceptance criteria, they will be published as IEC 61672 Edition 2, by IEC within 1.5 months of the circulation of the Report of Voting.

So how does the revised standard differ from the current versions, and how will this affect manufacturers, users and those testing sound level meters?

The 3 Parts have been revised to incorporate some changes resulting from experience in using Edition 1, to include some further possibilities for testing, and to incorporate a newly agreed Policy of TC29 on measurement uncertainty and conformance assessment. The aim of this Policy is to make the standards clearer to understand for manufacturers, test houses and users. The policy follows the guidance in ISO/IEC Guide 98 [4], but specifications in the standard are now defined in terms of acceptance limits, with maximum permitted uncertainties of measurement for manufacturers/test houses given separately, rather than as the combined tolerance limits given in Edition 1.

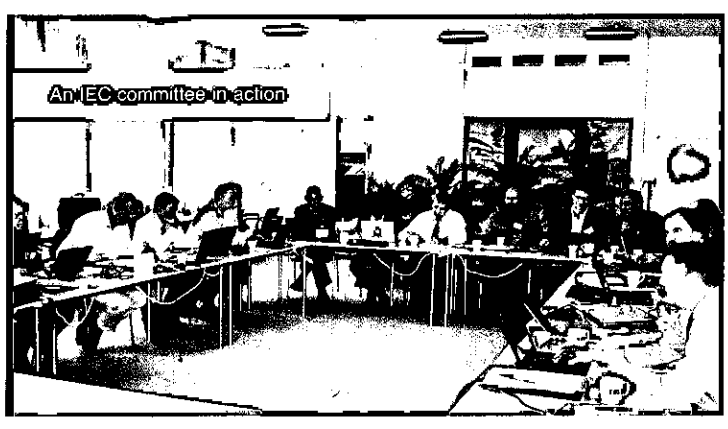
Conformance to a performance specification is demonstrated when a measured deviation from a design goal equals or does not exceed the corresponding acceptance limit(s) AND the testing laboratory has demonstrated that the associated uncertainty of measurement equals or does not exceed the maximum permitted uncertainty.

The relationship between tolerance limits, acceptance limits and maximum permitted uncertainties in shown in Figure 1.

Where AI = acceptance interval, TI = tolerance interval, U_{max} = guard band for the maximum-permitted uncertainty of measurement for a 95 % coverage interval, AL = lower acceptance limit, AU = upper acceptance limit, TL= lower tolerance limit and TU = upper tolerance limit.

Other main changes include:

- clarification of some definitions
- updating of references
- improved clarity on provision of under-range indicators
- fuller inclusion of sound level meters fitted with random incidence microphones
- where a sound level meter has the ability to display C-weighted peak measurements, a new requirement that a display of C weighted time-averaged sound levels must also be available
- addition of specification and test for long term stability
- addition of specification and test for high level stability
- requirement for manufacturer to provide advice on minimising the effect of mechanical vibration on indicated sound levels
- removal of Annexes on AU weighting and time weighting I
- addition of a detailed Annex giving example assessments of conformance to the specifications of the standard i.e. how to apply the new Policy P18


An IEC committee in action

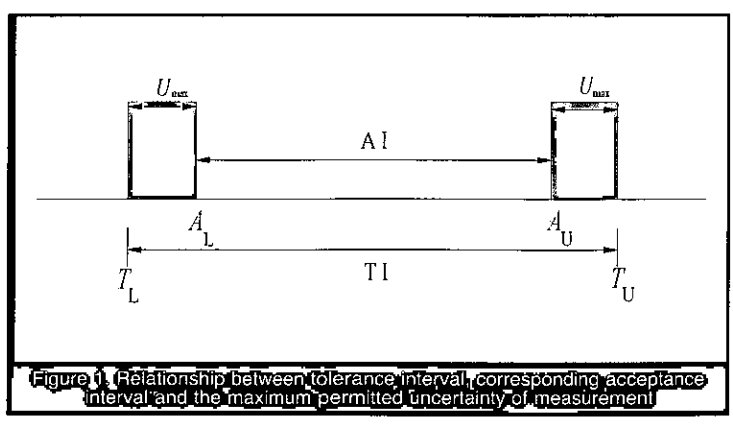


Figure 1. Relationship between tolerance interval, corresponding acceptance interval and the maximum permitted uncertainty of measurement

- P17 minor changes to account for practicalities gained from experience in use of Edition 1 e.g. levels of test signals required etc
- changes to the adjustment using a sound calibrator at the calibration check frequency to allow optimised performance across the full specified frequency range
- allowance of use of a comparison coupler for periodic tests, so the standard now gives a choice for acoustical testing of comparison couplers, sound calibrators where a special ring applied to the microphone may be necessary to avoid 'grid resonance' problems at high frequencies, and electrostatic actuators, as well as free-field testing. The aim here is to minimise the time and hence the cost of acoustical testing by providing more choice. Of course for these tests, and others, appropriate correction data has to be supplied and the standard is more explicit on what must be supplied. It now contains references to the recently published IEC 62585 [5], which provided manufacturers and others with information on how to measure these corrections. If the uncertainties of measurement on the correction data supplied are not provided this uncertainty is now assumed to be the maximum permitted, which may result in a failure of the meter to conform to the specifications
- use of the actual microphone response (rather than average or typical) for periodic testing
- self-generated noise both with the microphone installed and replaced by an electrical input signal device is now just reported, rather than being used as a conformance criteria.

One of the aims of the revision has therefore been to make the standard clearer for manufacturers, and make periodic testing easier for test houses to perform, both by providing additional testing options, but importantly aiming to ensure all the relevant information on corrections etc is readily available.

For the purchasers and users of sound level meets – following publication of the revised standard instruments will start to become available that have been manufactured according to Edition 2 of IEC 61672, and this will be clear from the markings as the year of publication of the standard must be included. When the meter undergoes a periodic test this will be performed using Part 3 of Edition 2. Sound level meters manufactured according to the Edition 1 of the standard will continue to be tested against IEC 61672-3: 2006 (BS EN 61672-3:2006 [6]). If you have a much older sound level meter originally manufactured to IEC 60651 or IEC 60804, then in the UK the British Standard BS 7580: Part 1:1997 [7] remains the appropriate standard for periodic testing.

Susan Dowson is at the National Physical Laboratory Teddington, and is currently Chairman of both IEC/TC29 and EPL 29 and a Member of IEC/TC29 MT4.

References

1. IEC 61672-1:2002, *Electroacoustics - Sound level meters - Part 1: Specifications*
2. IEC 61672-2:2003, *Electroacoustics - Sound level meters - Part 2: Pattern evaluation tests*
3. IEC 61672-3:2006, *Electroacoustics - Sound level meters - Part 3: Periodic tests*
4. ISO/IEC Guide 98-4:2012, *Evaluation of measurement data – The role of measurement uncertainty in conformance assessment (JCGM 106 from the Joint Committee for Guides in Metrology)*
5. IEC 62585:2012, *Electroacoustics - Methods to determine corrections to obtain the free-field response of a sound level meter*
6. BS EN 61672-3:2006, *Electroacoustics. Sound level meters. Periodic tests*
7. BS 7580-1:1997, *Specification for the verification of sound level meters*

Golden memories come flooding back as ISVR celebrates its 50th anniversary

By Frank Fahy

Three hundred people travelled from around the world to the University of Southampton in July to attend ISVR 50, a two-day symposium to celebrate the 50th anniversary of the Institute of Sound and Vibration Research (ISVR).

Strategic planning had begun in 2011 when a group of current and former members of the Institute, led by Professor Emeritus Joe Hammond, began meeting to decide the format of the celebrations, to which all current and former staff and students would be invited. It was agreed that it would be in the form of a symposium, to which a number of people who had close historical ties with the ISVR, and who had established successful careers in a spectrum of fields associated with it, should present brief talks about their professional occupations.

The event, in the Turner Sims Concert Hall, was opened by the Vice-Chancellor, Professor Don Nutbeam, who, after welcoming guests, praised the ISVR as "one of the jewels in the university crown".

Professor Emeritus Bob White, a former ISVR Director, presented the opening talk on *A brief history of the ISVR*. This long and complex subject could not be accommodated within the short time allotted, and the history of the ISVR will be the subject of an article in the November-December issue of the Bulletin.

Julie Brinton, Director of the university's Auditory Implant Service (until recently, the South of England Cochlea Implant Centre) surveyed the history of SOECIC in the ISVR. This service involves audiologists, surgeons, clinicians, psychologists and speech therapists, among others. Hearing which has been lost due to damage or congenital failure of the hair cells in the cochlea is restored to a substantial degree by the surgical insertion of an array of electrodes into the cochlea where they are activated by a signal from an externally located microphone and stimulate the auditory nerves. Preparation of the patients for the implant, and subsequent rehabilitation, takes place at the university: surgery takes place in Southampton University Hospital. The first two implants were fitted in 1990. The NHS then made the crucial decision to provide SOECIC with research funding. To date, more than 1,000 implants have been made. The first child received an implant in 1992; today, youngsters are routinely fitted at the age

of 12 months. SOECIC has been in the forefront of fitting bilateral implants since 2003.

SOECIC led the National Paediatric Bilateral Audit and the NHS has recommended that all children should be fitted with bilateral implants in a single operation, a world first. Collaborative research is done with the university music department. Julie's talk concluded with mention of new technical developments including miniaturisation, lasers, remote interaction and middle ear implants.

Professor Tim Leighton of the ISVR then entertained the audience with *Sound in Space*, a speculative audio review of what forms of sound might be recorded by a space probe as it approaches and lands on various planets and moons of the solar system. Microphones are small, light and robust, and such recordings would help to determine the physical and chemical constitution and properties of the atmospheres and of landing sites, which might be solid or liquid. Saturn's moon, Titan, has a smoggy atmosphere that conceals its surface from telescopic view, but which might have methane lakes and falls. He played simulation of the sounds of landing in such a lake or a hard surface. He then illustrated how the atmospheres of planets such as Mars and Venus would affect the sounds of valve and flue organ pipes and the human voice. Tim also showed a video of his brilliant revolutionary invention for cold, non-chemical, cleaning of a wide range of contaminants from surfaces of arbitrary material and geometry, including fissures.

Professor Goran Pavić of the Institut National des Sciences Appliquées in Lyon, France, presented *Modelling of vibration, sound and stresses using the Virtual Source approach.* He said that modern numerical techniques and computer packages give little or no control of the analysis process, do not provide the user with an understanding of the physics of the problems, or even a quantitative indication of the quality of the solution. He introduced what he described as a "do it yourself" analytical modelling technique, explaining how the natural modes of vibration, dynamic responses and stress distributions of a range of structural components for which there are no analytical solutions can be determined by virtually "embedding" them in larger, simpler, uniform master systems that have known analytical solutions. The numbers, positions, directions, amplitudes and phases of an array of virtual dynamic forces acting on a master structure, plus the actual force distribution on the target structure, are mathematically adjusted to satisfy, in a least squares sense, the actual boundary conditions of the target. The resulting response of the master structure within the boundaries of the region occupied by the target structure corresponds to those of the target structure.

The E J Richards Public lecture, established in honour of the founder of the ISVR, was given by Rob Harris, Director and Global Acoustics Leader at Arup, who spoke on *Thirty Years of Auditorium Design.* Rob, who has led teams that have designed many wonderful new auditoria all over the world, mentioned the inspiration that he received from the late Professor Emeritus Phil Doak while studying at ISVR and from researchers Harold Marshall and Mike Barron, who showed that lateral acoustic reflections from the side walls of a hall must arrive within a sufficiently short time of the sound arriving directly from the orchestra to promote among auditors of classical orchestral music a pleasant sense of immersion in a "bath" of sound. Consequently, modern concert hall designs reflect the great importance of hall width. Alternative seating configurations which incorporate discrete structures especially oriented to provide local lateral reflections have been developed for very large halls.

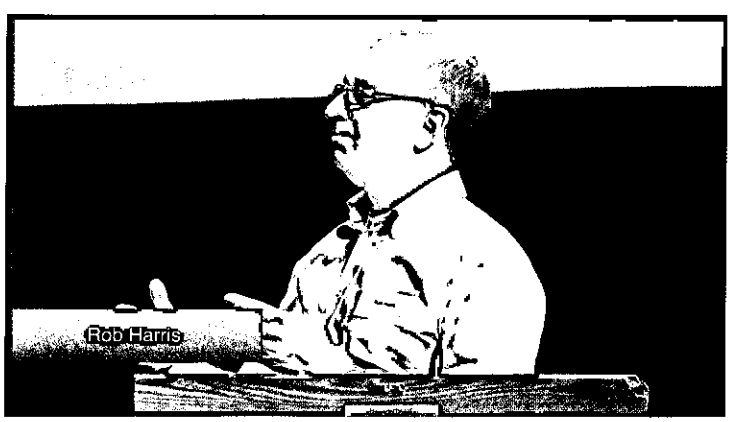
Rob explained that the acoustical design of concert halls in essence involves a blend of physics and architecture. What is practicable is affected by many factors such as budget, programme schedule, projected utilisation and site limitations (including ambient noise and vibration), together with satisfaction of the client, project managers, engineers, health and safety requirements and other agencies. Design success involves a balance between architecture, acoustical design and theatrical demands, such as sightlines. He proceeded to illustrate the application of this principle, and of steadily improving design aids, to a range of UK projects he led. Computer packages that simulate sound propagation, reflection and absorption have steadily improved but modelling of diffraction and scattering is still not fully satisfactory.

Computer modelling now includes "auralisation" whereby computed acoustic impulse responses are convolved with anechoically recorded music to allow a listener to experience the architecture and sound of a proposed auditorium before constructed. Rob closed by reviewing the rapidly changing context of acoustic design which places many more demanding requirements on physical and acoustical flexibility and provision for multiple forms of use, even in the same day.

Matthew Cartmell, Editor-in-Chief of *The Journal of Sound and Vibration*, presented the Doak Award, established in 2012 in memory of Phil Doak who initiated the journal in 1964, to Dr Brian Mann and Dr Neil Sims. In the words of the presenter, Phil "was, by all possible standards, an exceptional editor".

The first talk of the second day, *Human Vibration*, was presented by Professor Mike Griffin, leader of the ISVR Human Sciences Group and head of the Human Factors Research Unit (HFRU). He gave a comprehensive account of nearly four decades of research into the vibrational characteristics of the human body and its response to applied vibration. He explained that these vary with the posture of the body and showed that the intra-subject and inter-subject responses vary widely, making mathematical modelling extremely difficult: however, progress is being made. Mike briefly explained the adverse effect of vibration on comfort and task performance and illustrated various means of mitigation by choice of design, materials and construction of seats. The HFRU has played a major role in contributing to the development of standards for seating comfort and avoidance of damage caused by vibrating machines. The unit has also designed and provided instruments for the indication of vibration severity, conformance with standards and early diagnosis of incipient damage to users of vibrating machines and tools.

The next speaker, Professor Stuart Bolton of the Mechanical Engineering Department of Purdue University, arrived in the UK from Canada in 1974. He initially studied at the ISVR for an MSc in Sound and Vibration, and was awarded a PhD for his subsequent research into the propagation of sound in poroelastic materials, supervised by Phil Doak. As a tribute to the memory of his P20


Rob Harris


Reunion time

◂P19 erstwhile supervisor, his address was largely anecdotal, and concerned attempts to develop an experimental means of determining the complex wave number and wave impedance of sound propagating in poroelastic materials by means of traversing a probe microphone through a sample that was terminated by a rigid plug. A serious disagreement between theory and experiment of the acoustic impedance of the foam caused consternation. Stuart discovered that the wave reflection from the termination depended crucially on degree of contact between the foam and the terminating plug. He has investigated this phenomenon intensively and has exploited in the design of novel multi-layer sound absorbers and lightweight sound insulation packages.

Next, a talk entitled *Noise challenges in civil aerospace* was presented by Dr Colin Smith CBE, Director, Engineering and Technology of the Rolls Royce power division, which includes gas turbine engines for aircraft. The ISVR has enjoyed a continuous relationship with Rolls Royce over a long period. In 1968, Dr Mike Fisher was appointed Rolls Royce lecturer (subsequently Reader) and he, and subsequently more recently appointed colleagues, have carried out research and provided advice for Rolls Royce for more 45 years. Colin has a special relationship with the ISVR because he was instrumental in the decision by Rolls Royce to locate its Technology Centre for Gas Turbine Noise in the ISVR, which, inaugurated in 1999, has assisted the ISVR to become academic leaders in the field.

Colin noted that civil aerospace makes one of the largest contributions to the UK economy. He commended the vital intellectual contribution of the 28 UTCs in the world to Rolls Royce technological development. He noted that the EU has set strong targets for environmental protection and emphasised the responsibility of the industry for controlling atmospheric pollution and noise, but warned that pollution will inexorably increase with the growing global aircraft production, an increase that engines designers have to try to counteract. But, because of the long life of civil aircraft, today's technological developments will still be influential in 20 to 30 years' time.

Colin explained that increase in fuel efficiency can be achieved, but at the expense of increased noise; quieter aircraft are less fuel-efficient and produce more CO2. Engine noise has been steadily reduced over recent years, largely by means of increasing the diameter of by-pass fans. However, little further increase in fan diameter is practicable because undercarriages would get too large and heavy, there would be inadequate space for passenger to get on and off, and the wings would have to be too stiff to satisfy passenger comfort requirements in turbulence. He described current noise certification procedures as 'crude' because of variations of landing and take-off flight paths and wished for a 'real life' noise impact metric.

John Shelton of AcSoft presented a talk entitled *Seeing the wood for the trees? Advances in sound and vibration measurement instrumentation.* He traced the development of the sound level meter and associated metrics from the purely analog B&K 2203, of fond memory, to the modern version with analog signals from an electret microphone passing through an A-D converter to feed a software package running on a laptop, that provides all the necessary time histories, spectra and metrics. John then brought us right up to date by describing MEMS (microelectromechanical-systems) microphones that are very small, robust and cheap. Soon, microphones will generate a PCM signal directly. The types of mems microphone in mobile phones and other personal electronic equipment have rather small dynamic ranges and sound scattering shapes that disallow them from satisfying the Class 1 sound level meter standard. A survey of the performances of a large sample of devices containing mems-based microphones found not a single one to conform to the standard. However, after years of research, the National Physical Laboratory has produced a mems based device that does satisfy the Class 1 standard. Mems microphones are ideal for use in personal dosimeters and measurements of sound pressures in the ear canal. As an aside, John reported that many post graduates who came to him for interview, even from universities running prestigious acoustics courses, have received little or no training in the field use of sound level meters, a situation which he found inexplicable and unsatisfactory.

He brought his talk to an end with a rapid introduction to beam-forming, multi-microphone, array technology for locating an identifying noise sources, illustrated by examples.

ISVR Director Elect Professor Paul White talked about *Sound in the marine environment.* He concentrated on the importance and adverse effects of underwater sound on whales, porpoises and dolphins. He explained that sound plays very different roles in the lives of baleen whales, which use sound generation for social purposes, and which scoop up large numbers of small creatures with an open mouth, and toothed whales, porpoises and dolphins which use sound both to explore their environment and to locate and catch prey. If a baleen whale's hearing is severely damaged, it will live an isolated life without companions or mate. Deafened toothed whales starve and rapidly die. He illustrated the vast increase in ship noise between the 1960s and today which, in principle, can reduce the effectiveness of undersea communication by masking. However, it is not clear that man-made noise has a significant impact on communication.

Paul explained that many mass stranding of whales have occurred since one was reported in 1502, but except for three instances, there is no firm evidence that noise was P22▸


Dr Colin Smith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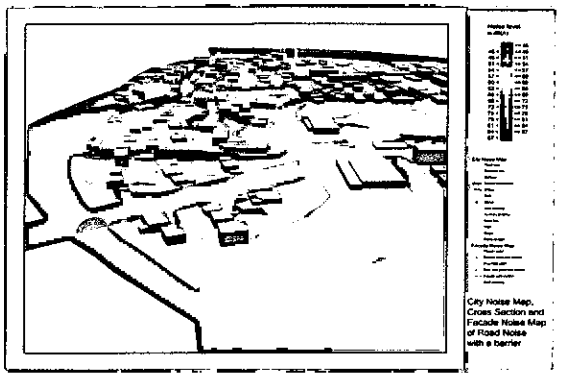

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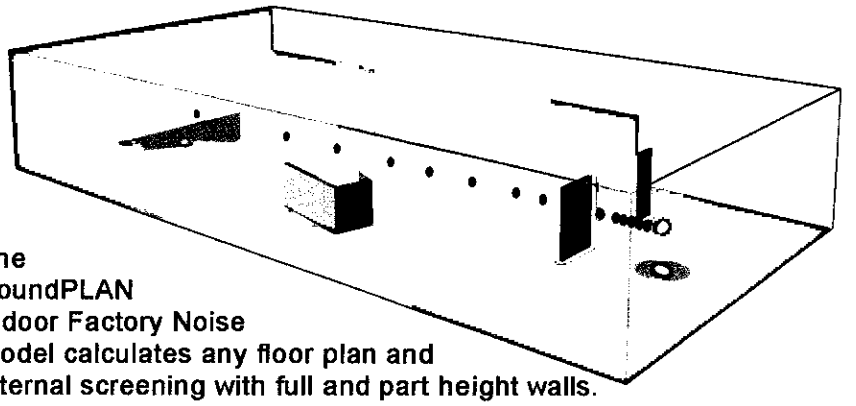

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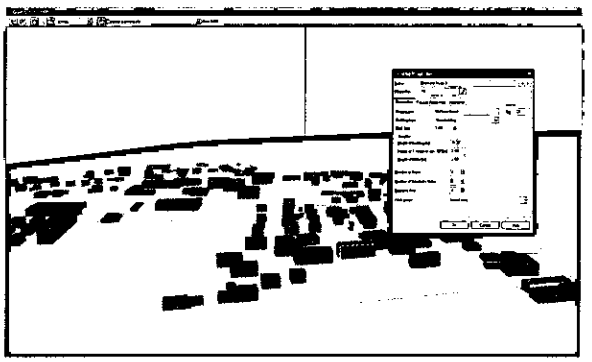

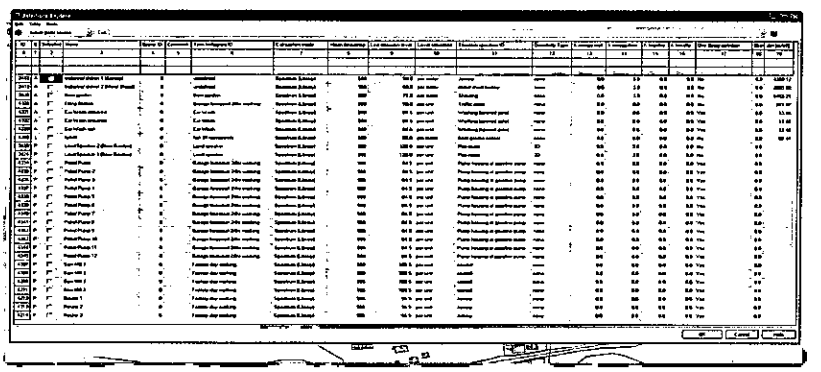

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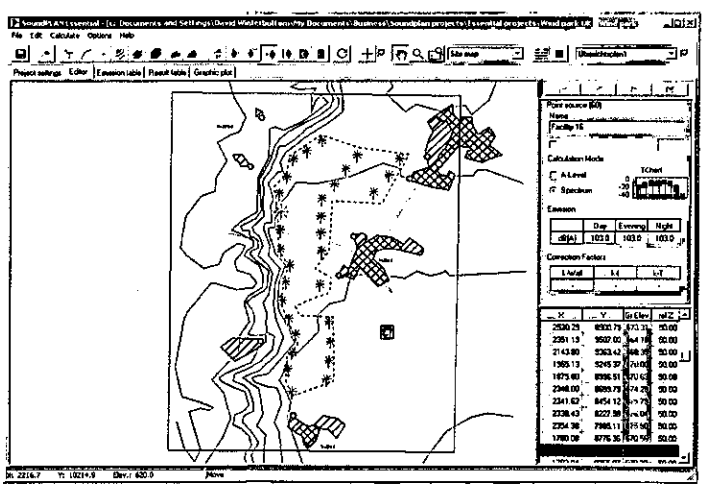
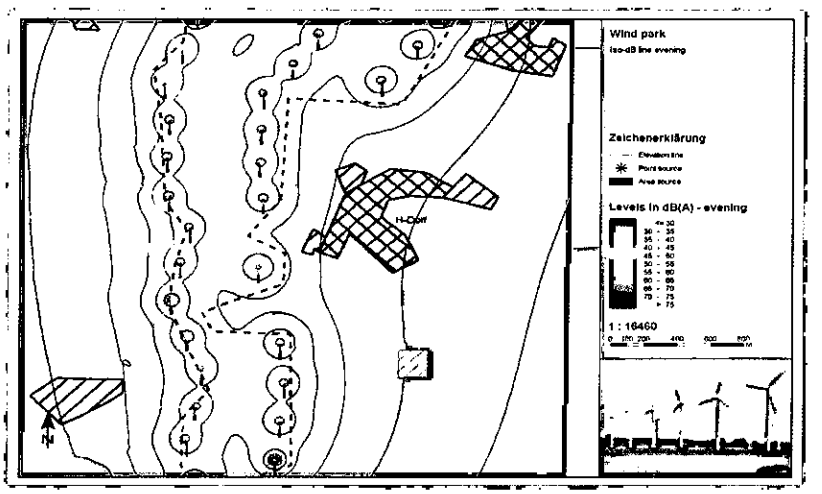




P20 implicated. The only incidents for which there is clear evidence of killing of whales by sound occurred during a naval exercise in the Mediterranean in 1996, when 12 whales were stranded that do not normally strand, and subsequently by beaching and deaths in the Bahamas after which the US Navy admitted that their mid-frequency active sonar caused the tissue lesions that killed the animals. Paul concluded that it is extremely difficult to establish the degree of severity of man-made noise on marine animals because of many confounding factors and because the effects on so few individuals and other marine species have been studied.

John Dixon, of ISVR Consulting and a former member of the Institute's Automotive Design and Advisory Unit (ADAU), spoke on *Automotive Engineering is silenced at Southampton*, in which he concentrated on the noise control work of the ADAU on successive models of Ford Transit vans. The ADAU carried out ground breaking research on the sources and control by design of automobile engine noise, backed up by experimental results from seven test cells in which engines from manufacturers all over the world were tested and noise sources identified and suppressed. The unit also invented and developed various very successful non-IC devices that simulated combustion forces and engine sound radiation without the need to run an engine. After the unit was disbanded and the test cells dismantled John has continued to provide consultancy advice to road, rail and sea-borne vehicles.

Professor Steve Elliott, another former Director of the ISVR, gave a fascinating talk entitled *Active control of vibration in aircraft and in the cochlea* that linked ISVR work on active noise control in propeller driven aircraft with the remarkably large dynamic range of the human auditory system. He described theoretical and laboratory studies and successful physical implementation of active control of noise in a propeller driven aircraft carried out by himself and Phil Nelson in the 1980s. In a subsequent commercial development, more than 1,000 active noise control systems have to date been fitted into aircraft by Ultra Electronic Controls , a UK company led by an ISVR alumnus who was involved in the early ISVR research. The system, which produces a 10 dB(A) noise reduction, comprises 46 vibration sensors and inertial actuators distributed over the fuselage frames, and 72 monitor microphones distributed within the trim, all controlled by a single controller. The cable network contributes 50% of its total weight. This penalty could be minimised by installing a distributed system of independent controllers, actuators and sensors. ISVR studies on simple structures reveal that as the gains of the controllers are increased, the vibration at first decreases to a minimum, beyond which it increases. The minimum corresponds with maximum power dissipation by the units and new control algorithms have been developed to exploit this as a control parameter for implementing self-tuning of individual units.

Steve explained how the cochlear hair cells and associated structures form a distributed, 12,000 unit, self-tuning feedback system which involves chemically based, actively controlled changes to the shapes of the outer hair cells. It operates at the very limit of stability to produce an amplification of low level received sound by up to 40dB (gain of 100). A mathematical model of the waves in the basilar membrane shows how they are partially reflected back towards the tympanic membrane by small variations (1%) in the individual control loops. Sound is consequently radiated from the ear canal (otoacoustic emission) and is used for auditory health screening of young children. Steve explained how mathematical modelling is being used to improve understanding of the system behaviour, and possibly will aid those who are involved in procedures to ameliorate hair cell function in hearing impaired persons.

The final talk, *How can we help hearing impaired people to better understand speech?* was presented by Dr Stefan Bleeck, acting head of the ISVR Hearing and Balance Centre (HABC).

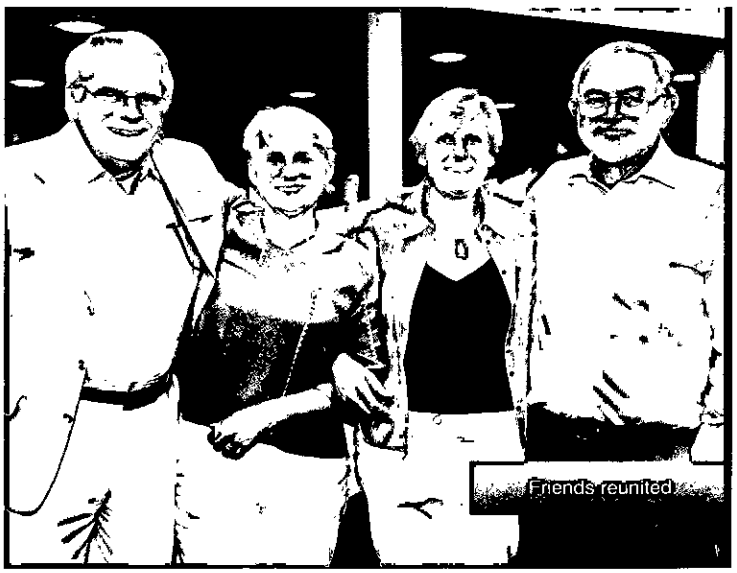
He explained that its mission was "to improve the quality of life of the hearing and balance impaired". The HABC played a major role in trials which persuaded the NHS to implement the "Universal Newborn Hearing Screening" programme, which tests babies in their first few days of life for their otoacoustic response to clicks. On average, in England, 13,000 babies a week are screened, and 21 are identified with permanent hearing impairment, allowing vital early clinical intervention and support. Stefan praised the vital contributions of Denise Cafarelli Dees, Roger Thornton and Mark Lutman to the programme design and implementation, and acknowledged the collaboration with the university's Faculty of Medicine, the MRC Institute of Hearing Research and the University of Milan.

Stefan explained that 50% of UK 60-year-olds suffer hearing loss and that, even with today's technology, current hearing aids do not work well in noisy environments, typically providing an increase in tolerable signal-to-noise ratio for hearing impaired wearers of less than 5 dB. He introduced the concept of "sparse coding" which is based upon the fact that the processing of noise inputs involves many more neurons than that of coherent speech. Speech can be accurately represented by only a few sparse components of what are known as "atoms" or basis vectors, whereas noise needs hundreds of components. A mathematical description of the decoding process followed. Stefan played some results of early research, which introduced some "musical" sounds, but substantially attenuated the broadband noise. Research is at an early stage but the technique has many potential applications.

The symposium closed with an excellent supper and party, which featured two sea shanties, live music from Italy, India, Scotland, England and elsewhere, and a very funny nautical dialogue between Admiral Professor Lord Nelson and Health & Safety pest, Hardy Flintstone

More details can be found at **www.isvr50.soton.ac.uk**


Time to reminisce


Friends reunited

UAC 2013: successful staging of new underwater acoustics conference

By Peter Dobbins, chairman of the IOA Underwater Acoustics Group

Introduction

Between the 23 and 28 June the first Underwater Acoustics Conference (UAC) was held in Corfu.

UAC has been born from a merger of the previous European Conference on Underwater Acoustics (ECUA), which the IOA organised last year, and the Underwater Acoustics Measurements: Technologies and Results (UAM) conference, to form a large conference covering all fields of underwater acoustics to be held every other year in Europe.

The conference chairmen were Professor John Papadakis of F.O.R.T.H., Greece, and Professor Leif Bjorno, Denmark, who previously ran the UAM conferences. They were supported by a large scientific committee, which included several members of the IOA Underwater Acoustics Group Committee. Details can be found on the conference website at www.uam-conferences.org.

The conference attracted some 300 registered attendees from a diverse range of organisations, including universities, public and private research institutes, companies and corporations. There were researchers from Europe, United States, Canada, Australia, China, Japan, Korea, and many other countries and they gave more than 290 presentations organised into 42 structured sessions, in addition to some eight poster presentations.

IOA participation

The IOA was not directly involved in running this event. However, most of the Underwater Acoustics Group (UAG) Committee were in attendance and organised structured sessions, as well as presenting papers.

We also took the opportunity to hold the UAG AGM and to present two IOA medals, and we are grateful to the conference organisers for making space in the programme for these activities.

The first award was the 2013 Rayleigh Medal, presented to Jacques Yves Guigné by the IOA President, Bridget Shield, in a plenary session following the opening ceremony, chaired by Nick Pace. See page 7 for full details. Professor Guigné then gave the Rayleigh Medal Lecture, entitled Acoustic Interrogation of Complex Seabeds.

This paper gave an illustrative description and introduction to a stationary acoustic interrogating approach to mapping the sub-bottom structure of the seabed which delivers a wide volumetric "acoustic core". This pioneering method yields vertical and lateral scales of metres down to tens of metres in depth, thus producing a large, detailed, volumetric, layer-by-layer footprint, unprecedented in physical coring or acoustic profiling.

The second award was the 2012 AB Wood Medal, presented to John Smith of dstl (Defence Science & Technology Laboratory) by the UAG Chairman, Peter Dobbins, as part of the closing ceremony.

Dr Smith is a physicist with a strong theoretical bias who has made a major contribution to the understanding of wave and structure interaction in underwater acoustics. His initial P24

◀P23 work was on the development of materials for use in underwater acoustic systems that are designed to act as absorbers or barriers. Here he worked on developing models to predict how the performance of the materials would vary with frequency and temperature, depending on their constituent parts. John's second major contribution has been on modelling and understanding the acoustic wave propagation in plates and structures, and the coupling with acoustic waves in a fluid medium loading the plate. More recently John has investigated the concept of metamaterials and the possibility of making acoustic cloaks based on such materials.

Sessions

The main body of the conference was the 42 structured sessions. It is not possible to report on these in detail, although the programme and abstracts are on the conference web site at www.uam-conferences.org/docs/UA2013BoA.pdf. Below are comments on just a few of the sessions. For further information, it is anticipated that the proceedings will be made available on the conference website shortly.

Sonar signal and information processing

Although the title doesn't say so, apart from one or two papers, this session was all about the traditional (since WWII) role of sonar for detecting submarines at long ranges using low frequencies. The fly in the ointment these days is that this activity is more likely to be carried out in shallow coastal waters, which makes it all a lot more difficult than operating in the deep open ocean. Representing, perhaps, one of the latest developments, a paper by Paul Hines of DRDC, Canada, compared the performance of conventional Pulsed Active Sonar with that of Continuous Active Sonar (CAS). His conclusions were generally supportive of CAS, but the experiment he talks about has not yet been done!

Synthetic aperture sonar: state-of-the-art

After many years in the wilderness, Synthetic Aperture Sonar (SAS) is now a reality and the papers in this session were mostly about refinements to the basic concept. This covered subjects such as the influence of the environment in the form of internal waves and sound speed variations, speckle reduction and contrast enhancement. This last topic was discussed in a paper by Stig Asle Vaksvik Synnes and Roy Edgar Hansen which showed a clear advantage in using ultra wideband signals. Experiments demonstrated that the details of a small cube were sharpest in a wideband processed image, slightly defocused in a multiband processed image and quite blurred in a conventional narrowband processed image.

Radiated noise and vibration including from marine renewable energy developments & marine renewables

The UK Government has targets for deployment of 35GW of offshore wind and 2GW each of tidal and wave energy by 2020, with further substantial increases planned for 2050. This session looked at the complex interactions between the environment and marine renewable energy devices, and in particular, radiated noise and vibration. The papers distinguished between the noise generated by construction activities (pile driving, for example) and the longer term operational noise. The session included a subsession on activities at the European Marine Energy Centre (EMEC) in Orkney which included presentations on the underwater noise emitted by wave and tidal stream energy devices by Stephen Robinson and Paul Lepper, processing techniques to correct the degradation in sonar performance due to the highly turbulent environment where such devices are located by Peter Dobbins and methodologies for measuring both the background ambient noise and the noise radiated by devices by Ed Harland, presented by David Cowan of EMEC.

Underwater soundscapes: definition and quantification

One of the most interesting sessions took place on Thursday afternoon when Jennifer Miksis-Olds and Mark Prior initiated a discussion meeting on how to best define and quantify underwater soundscapes. The very first minutes of the discussion showed that physicists and biologists disagree with the acoustic terms used in the first place. Physicists, for instance, would prefer the term "sound fields" rather than "soundscapes" because the latter is not defined in acoustic concepts. Biologists, however, argue that the expression "soundscapes" has specifically been created to refer to the acoustic environment consisting of multiple abiotic and biotic sound sources, resulting in complex sound patterns in time and space, comparable to patterns of a landscape. Sound fields, in contrast, is a neutral expression used in a wider context, which also includes the sound field created by a single tone.

The course of the discussion created the impression that there is a general disagreement between disciplines, in particular between physicists who have conducted acoustic research for decades and biologists who have just recently entered the field. Browsing through the papers in the proceedings for this session it is interesting that the term soundscape is not actually used by physicists, whereas it is used by biologists, but the definition is different in each case. This is all rather disturbing and does not bode well for establishing standards for either terminology or measurement methods that will be adopted by all those working in this field.

Sonar performance modelling and verification: applications to active and passive sonar

This session was related to the sonar signal and information processing discussed above through the concentration on shallow water performance in many of the papers and, because of this, a bias towards performance limitations due to reverberation and clutter, rather than ambient noise. Of particular interest were two papers by Michael Ainslie and others describing both results from the IOA's 2010 David Weston Memorial Workshop, held at the ▶

Underwater Acoustics Group Chairman Peter Dobbins presents the 2012 AB Wood Medal to John Smith

UAC Conference Chairmen John Papadakis (Left) and Leif Bjorno (Right)

University of Cambridge, and new results based on the scenarios specified for that workshop.

The general conclusion was that no single model has been identified that gives uniformly reliable predictions for all cases considered. Instead, analytical methods can provide the necessary insight to determine the most accurate model for each scenario. Further, the use of a combination of different models is a powerful technique for assessing models' strengths and weaknesses and where significant differences arise, these can be analysed and understood.

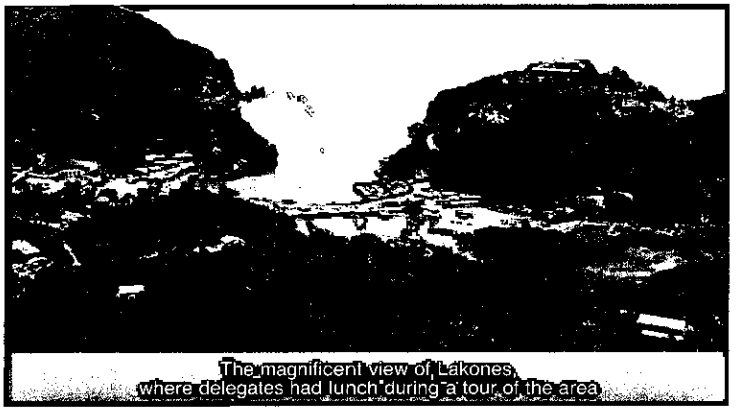
Passive and/or active marine mammal monitoring

This session included two papers on long range, low frequency marine mammal monitoring and one on the European "Achieve QUieter Oceans by shipping noise footprint reduction" (AQUO) project. A paper presented by Aaron Thode and others was refreshingly concise, yet comprehensive. This presentation reviewed the sperm whale detection and tracking performance of a simple two-element vertical array placed at the depth of the sound speed minimum. The results suggested that provided propagation paths are properly modelled, even under sea state 5 conditions, sperm whale passive detection ranges are possible up to 35 km, with tracking ranges up to 19 km.

Student prizes

Prizes were also awarded for the best papers presented by graduate students. The choice was made by members of the conference Scientific Committee, and it is worthy of note that the decision was so close that they awarded two joint first prizes. The three students were:

- Julius Piercy from the University of Essex for 'The conductor's guide to reef health' (1st)
- Sergio Mascolino from University College Dublin for 'Will you sing or will you dance? Male damselfish strategies in a noisy environment' (1st)
- Angeliki Xenaki from the Technical University of Denmark for 'Inversion assuming weak scattering' (3rd).



The magnificent view of Lakones, where delegates had lunch during a tour of the area

The future

Currently, the plan is that UAC will be held again in 2014 in Greece (Rhodes has been suggested) and thereafter every other year on even numbered years.

In the longer term, the present chairmen, Leif Bjorno and John Papadakis, aim to stand down and they are actively seeking new volunteers for the posts. It is to be hoped that whoever takes over can continue to produce such a successful event.

Right result puts Campbell Associates 'over the moon'

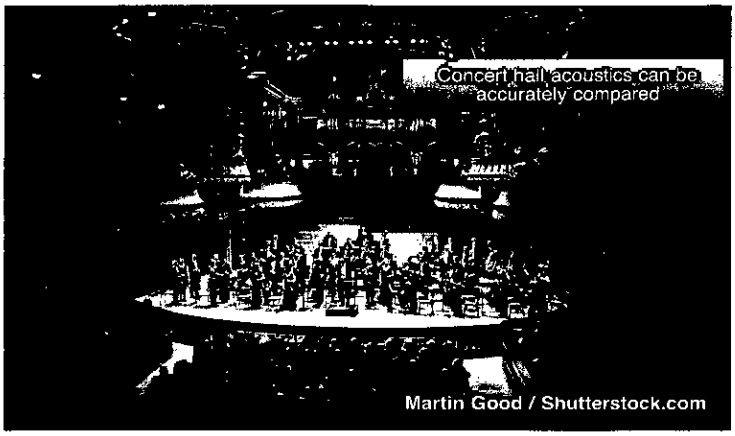
Nine teams from the acoustic industry took part in Campbell Associates' second annual five-a-side football tournament in Bishops Stortford in June.

Stansted Environmental, last year's winners, fielded a strong team and did a good job at defending their title. However, they were knocked out in the semi-finals by Campbell Associates, who went on to win the tournament by beating Pace Acoustics 2-0 in the final.

Other teams taking part were: AIRO, Cole Jarman, Bickerdike Allen, Sandy Brown, Sharps Redmore and SRL. The event has so far raised more than £975 for Prostate Cancer. Donations can still be made via Campbell's Justgiving page **www.justgiving.com/acoustic-cup-2013**

Winning captain John Campbell receives the 'Acoustics' Cup' from his father Ian

New method to compare concert hall acoustics



Researchers at Aalto University in Finland have devised a method that allows accurate comparisons of concert hall acoustics.

The team, led by Associate Professor Tapio Lokki, developed a way to capture the acoustics of a concert hall with a symphony orchestra simulator. It consists of 34 loudspeakers reproducing synchronised recordings of individual musicians playing parts of symphonies in an anechoic chamber.

The project has resulted in Professor Lokki being presented with the Early Career Award from the International Commission for Acoustics.

He said: "People have different tastes and unique preferences when it comes to the acoustics of a concert hall. Thus, we cannot say which concert hall is better than another, but we certainly have learned why concert halls are different and we are learning how to make a hall sound a certain way," he said.

The symphony orchestra simulator has been played in many famous European concert halls and that music has been recorded in different locations within the halls and analysed.

The simulator is necessary because it guarantees that the concert hall is the only changing factor influencing sound in these analyses. Later in the laboratory, the objective recordings allow very accurate comparisons of the characteristics of the acoustics.

When listening to different halls with spatial sound reproduction in the laboratory, subjective listening tests have also been conducted with sensory evaluation methods that provide revealing differentiating perceptual factors between concert halls.

With this combination of objective and subjective sensory data, Professor Lokki's team has been able to explain the preference ratings of concert hall acoustics.

The goal of this research is to better understand why we hear sounds differently in different spaces. According to Professor Lokki, this will lead to research that focuses on analysing exactly how humans perceive sound. ◘

Project to develop the world's first comprehensive model of the human voice

Swedish researchers are leading the development of the world's first comprehensive model of the human voice, which could contribute to better voice care, voice prosthetics, talking robots and teaching opportunities.

Three research groups from Stockholm's KTH Royal Institute of Technology are collaborating with voice and computing experts at universities and research institutes in France, Germany and Spain on the €3 million Eunison project, which involves physical models, and simulated visualisations of the voice.

KTH music acoustics professor Sten Ternström says that project will render the 3-D physics of the voice, including its acoustic output, which would find profound applications in fields such as speech technology, medical research, pedagogy, linguistics and the arts.

"We need a better understanding of how the voice works and how it fails," he said.

The university's "Lindgren" supercomputer will provide the colossal computing resources for the project. "We are talking about fast movements of tens of thousands of points in three dimensions, so there will be many calculations requiring heavy computation."

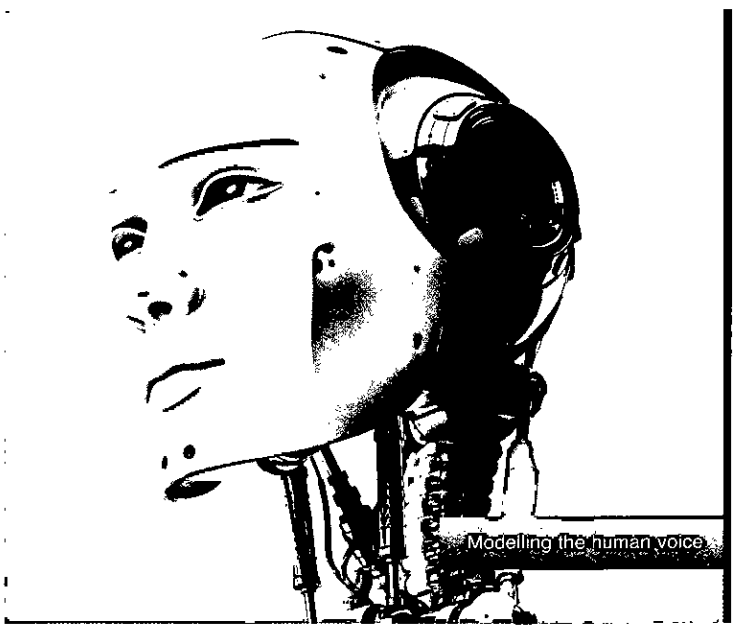
Though Eunison will rely on supercomputers to create simulations and visualisation, the project will also use mechanical models of the vocal chords, upper respiratory tract and tongue, made from silicone and plastic, to verify that the simulations are correctly calculated.

"The voice is a very complex phenomenon that requires a lot of work to emulate and understand," said Professor Ternström. "So, we are also interested in how much the model can be simplified, without affecting the voice sounds."

Unlike previous research on the voice, Eunison will be an end-to-end look at the voice, combining findings from multiple disciplines. Previous efforts have been fragmentary, and the models that do exist – of parts such as the vocal chords or vocal tract – are simplified in order to avoid the heavy physics calculations, he said.

"Our complete model of the human voice will resemble a puppet," said Professor Ternström. "The scientist pulls on one or more strings, and then we can see what happens."

The voice model will be made operable online, so that researchers anywhere can enter data and get a visualisation. ◘



New method to assess sustainability of noise reduction devices

A new method of assessing the sustainability of noise reduction devices (NRDs) used in transport infrastructure, such as noise barriers or absorptive claddings, is presented in a recent study. The new set of specially designed sustainability criteria allows NRDs to be easily and accurately evaluated, its developers suggest.

Noise reduction is a key part of the European Commission's Environmental Noise Directive; however the sustainability of transport must account for every aspect of the system, including accompanying infrastructure, such as NRDs. However, despite the fact that many NRD projects are often conducted at large scales, and can have substantial impacts on the environment, methods to accurately assess the sustainability of different devices are lacking.

In this study, conducted under the EU QUIESST project[1], researchers developed a tool for policymakers and industry professionals to aid decision-making and help evaluate the sustainability of different NRD options.

The researchers first defined "ustainability" as encompassing social, economic and environmental concerns, and also included a "technical" aspect, relating to the performance of engineering projects, such as NRDs. The sustainability of an NRD over its life cycle will therefore include diverse factors such as access or land property issues (social); construction and maintenance costs (economic); obstruction of animal movements (environmental) and material selection (technical).

They then employed a "Top-Down-Bottom-Up" approach to identify appropriate sustainability indicators for NRDs. The initial Top-Down process involved reviewing existing indicators, frameworks and tools used to assess sustainability. From this review, a set of 22 primary criteria which were potentially suitable for assessment of NRDs were selected. These included: land use, social acceptance and life cycle cost.

The suitability of these proposed sustainability criteria was then evaluated using a Bottom-Up process. This consisted of surveys, group workshops and interviews with stakeholders involved in NRDs at every stage of the life cycle, such as staff in road and rail authorities, manufacturers and researchers across Europe. The results of these were used to rank and rate each criterion.

The results showed that stakeholders were in general agreement over the importance of the criteria selected; 93% were ranked as "important" or "very important" in surveys. The researchers do note that the set of criteria drawn up for this study is not definitive; however, new criteria could easily be added by users in the future and assessed using the same approach.

The researchers also examined multi-criteria decision making tools which identify the best NRD options once the primary criteria have been selected. From this, the study concludes that although reliability and accuracy are key, there are other considerations to be taken into account, for example, the results must be easy to use and interpret, and the software must be easily available for stakeholders.

This report is based on an article in *Science for Environmental Policy* published by the European Commission ◘

References

1. See: www.quiesst.eu

Noisy airfield owners 'will continue to hold motor events'

The owners of a former airfield in Yorkshire say they will continue to allow motor activities, despite losing the latest in an eight-year series of court hearings over excessive noise.

A judge sitting with two magistrates at Leeds Crown Court rejected an appeal by Elvington Airfield against convictions for breaching a noise abatement order issued by City of York Council.

But after the hearing the owners said they would continue to host motor activities which, apart from sports events, included driving training and companies showcasing cars.

The council made the noise abatement order after numerous complaints from nearby residents about engine noise when the airfield staged motor sports, in particular Auto66 races.

The owners were convicted last year of twice breaching the order. In rejecting their appeal, Judge Guy Keal QC said they had been reckless in allowing the Auto66 events that breached the order because they knew there had been complaints and they had failed to take the proper measures to limit the noise.

The two companies behind the airfield were fined £1,750 for each offence and a director £500. They were also told to pay £11,000 costs, plus the £14,500 costs and a £45 statutory surcharge ordered by a district judge at the original hearing.

Airports Commission seeks views on aviation noise paper

The Airports Commission has published Aviation Noise, the fifth in a series of discussion papers, for public comment. The paper explores current scientific understanding and existing policy on aviation and noise and seeks responses to questions to develop the evidence base. It discusses the impacts of aviation noise on health, the issue of annoyance and how this develops over time. It considers different methodologies for measuring noise and approaches to mitigation. And it looks at specific issues, including night noise.

Sir Howard Davies, the Chair of the Airports Commission, said: "Understanding the impact of noise from aviation on communities around airports and under flight paths is central to the Airport Commission's work.

"Responses received on this important issue will inform the Commission's assessment of options to make best use of existing airport capacity and any future recommendations to Government for new airport capacity."

In particular, responses are sought to the following questions:

- What is the most appropriate methodology to assess and compare different airport noise footprints?
- How could the assessment methods it describes (in chapter 4) be improved to better reflect noise impacts and effects?
- Is monetising noise impacts and effects a sensible approach? If so, which monetisation methods described here hold the most credibility, or are most pertinent to noise and its various effects?
- Are there any specific thresholds that significantly alter the nature of any noise assessment, e.g. a level or intermittency of noise beyond which the impact or effect significantly changes in nature?
- To what extent does introducing noise at a previously unaffected area represent more or less of an impact than increasing noise in already affected areas?
- To what extent is the use of a noise envelope approach appropriate, and which metrics could be used effectively in this regard?
- To what extent should noise concentration and noise dispersal be used in the UK? Where and how could these techniques be deployed most effectively?
- What constitutes best practice for noise compensation schemes abroad and how do these compare with current UK practice? What noise assessments could be effectively utilised when constructing compensation arrangements?

The document can be found at **https://www.gov.uk/government/news/airports-commission-considers-aviation-noise** Responses are sought by 6 September.

Heathrow to rank aircraft by noise

Heathrow airport is to rank airlines according to how noisy its aircraft are as part of plans to make it quieter. It also plans to significantly increase fines for airlines that break noise limits and to trial new plane departure routes with air traffic controllers.

Other plans include steeper aircraft approaches into the airport and the establishment of a noise-insulation scheme for nearby buildings. Heathrow already imposes higher charges for the noisiest aircraft.

Later this year Heathrow will launch the Fly Quiet scheme, which will publicly rank airlines according to their noise performance.

The plans could lead to the extension of the adobe building programme for local schools. The scheme involves the construction of igloo-like shelters, made from bags of earth and plaster, which allow pupils to study outside without being disturbed by aircraft. Heathrow part-funds adobe buildings at Hounslow Heath primary school.

Heathrow Chief Executive Colin Matthews said: "Heathrow is at the forefront of international efforts to tackle aircraft noise and, as a result, even though the number of flights has almost doubled since the 1970s, fewer people are affected by noise.

"We will continue to work with airlines, the air-traffic control company Nats, policymakers and local communities to further reduce aircraft noise while safeguarding the vital connectivity and economic growth that Heathrow provides."

"A quieter Heathrow is not about adding new runways at Heathrow. It sets out important steps that can, and are, being taken now to reduce aircraft noise. However, Heathrow recognises that if it is to grow, a comprehensive package of measures to tackle noise will need to be put forward to ensure there does not have to be a choice between more flights or less noise. "

Mr Matthews said noise mitigation measures meant that Heathrow today was significantly quieter than it was four decades ago. Since the early 1970s, when the jet age began, both the area and the number of people within Heathrow's noise footprint had fallen around tenfold.

This was despite the fact that during the same period the number of aircraft using Heathrow each year had nearly doubled and the number of dwellings within the footprint had also increased significantly. The fall in population within each contour had continued in recent years, as the newest generation of aircraft like the A380 "superjumbo" had started to enter service with airlines.

He added that recent research by industry-body Sustainable Aviation suggested that this trend would continue. Its Noise Road-Map suggested that by 2050 advances in aircraft technology would allow the number of flights in the UK to double without an increase in aircraft noise.

Noise from radio-controlled rallycross buggies

By Kieran Gayler of Sharps Redmore

Background

In late 2010, Sharps Redmore was approached for advice by the operator of a race circuit for 1/8th scale, internal combustion, radio-controlled rallycross buggies. Since its opening, the circuit (site 1) at Abberton, Essex had generated a number of noise complaints from local residents and the local authority had been investigating the noise nuisance claims. Measurements and an assessment by Sharps Redmore on a busy competition day in early 2011 unfortunately confirmed that the operation of the site did, or could, amount to a nuisance and the decision was taken by the operator to close the circuit to avoid the now almost inevitable (and probably justifiable) noise abatement notice. The circuit operator then embarked on an almost two-year long search for a site, planning application and construction of a new circuit, in a considerably less sensitive location (site 2) at Marks Tey, adjacent to the A12 south west of Colchester. This culminated in the new, larger circuit being completed and ready for operation in early 2013, the first competition day taking place in early May. Sharps Redmore was involved in the entire process and we learnt a lot about this nitro-fuelled niche sport along the way. This article tells the story.

The sport

Radio-controlled racing is a popular, if niche, sport across the world, particularly so in the USA where, as you might expect, the largest circuits in the world can be found. The sport covers various different scales and power sources, including track and off-road 1/8th, 1/10th and large scale (up to 1/5th), powered by batteries (electric) or internal combustion engines – the fuel for which is normally a nitromethane and methanol mix ("nitro").

The sport is, in effect, governed by an international body, the International Federation of Model Auto Racing (IFMAR). The European Federation of Radio Operated Model Automobiles (EFRA) represents European member countries on IFMAR and the British Radio Car Association (BRCA) is the UK's governing body for radio controlled model car racing. Unlike more traditional motorsport, however, there are no obligations or requirements on any driver or track/circuit to be licensed, affiliated or in any other way accredited. Most drivers do become members of the BRCA and most formal tracks, because of the attraction of holding affiliated championships (regional, national and European), are affiliated with the BRCA. Drivers competing beyond national level (i.e. at European championships) do require EFRA licences. At higher levels, the sport is semi-professional, with the best drivers often being sponsored by car manufacturers to race their vehicles. Most of the major manufacturers have dedicated full-time race teams.

The circuits which are the subject of this article are principally for off-road racing of 1/8th nitro buggies (Figure 1). These are powered by 2-stroke, single piston engines which typically operate at up to 40,000 rpm, burning a 25% nitromethane fuel (Figure 2). Under IFMAR rules, the engines are limited to 0.21 cubic inches (3.5 cc). The buggies are four-wheel-drive and, at the high end, are capable of reaching speeds of up to 75 km/h. Their size is limited under IFMAR and EFRA rules (Figure 3) and there are various technical specifications which must be met, including limits on wheel and tyre size, body shape and rear wing dimensions and angles.

Noise levels

There is no escaping the fact that these buggies are extremely noisy. There are no rigorously enforced noise limits in existence for individual vehicles in the sport, albeit the EFRA handbook (2013, Appendix 2 – 5.3.1) contains technical specifications which include a noise limit for the muffler with INS (Induction Noise Silencer) box of 83 dB's (*sic*) measured at 10 metres. Assuming "Static Noise Test" conditions (BS ISO 5130:2007+A1:2012), this is equivalent to 109 dB at 0.5 metres. For comparison, Chart 5.18 of Appendix 1 of the Motor Sport Association Common Regulations for Competitors: Vehicles, contains the static noise test limits for UK motorsport. These are shown in Figure 4.

It can be noted that the EFRA limit for the radio-controlled buggies (equivalent to 109 dB at 0.5 metres) is actually similar to the highest of the MSA limits (108 dB for rally cross, single-seater and sports racing cars; 110 dB for sports libre cars) before taking account of the fact that the buggies are 1/8th of the size, which could account for an additional 11 dB (crudely assuming a 10-log increase with size)!

The exhaust systems do, however, include silencers (Figure 5) and EFRA operates a system of "homologation", or approval, of the silencer systems, producing an annual list of approved systems for competition. It appears, from the foreword to the 2013 approved muffler list, that EFRA has aspirations to reduce noise levels by 2014, but it openly acknowledges that "manufacturers have no priority for this", whilst also recognising that the "noise generated is a combination of RPM, INS box, muffler, power, mechanical noise, clutch system, gearing etc. Only two parts are controlled by the homologation system." As with all motorsport, the relationship between a static test value and that produced under race load conditions on the track is difficult to define and certainly not uniform.

EFRA rules state that the 83 dB noise limit (for a muffler with INS box) is to be measured at 10 metres distance and 1 metre high for a single car. EFRA's definition of a noise level is always final, EFRA may noise test any car at any time during the event and, finally, EFRA noise testing equipment will make all tests regarding noise levels. Correspondence with EFRA revealed that the noise limit has been in place for 25 years, and has increased from 81 to 83 dB at some stage, to reflect the increased power of the engines which now also operate at higher revs than historically.

EFRA does not specify, however, how the test should be carried out, and there is no reference to any standard for measurement (ISO 5130, for example). As EFRA has pointed out to us in correspondence, it is difficult to undertake a true "static test" of the r/c

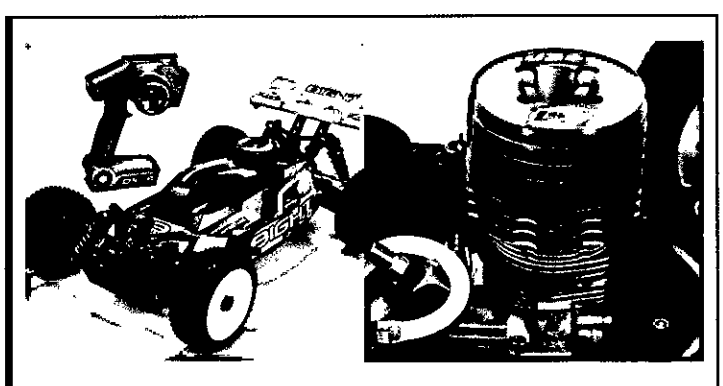


Figure 1
A Losi 8ight, a typical 1/8th scale competition specification 4wd buggy

Figure 2
Single-piston "nitro" engine

Images from www.Losi.com

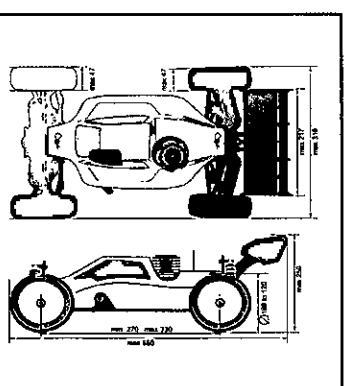


Figure 3
EFRA dimensions for 1/8th scale internal combustion buggy

buggies, in particular because it is difficult, if not impossible, to hold the simple single piston engines at ¾ revs (as would be required under ISO 5130) without load on the wheels and the clutch engaged and the engine will, as a result, simply over-rev. It should be remembered that these are relatively crude, single piston two-stroke engines with a glow plug, mechanical servo-driven throttle and no electronics, not sophisticated race cars with electronic engine management systems and rev counters.

The BRCA does not impose any noise limits and does not routinely undertake noise testing at any events. The BRCA tells us that it has worked with the MSA Noise Officer and various local environmental officers around England and Wales with varying results. They have stated a desire for noise to be limited to the "low 80s" but have yet to devise a method for measuring and enforcing this. The BRCA allows itself to default to the worst case, which is, in its view, the MSA motor sport limits. Furthermore, it tells us that it has used the static noise test but discovered that almost all of the available pipes fail the EFRA specified level, which brings into question the EFRA homologation and testing process. The EFRA limit is, theoretically, for the muffler box only (ignoring the contribution of engine noise), although it is unclear how EFRA sees it would be possible to separate the two elements in its testing process.

Chart 5.18: Maximum Noise Limits

The following table gives alternative distance readings. (Noise measured in dB(A).)

	0.5m	2.0m	
Section 'A'	105	93	CAR RACE (SALOON AND SPORTS CARS) MAXIMUM AT ¾ MAXIMUM RPM
Section 'B'	108	96	CAR RACE (SINGLE SEATER AND SPORTS RACING CARS) MAXIMUM AT ¾ MAXIMUM RPM
Section 'C'	100	88	STAGE RALLY, AUTOTEST, TRIALS, MAXIMUM AT 4,500 RPM
Section 'D'	98	86	ROAD RALLY MAXIMUM AT ¾ MAXIMUM RPM
Section 'E'	100	88	CCV MAXIMUM AT ¾ MAXIMUM RPM
Section 'F'	108	96	AUTOCROSS AND RALLYCROSS MAXIMUM AT ¾ MAXIMUM RPM
Section 'G'			HILLCLIMB AND SPRINT MAXIMUM AT ¾ MAXIMUM RPM –
	110	98	RACING AND SPORTS LIBRE CARS AND CARS COMPLYING WITH S.12 AND S.13
	108	96	ALL OTHER CATEGORIES

Figure 4. MSA static noise test limits

As part of the planning and search for Site 2, we undertook measurements of a typical single buggy. We undertook the measurements on the track at site 1 just prior to its closure to provide base data for future assessment. The measured levels, which were subsequently used for the SoundPLAN models developed in the assessment of site 2, are shown in Table 1. P32

P31 The variance in the ratio between sound pressure and sound power results from the difference between point source (static testing), moving point source (acceleration from corner) and, theoretically, full speed straight line source. Because these are not standard noise sources to be found in the modelling software's libraries, checks were undertaken in the modelling software, whereby we modelled a receptor at 1-metre from each source to reflect the measurement position used in the data gathering. We adjusted the sound power level to achieve the measured sound pressure level at that point and in doing so, we could be sure that the models reflected the reality of what we had measured on site.

Figure 6 shows the 1/3 octave spectrum of the static engine testing level, which was undertaken at maximum revs, as opposed to being a true static test in accordance with ISO 5130. It can be seen that the single piston nitro engines do emit tonal noise, concentrated in the 500Hz and 630Hz 1/3 octave bands (directly related to the engine speed at 30,000 to 40,000 rpm). This gives the engines a very distinctive and recognisable sound, which draws attention to the noise source and can, of itself, enhance the likelihood of complaints. At site 1, many of the nearby residents described this as a high-pitched whine or buzzing and by one resident it was compared to the noise made by a mosquito inside their property.

In addition, smooth acceleration (as might be the case in Formula 1, for example) is not a feature of competitive r/c nitro buggy racing. The nature of throttle control in races is, in fact, far from smooth. Most drivers "feather" the throttle to pulse fuel through the system to keep the carburettor clear and deliver power to the wheels without losing traction on the off-road surface (a crude system of traction control). This is enhanced by the off road nature of the sport, which includes jumps, banked turns and obstacles to further add to the intermittency of the engine noise.

Comparison of the locations of sites 1 and 2

Site 1, unfortunately, was never likely to be an acceptable location for such a high-level noise-generating activity. The track was no more than 140 metres from the nearest receptor. There were no other major noise sources in the vicinity, with the local road through the village being a "B" road, and not particularly heavily trafficked. A further disadvantage was the proximity of some large isolated properties, well away from even the B road through the village. Background noise levels were relatively low, especially at the isolated properties. The noise from the track was clearly audible and disturbing at all locations and there was no masking effect from any other noise sources. The construction of the track (with banked edges, but no additional screening) was such that mitigation options were not readily available, compounded by the fact that there were receptors in all directions meaning screening would need to fully enclose the track, making access and visibility difficult. The only reasonable conclusion was that the activity could not continue in this location.

Having closed and dismantled site 1, the client engaged us to continue advising in the search for an alternative site, a search which, ultimately, took over a year and the consideration and crude assessment of several sites ranging from a disused quarry to an isolated field in a rural location, before coming across "site 2."

Setting aside commercial (rent, availability, access) considerations, which the client successfully resolved, site 2 presented an opportunity to position the track some distance (minimum 300 metres) from any receptor. A further advantage was that those nearest receptors were in very close proximity to a major busy dual carriageway, so background noise levels would be high. The receptors further away and, as a result, subjected to lower noise levels from the dual carriageway were separated from the site by a larger distance, an expanse of agricultural land and a mainline railway.

Figures 7 and 8 show the locations of the two sites (at the same scale) for comparison.

The planning application, submitted in August 2011, was for "Change of Use of land to form racetrack for remote controlled vehicles". This, perhaps obviously, does not fall into any particular planning use class (i.e. *is sui generis*). Our noise assessment followed in October 2011 at the request of the local planning authority.

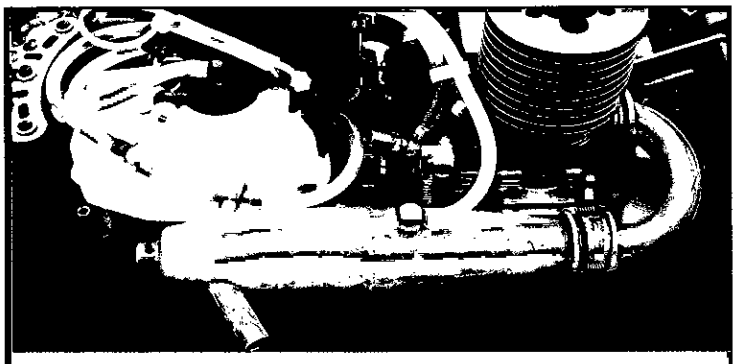


Figure 5. Typical engine and silenced exhaust system

Source	Measured Sound Pressure Level L_p dBA @1m	Equivalent Sound Power Level L_w dBA
Static engine testing	99	108
Full speed straight line	94	111
Acceleration from corner	84	110

Table 1

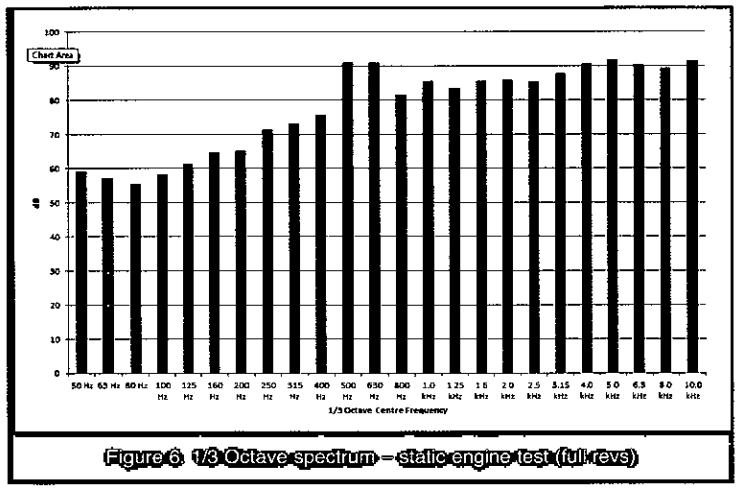


Figure 6. 1/3 Octave spectrum – static engine test (full revs)

Assessment methodology for site 2

In a similar way to mainstream motorsport, there is not an established or well-founded method of noise assessment. Noise from nitro powered radio controlled buggies is a unique and unusual source of noise and this makes the likelihood of a "standard" method of assessment even less likely. We decided, therefore, to assess site 2 by reference to the three main methods of noise assessment used regularly for many other noise sources. These were:

1. reference to guideline noise levels or absolute thresholds, for example those contained in the World Health Organisation (WHO) Guidelines for *Community Noise* and British Standard (BS) 8233:1999 "*Sound insulation and noise reduction for buildings*". We also, as it is important, set the noise levels and guidelines into context with the existing noise climate, especially where that noise climate was already in excess of those guideline values.
2. reference to the existing background noise level (L_{A90}). This is the method employed by BS 4142:1997 "Method for rating industrial noise affecting mixed residential and industrial areas" to determine the likelihood of complaints about noise "... of

Figure 7. Location of Site 1

Figure 8. Location of Site 2

	Dual Carriageway Only	Track Only	Dual Carriageway +Track
Receptor	$L_{Aeq,1Hr}$	$L_{Aeq,1Hr}$	$L_{Aeq,1Hr}$
Beside Dual Carriageway (N)	71.1	41.1	71.1
Farmhouse (S)	56.0	48.0	56.6
Village (N)	50.7	41.0	51.1
Opposite Side of Dual Carriageway (E)	73.8	46.4	73.8
Opposite Side of Dual Carriageway (NE)	68.4	40.9	68.4

Table 2

an industrial nature in commercial premises..." amongst others.

3. reference to the change in noise level that would result from the proposal. This would normally be applied to a change in the level of an existing source (road traffic, for example), as opposed to the change brought about by the addition of a new noise source. In this case, however, we looked at how the noise levels from the track would influence the existing noise climate (if at all).

Existing noise climate at site 2

Competition race days would generally be held on a Sunday. As such, noise surveys were undertaken over an entire day on a Sunday. The measurements were undertaken at two locations:

1. Southern site boundary, approximately 15 metres from the dual carriageway, to reflect the noise climate at properties fronting the dual carriageway to the north east.
2. Northern field boundary with the railway line, approximately 300 metres from the dual carriageway, to reflect the noise climate at properties in the village to the north, and the farmhouses a similar distance from the dual carriageway to the south.

The noise levels throughout the survey were dominated by the dual carriageway. For this reason, noise from the dual carriageway was also included in the computer modelling.

For information, the existing ambient noise climate, as surveyed, was between 70 and 73 dB $L_{Aeq\ 1Hr}$ at position 1 (South) and between 61 and 65 dB $L_{Aeq,\ 1Hr}$ at position 2 (North). Background noise levels were between 62 and 68 dB $L_{A90,\ 1Hr}$ at position 1 and between 56 and 60 dB $L_{A90,\ 1Hr}$ at position 2.

Noise from circuit operation

Computer model inputs

Noise from the operation of the circuit was modelled using SoundPLAN software, using the source data obtained from site 1. Competition days give the worst-case noise levels. Competitions are an all-day event, with a number of heats during the day, followed by "A", "B" and, sometimes "C" finals. There would be, typically, 10 buggies on the track in each heat and final.

Heats are generally seven minutes long. Laps are both timed and counted and drivers are given points for both fast lap times and the number of laps travelled. A seven minute heat does not usually involve pit-stops and most of the buggies can last for up to 10 minutes on a single tank of fuel.

Finals are usually run over 20 minutes under the same conditions (European and World Championship finals are run over 40 minutes or one hour). The winner is determined by who has travelled the most laps in the least time, with a "Time + Final lap" system (i.e. when the time expires, drivers complete the lap in progress at that time). The cars all contain computer transponders which are detected by relay systems around the track, with a central computer system analysing the results.

Each source was modelled with the model programmed to the following (peak hour) operating conditions:

- 2 x 20-minute finals (i.e. track in race-conditions operation for 40 minutes in an hour).
- 10 vehicles compete in each final.
- Static engine testing/warming-up by 20 competitors (usually on tables located to the rear of competitor's cars/vans in the car parking area). This would typically be for around five minutes by each competitor.

At the time of the planning application assessment, the track layout used for the models was provided to Sharps Redmore by the client's track designer but was an indicative layout only. The circuit was modelled, however, with the proposed earth banking around (to four metres height), with banked corners to the track. Alterations to the final track layout within the four metre high bunding would be, it was considered, unlikely to affect noise emissions to any significant degree. Indeed, one of the advantages of the track construction (see below) is that the layout can be reconfigured quickly and easily to add variety to the course and set different challenges to drivers.

The SoundPLAN model results were verified against measured values taken at site 1 at a fixed measurement position, a known distance and unscreened from the track on the race day (similar operating conditions) in early 2011.

For the models which included noise emissions from the dual carriageway, traffic flow data was obtained from the Highways Agency. These model results were also verified against measured levels from the noise surveys undertaken on site.

The topography of the site and surrounding land was incorporated into the models using the NextMAP Digital Ground Model system.

Outputs from the SoundPLAN models are shown in figures 9 and 10.

It was clear from the models that the track, except in close proximity, has relatively little influence on the existing noise climate, which is dominated by noise from the dual carriageway. From the models, the calculated results at each receptor point are shown in Table 2.

Using these calculated levels, the assessment was undertaken against the various assessment methodologies discussed. P34

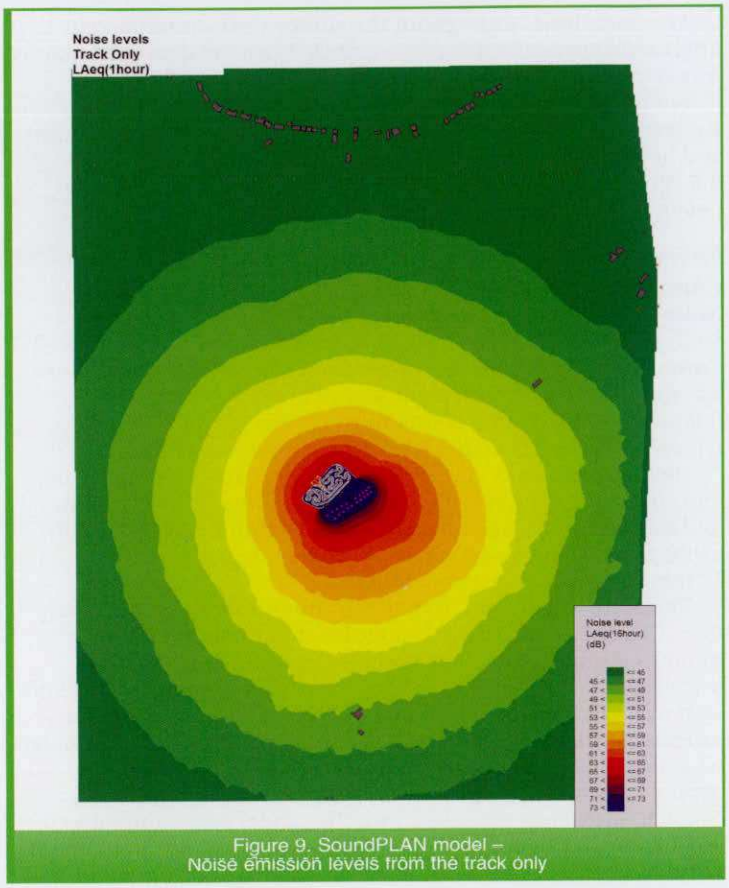


Figure 9. SoundPLAN model – Noise emission levels from the track only

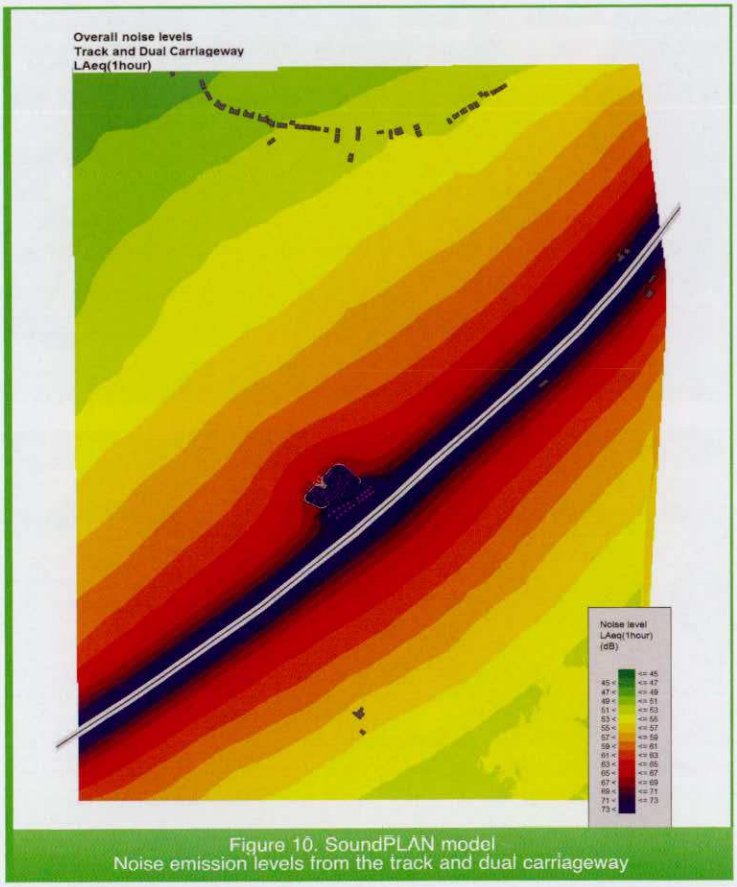


Figure 10. SoundPLAN model Noise emission levels from the track and dual carriageway

P33 Our conclusions were as follows:

- The noise emissions from the site affecting any nearby residential receivers would be well within World Health Organisation guidelines for community noise, specifically against the lowest daytime "annoyance" threshold. This was also set into context against an existing noise climate already significantly above this threshold value.
- Changes in noise levels as a result of the introduction of the proposed facility, at any nearby residential receiver would be negligible and insignificant when compared with the noise levels generated by the dual carriageway. When also taking into account other noise sources in the vicinity, and measured data, there would be no change in the existing noise climate.
- Under a BS 4142-type assessment, the rating noise level from the proposed facility (including a penalty for tonal noise from the single piston engines) would be between 3 and 7 dB below the background noise level at any time of the day on a Sunday at the most exposed receptors. Whilst not a "complaints unlikely" situation, we took this as an indication that noise complaints would not be expected given the existing noise environment.

For the "BS 4142" assessment, whether the tonal noise emissions are sufficient to meet the BS 4142 criterion that "*the noise contains a distinguishable, discrete, continuous note*" is questionable in this case. Whilst the noise at source is tonal, the resultant levels at the receptors were between 8 and 30 dB less than the existing ambient noise climate, meaning the tone is actually very unlikely to be distinguishable, discrete and continuous.

Considering the three assessment methodologies individually, and in combination with each other, we concluded that there was unlikely to be adverse noise impact, harm or disturbance from the operation of the proposed facility. A sterner test of the acceptability, or otherwise, might have been if the assessment had "failed" on any of the tests, i.e. exceeded the WHO guidelines, or brought about a noticeable change in the existing noise climate, or shown a likelihood of complaints resulting from a BS 4142 assessment. Our very careful and methodical site selection, however, means that the track is some distance from receptors, the background and ambient noise levels at those receptors are already high as a result of the adjacent dual carriageway and, as such, the impact of the track is limited in that environment.

Construction process

Planning permission was granted in November 2011, subject to a number of planning conditions (including pre-commencement conditions relating to highways, landscaping and earthworks). Of note in relation to noise emissions, there are conditions limiting hours of operation, number of events per year and the number of vehicles allowed to attend each event (referring to competitors' vehicles rather than the radio controlled buggies).

The track covers an area approximately 150 metres in length and 50 to 70 metres wide. The whole site covers an area of just under 1 hectare.

After discharging a number of pre-commencement planning conditions, work to turn this corner of an agricultural field into a radio-controlled buggy race track began in June 2012. Progress was slow, principally as a result of the wet summer of 2012 hampering the necessary import of almost 25,000 tonnes of soil (which may otherwise have gone to landfill) to form the track bed and banking. The banking is up to 4.5 to 5 metres high and approximately 15 metres wide at the base and 6 metres wide at the crest (Figure 11). This performs an acoustic screening function as well as providing the banked corners for the track. The internal track bed was then covered in artificial grass (Figure 12) –"astro-turf" recovered and recycled from several local authority sports pitches which were being re-laid.

The drivers' rostrum (elevated above the track) and other facilities are formed from shipping containers and other re-usable portable buildings. Much of the track edging is formed from waste tyres. Construction was completed in December 2012, and, with a slight delay for the winter weather, final touches were added in early 2013 and the first buggies were run round the track in early spring. Competitive racing began in May 2013, although take-up for race days has been slow as a result of the delayed opening

(meaning drivers had already booked into summer race seasons at other national facilities).

Surveys after opening

Beyond verification of the 1-metre distance source levels, we have been unable to undertake surveys to check the levels in reality against modelled values. When site 2 became operational, it was our intention to undertake surveys to assist in future similar projects. However, because of the delayed opening of the site, many potential competitors had already booked into summer race seasons at other national facilities and take-up of the competition days has, so far, been slow. What we have found is that, because of the high background levels generated by the adjacent dual carriageway, finding a measurement position where noise from the track is discernible, or measurable, has so far proved impossible. This may be made easier during a fully-booked competition day (10 cars on the track at a time), although we are doubtful.

We identified, from the models, that a position 50 metres to the north of the track would give a worst-case track level (LAeq) approximately equivalent to that from the dual carriageway (so we could identify at least a measurable change in the ambient level with the track operating). In closer proximity, noise from the dual carriageway becomes dominant, and at further distances, noise from the track becomes too low a level to measure reliably. Our attempts to measure noise from the track in isolation from the high background noise levels from the dual carriageway have, as a result of the combination of factors mentioned above, not proved successful so far.

It can be assumed, however, that the propagation of sound over the terrain modelled is as accurate as it can be in the modelling software, so the accuracy of the models is, to a large extent, dependent on the correct input data and assumptions. We verified the source data obtained at 1-metre against the original models using measurements from the previous operation site P36

Figure 11. Construction of soil banking

Figure 12. Artificial grass track-bed

P35 (site 1). An advantage of this project was the ability to measure at the previous site to inform future models. For many projects this would not be a possibility.

Lessons learned/further work required

- Site selection is key. These facilities are unlikely to be acceptable in a quiet rural area, or in low background levels, or in close proximity to receptors. Isolation is not necessarily easy in the UK, but the first port of call must be separation from receptors.
- More work is needed by the governing bodies on noise limits and monitoring. Such work is currently sketchy or non-existent and not supported by any substantive research it appears.
- More effective "at source" noise control might begin to make the location of these facilities closer to receptors, in lower background noise environments, more acceptable.
- The assumptions in the models are critical (i.e. the number of cars, their levels, on-time, etc.). As with any modelling or calculation exercise, the quality of the inputs dictates the reliability of the outputs.
- No single assessment methodology is appropriate in isolation and a judgement has to be made on which of the recognised generic methodologies are applied in individual circumstances.
- The verification of the noise models, as discussed, has proved difficult other than at close quarters. We are continuing to work on this aspect and hope to arrive at a suitable measurement process in due course. This could potentially be during the winter race series where the operator is hoping to attract larger numbers of competitors to the all-weather track (many similar tracks close in the winter). ◘

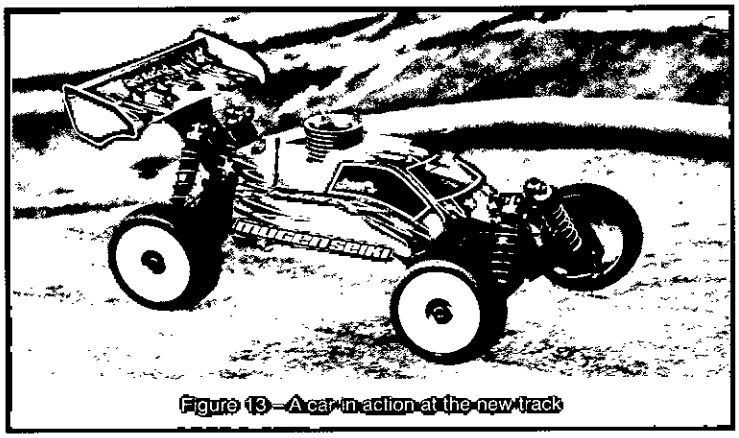


Figure 13 – A car in action at the new track

Wind turbine noise Good Practice Guide – 'the good and the bad'

By Dick Bowdler

In the last issue of *Acoustics Bulletin* Richard Perkins reported on the presentations at the meeting in Bristol in May. Regrettably I was unable to attend so I did not hear at first-hand what I am told was a "lively discussion".

I have written at length in this publication and elsewhere of my concern that the IOA should not have taken on the writing of the Good Practice Guide (GPG) on the terms agreed with DECC – particularly the ban on consideration of the limits. Richard's comments at the wind farm meeting in January 2012 that the work of the group "would be in vain if government did not feel they could endorse it at the end of the day" expresses a position that I do not feel the Institute should be proud of and will leave a perception in some minds that we are not independent. I am disappointed that the Institute does not feel strong enough professionally to take on a technical task that might result in some criticism of government guidance. Indeed, I am disappointed that the Institute is not up in the front helping formulate government policy on noise. The noise limits for wind farms are in need of fundamental review. Until they are looked at properly there will be no consensus on how we can progress renewable energy of all kinds in a sustainable way.

But enough of that. What of the GPG and, since there was a lively discussion, some of the criticism?

Technically the document will be very useful and should reduce considerably the number of disputes on technical matters in wind farm applications and at public inquiries. I have already quoted it in several reports dealing with wind farm noise assessments. In two public inquiries, to my knowledge, inspectors have come back after an inquiry is finished and asked for comments from the parties on how the GPG might affect the evidence already given.

Sections 2.2 to 2.5 of the GPG provide very helpful clarification of the background noise measurement procedure. In the past this has often been a source of argument at public inquiries. In some cases the background noise levels have been rejected as being unreliable and, in at least one case, a public inquiry has been adjourned to allow for proper background noise levels to be established. These sections should minimise such argument. Section 2:6 gives detail of wind measurement procedures. It is particularly useful in starting to ensure wind measurements are as accurate as the sound measurements. Up till now, there has been no control over the accuracy of the wind measurement and few ways of checking whether it is reliable. Sections 2.7 to 2.9 also clarify the position by tightening up the requirements for data collection.

Section 3.1 expands on ETSU-R-97, in particular the use of directional analysis. This has arisen in public inquiries in the past and this section formalises its use. Section 4 establishes the procedure for turbine noise prediction. This is largely a confirmation and an extension of a procedure already used in most noise assessments – but not all – and it will formalise the position and hopefully reduce debate on specific projects. The one criticism I have is that the matter of "warranted" noise levels should have been better clarified. The use of "warranted" levels was found to be inadequate following the "Bulletin Article Method" in 2009 and though there is some more explanation it is still not adequate.

Perhaps one of the most useful pieces of analysis is section 5 which discusses the contentious area of cumulative noise. Whilst it offers little in the way of solutions that is not a criticism because, as many of us have discovered, there is no solution in many cases. Interestingly we may be about to get a policy decision from both Scottish and Westminster governments on this as Harelaw in Scotland is to be decided by Scottish Ministers and Turncole in Essex has been recovered by the Secretary of State because of the importance of the arguments to government policy. The main arguments in both cases were cumulative issues, though not only in the case of noise.

But what of the GPG's deficiencies? The biggest is the loose drafting which will inevitably result in arguments about, not the technical content, but the interpretation. At consultation stage I suggested it was far, far too long. Even though it is now half the length it is still far, far too long. The longer it is the more difficult it is to draft it tightly and unambiguously. Let me give a few examples of what I mean:

- The excellent section 2.5 is spoilt by the wording of the first paragraph – "the following guidelines are offered": Offered? Does this mean "for your consideration"? Why can it not say "We recommend that:" or "Best practice is:" ◘

Turbine noise levels are plotted against standardised 10m wind speed

- Section 3.1.20 says: Where a noise limit is required at higher wind speeds, it should be restricted to the highest derived point. A dispute as to what this means has already arisen at public inquiry in June 2013. What the GPG says is that the noise LIMIT should be restricted to the highest BACKGROUND NOISE LEVEL – not to background noise plus 5dB. Does it really mean this?
- Section 3.2.4 records current practice in establishing day time limits. Does this mean current bad practice or good practice? It does not say, it only says what current practice is. Indeed some of it is contrary to ETSU-R-97 so presumably it is bad practice. If the GPG is not going to make a positive recommendation then it should say nothing.

Finally, let me deal with what appears to be the main objection. This is the introduction of the "standardised" 10m wind speed instead of the "measured" 10m wind speed for background noise. As I understand it, REFs objection to the wind shear method (which was first put forward in the Bulletin article in March/April 2009) comes from Mike Stigwood's analysis. In principle he argues that the "article" method gives less protection than the "ETSU" method. I'll come to that in a minute but the main point in making the change was to put right something that was technically and scientifically inaccurate.

Turbine noise levels are plotted against standardised 10m wind speed because that is how their sound power levels are described under IEC61400. In other words, they are plotted against the hub height wind speed divided by a fixed figure dependent on the hub height. So five or 10 years ago, when we plotted turbine noise and background noise on the same graph, the turbine noise was plotted against **standardised** 10m wind speed but the background noise was plotted against **measured** at 10m. In high wind shear conditions, as Mike Stigwood rightly points out, the measured 10m wind speed might be 3m/s but the standardised 10m wind speed might be 5m/s – we had apples and pears on the X-axis – so the two curves simply could not be compared. Hence, the GPG proposes that background noise should be plotted against "standardised" wind speed so that it relates properly to the turbine noise plot and so we only have apples on the X-axis. Of course the group could equally have changed the turbine noise to measured 10m wind speed and left the background noise at measured 10m so they only had pears on the X-axis.

Mike's argument against this can be found on his website and a summary is at: **http://www.masenv.co.uk/uploads/Summary%20ETSU%20IoA%20article.pdf**

Mike perpetuates the original scientific inaccuracy. Let me refer to figure 3 in his summary. He shows a curve for turbine noise limit plotted against wind speed. Presumably it is 10m wind speed, though it does not say. If it is he does not say whether it is measured 10m wind speed or standardised 10m wind speed. That is convenient because the green broken line assumes the X-axis is measured wind speed and the blue broken line assumes the X-axis is standardised wind speed. He has apples and pears on the X-axis so technically and scientifically it is wrong – the green and blue lines simply cannot be compared.

Does the GPG method give worse protection to residents than the "ETSU" method? The situation is that the "ETSU" method understated protection when wind shear was greater than the standard wind shear of about m=0.16. This is just the same as ETSU understating impact when background noise is less than the average background noise. The GPG method understates protection when the wind shear is greater than the **average** wind shear during the monitoring period. In effect, the wind shear is averaged together with the background noise level. Whether that is the right or wrong way of doing it is another argument.

In conclusion, as far as it goes, the GPG will make a helpful contribution to good practice in turbine noise assessments. It will prevent some of the commonest arguments at public inquiry – or at least make it clear which party is right. Unfortunately I think the loose drafting will introduce a different set of arguments about interpretation and eventually the question of limits will have to be addressed.

The highs and lows of domestic sound insulation

By David Trew and Tomasz Galikowski of Bickerdike Allen Partners, London

Introduction

This article is composed of two parts. The first discusses the design standards currently being used to set increasingly high standards of sound insulation. Building Regulations minimum sound insulation performance standards are rapidly going out of fashion as higher acoustic standards are frequently required as part of various sustainability requirements. These include the "voluntary" Code for Sustainable Homes credits and the Bronze, Silver and Gold sustainability scores for sound insulation available within the Scottish Building Standards.

Part two discusses problems and potential solutions associated with the low levels of sound insulation which is unfortunately prevalent in the existing housing stock. Baxter and Mills appeared to have removed a remedy for those suffering in dwellings with very poor levels of sound insulation. This part of the article will present a typical case study of some "problem flats" and discusses a potential remedy through the Housing Health and Safety Rating system.

The highs

Introduction

The current regulatory minimum sound insulation performance standards are presented below along with higher acoustic performance standards available for optional credits for sustainability rating systems.

English Building Regulations – Approved Document E (2003)

The Approved Document E[1] numerical performance standards to be achieved for newly built or converted dwellings are shown in see Table 1.

Code for Sustainable Homes

The Code for Sustainable Homes (CfSH)[2] is an environmental assessment method for rating and certifying the performance of homes. It covers nine categories, each containing various environmental issues. Sound insulation is part of Health and Pollution category and its aim is "to promote the provision of improved sound insulation to reduce likelihood of noise complaints from neighbours". Optional credits are awarded when the sound insulation performance surpasses the performance set out in Approved Document E. See Table 2.

Scottish Building Regulations – Technical Handbook (2011) Part 5: Noise

Technical Handbook Section 5: Noise[3] is one of six categories covered by the Domestic Building Regulations for Scotland. The current numerical performance standards for new build and conversions are set out in Table 3.

Section 7 of the handbook (Sustainability) makes it possible for developers or planning authorities to pursue higher performance standards of categories ("Aspects") covered by the Technical Handbook. A certification scheme is introduced based on three core Sustainability Levels known as Bronze, Silver and Gold levels. In order for the building to be recognized as achieving any of these levels, all aspects under that particular level must be met.

Sound insulation is part of Well-being and Security Aspect. The performance standards quoted in Table 3 are treated as benchmark levels (Bronze level). Silver and Gold require that the sound insulation performance of separating partition is 2 dB and 4 dB better than that of the benchmark standard, respectively. Table 4 summarizes the performance levels.

Comments

The introduction of pre-completion sound insulation testing and Robust Details has had a significant benefit with regards to demonstrating compliance with regulatory sound insulation performance standards. There are various example constructions available (such as those in Approved Document E and those presented the Robust Details manual) to assist designers to comply with the performance standards required for new-build homes. The designs can, if built correctly, consistently achieve current regulatory minimum performance standards. The design details provide a margin of safety, albeit limited, to accommodate variations in performance from site to site, room geometry and to account for measurement uncertainty to some degree. Some faults in workmanship or detailing can also be accommodated with a relatively low risk of a failed sound test.

However, in the authors' experience these regulatory minimum standards are rapidly going out of fashion. Higher acoustic performance standards are now becoming the norm for many new-build developments. Not all of the example constructions designed to meet minimum regulatory standards have the safety margin required to consistently achieve the higher performance standards. A commitment to achieve higher performance standards across a development, to meet sustainability targets, therefore substantially increases the risk of failed sound tests.

New construction details are continually being developed to provide higher acoustic standards. However those which can routinely achieve the highest on-site requirements are thin on the ground. This creates problems when commitments to achieve these highest standards are made early on in the design stage without appreciating the design constraints and practical implications for designers and contractors to achieve these standards consistently.

The lows

Introduction

This article now presents examples of very poor standards of sound insulation in existing housing stock and investigates the Housing Health and Safety Rating System (HHSRS)[4] as a potential mechanism to address this issue. There are many examples of newly constructed or newly converted dwellings with poor standards of sound insulation. It is expected that the Building Control and/or property warranty system is available as a remedy for these. This article focuses on older properties normally constructed well before any Building Regulations minimum acoustic standards.

Pre 1998 – Statutory nuisance provisions of Sections 80 and 82 of Environmental Protection Act 1990

Prior to 1998 local authorities could deal with complaints about poor domestic sound insulation by serving abatement notices requiring remedial works, under S80 of the Environmental Protection Act (EPA). However, the Baxter and Mills[5] judgment involving two separate cases of poor sound insulation prevented many authorities using this mechanism for remedial measures.

1998-2006 –Statutory nuisance provisions of Section 79 of Environmental Protection Act 1990

Despite the judgment and the precedent set by the Baxter and Mills cases, there are records that notices were still being served using the "prejudicial to health" Section 79 limb of the EPA.

A second judgment, Vella 2005[6], tested the use of the "prejudicial to health" limb of the EPA. This case failed and had a similar impact of preventing the EPA being used as a mechanism to remedy flats with very poor standards of sound insulation.

The case and the judgment acknowledged that improvements were available on the horizon "*Parliament has provided for a separate statutory code under which local authorities have express powers and in the most serious cases duties to deal with sound insulation. In addition, government has, by means of the decent homes standard, introduced a scheme by which planned*

Dwelling Houses and Flats		Airborne standard $D_{nT,w} + C_{tr}$ dB	Impact standard $L'_{nT,w}$ dB
Purpose built dwelling-houses and flats	Walls	at least 45	N/A
	Floors and stairs	at least 45	up to 62
Flats formed by material change of use	Walls	at least 43	N/A
	Floors and stairs	at least 43	up to 64

Table 1. Approved Document E numerical performance standards

Credits	Airborne standard $D_{nT,w} + C_{tr}$ dB	Impact standard $L'_{nT,w}$ dB
1	+3 (at least 48 dB)	-3 (up to 59 dB)
3	+5 (at least 50 dB)	-5 (up to 57 dB)
4	+8 (at least 53 dB)	-8 (up to 54 dB)

Table 2. Code for Sustainable Homes – assessment criteria

Dwelling Houses and Flats		Airborne standard DnT,w dB	Impact standard L'nT,w dB
New build and conversions not including traditional buildings	Walls, floors and stairs	at least 56 dB	up to 56 dB
Conversions of traditional buildings	Walls, floors and stairs	at least 53 dB	up to 58 dB

Table 3. Technical Handbook – acoustic performance requirements

Aspects	Airborne standard $D_{nT,w}$ dB	Impact standard $L'_{nT,w}$ dB
Bronze	at least 56 dB	up to 56 dB
Silver	at least 58 dB	up to 54 dB
Gold	at least 60 dB	up to 52 dB

Table 4. Technical Handbook – higher sustainability performance standards

improvements to the social and private housing stock in this country will be made by 2010". Although not explicitly stated, this new regime will have been the Housing Health and Safety Rating System.

The Housing Health and Safety Rating System Regulations (2005)

On 6 April 2006 The Housing Health and Safety Rating System (HHSRS) came into force. This replaced the Housing Fitness Standard. This provided a duty under the Housing Act 2004 to all councils in England and Wales to assess potential health and safety risks to dwellings. These health and safety risks now included noise both from outside the dwelling and inside the dwelling from normal domestic behaviour. Noise from anti-social or unreasonable behaviour was excluded from the HHSRS as this is already adequately covered under the EPA.

The HHSRS provides an objective methodology for rating Health and Safety Risks in a home. If there are risks to the health or safety of occupants that the inspector thinks should be dealt with, owners and landlords will have to put matters right. If the officer finds a serious hazard (i.e. one in the higher scoring bands A – C, called a Category 1 hazard) the local authority will be under a duty to take enforcement action. Category 2 hazards (i.e. those in scoring bands D - J) will be ones that the officer judges are not as serious. For these less severe hazards local authorities are still be able to take discretionary action if they think it necessary.

Current guidance

In the authors' opinion, the HHSRS presents, at first impressions, a transparent and thorough objective method of testing the severity of various health and safety risks. However, there is little P40

Example reference	Details	Estimated acoustic performance[1]	HHSRS Rating and category
14.1 ODPM Worked examples V2 – March 2004	Environmental noise only – Poor single glazed traditional sash windows. Busy road on one façade. Main line rail on the other. Environmental noise will interfere with activities and disturb sleep	N/A for sound insulation	2445 - B Category 1 Enforcement required
14.1 ODPM Worked examples V2 – March 2004	1960s conversion. Terraced house to flats. Party floors acceptable sound insulation. Basic timber stud partition between living room and bedroom of neighboring flat is poor.	Wall 40 $D_{nT,w}$ 33 dB $D_{nT,w}+C_{tr}$	815 - D D Cat 2 Enforcement optional
14.02 LACORS/BCC V2 – January 2007	1970s conversion. Terraced house to flats. Party floors 225 joists, 18mm floor boards, lath and plaster ceiling. No insulation. No pugging. Little external noise. Flats stacked equally. Carpet.	Floor 45 $D_{nT,w}$ 39 dB $D_{nT,w}+C_{tr}$ 51 dB $L'_{nT,w}$	49 H+ Cat 2 Enforcement optional
14.03 LACROS/BCC V2 – January 2007	Converted house. Basic timber separating floor. No carpets. No insulation. Plasterboard and skim ceiling	Floor 39 dB $D_{nT,w}$ 32 dB $D_{nT,w}+C_{tr}$ 71 dB $L'_{nT,w}$	815 D Cat 2 Enforcement optional

[1] The worked examples do not include objective data in the form of measurements of noise levels or sound insulation performance. Guidance documents recommend the use of measurements. These are estimates based on the authors' experience of comparable sites.

Table 5. HHSRS Worked examples

P39 detailed guidance on how to assess the risks associated with noise impacts.

There are many guidance documents which included worked examples, such as those produced by the Office of the Deputy Prime Minister (ODPM)[7] when the HHSRS system was launched. In addition to this, Local Authorities Coordinators of Regulatory Services (LACORS)[8] provide a useful selection of worked examples to guide inspectors making objective assessments of health and safety risk. From these sources there are four noise worked examples which are summarised in the Table 5.

The above worked examples suggest that high levels of anonymous external transportation noise can be rated as a Category 1 Hazard triggering enforcement action. Conversely, high levels of noise from neighboring flats through very basic separating wall or floor constructions are only rated as a Category 2 Hazard reducing the likelihood of enforcement action. In the authors' opinion neighbour noise through very poorly performing walls and floors presents an equal if not higher health risk than external environmental noise.

Useful evidence based benchmark standards are presented in the document *Housing and sound insulation*[9] which presents a rating system known as the Occupant Equivalent Rating (OER) system. This was based on more 800 interviews and measurements taken over a wide range of dwellings. This system uses 3 dB bands to rate the sound insulation between A* (excellent) to G (intolerable) and can be seen in Table 6.

This system would rate the sound insulation performance of worked examples 14.1 and 14.03 as "intolerable". However, the HHSRS worked example ratings marginally falls short of the threshold for a Category 1 Hazard reducing the likelihood of enforcement action.

Occupant Equivalent Rating (OER) for airborne sound insulation	Airborne performance dB $D_{nT,w}$
A* EXCELLENT	>64 63 62
A	61 60 59
B	58 57 56
C	55 54 53
D	52 51 50
E	49 48 47
F	46 45 44
G INTOLERABLE	43 42 <41

Table 6. OER Ratings for airborne sound insulation

Existing use of HHSRS

A summary of the current use of HHSRS both generally and in relation to noise hazards has been summarised by Kayani[10]. A 2011 review found that less than 10% of dwellings with Category 1 Hazards were dealt with in any year. A 2010 study from Noisedirect[11] used Freedom of Information Requests to 98 local authorities in London and the South East to provide an indication of how frequently HHSRS is used for noise hazards. Only 5% of the 89 respondents had taken enforcement action and only four notices (including 1 Hazard Awareness Notice) were served.

This research was limited to London and the South East. Bristol City Council is more proactive in the implementation of the HHSRS. It is understood that the current approach, if the problem cannot be resolved informally, is to use Hazard Awareness Notices under the Housing Act 2004 for both Category 1 and Category 2 noise hazards, with around 10-12 notices served to date.

Typical case study–eviction notice

Legal proceedings had begun for a possession order in relation to residents in a purpose built mansion block flats. Complaints had been received regarding noise disturbance through a separating floor. Bickerdike Allen was requested to provide an opinion on the level of sound insulation.

The separating floor comprised a basic timber floor with plasterboard ceiling. No opening up works were carried out and no details were available regarding the construction of the floor. Based on the results of the testing, it is unlikely that there was any absorbing material insulation and/or pugging in the floor. The property was likely to have been constructed with lath and plaster ceilings which had subsequently been replaced with plasterboard during refurbishment works.

The average airborne result was around 42 dB $D_{nT,w}$ and 34 dB $D_{nT,w}+C_{tr}$. Floor finishes could not be removed. The impact results on the floor finish varied from 37 dB $L'_{nT,w}$ on a carpet to around 71 dB $L'_{nT,w}$ on vinyl. The performance on the bare floor will have been higher than 71 dB $L'_{nT,w}$.

The sound insulation was found, unsurprisingly, to be poor with normal domestic behaviour likely to cause significant disturbance to other occupants. The performance would be rated as "intolerable" using the OER rating system.

Commentary on case study

The HHSRS system was not used in the above case. Based on the guidance currently available, this case is very similar to worked example reference 14.03. This example is marginally below the threshold for a Category 1 hazard and enforcement action would be optional. An inspector carrying out an assessment of this property, using the worked examples for guidance, is likely to have come to a similar conclusion, i.e. a Category 2 hazard. If enforcement action

had been made this would have included expensive remedial work and could set a precedent for other similar properties in the area.

It is suggested that these "intolerable" OER objective thresholds could be used to test for a Category 1 Hazard. This is in addition to other variables such as stacking arrangements, plumbing noise, noise from communal areas and external noise intrusion.

Comments

The HHSRS system provides a regulatory framework to offer improvements to those suffering from exceptionally poor levels of sound insulation. The objective assessment methodology offers some limited technical guidance for domestic sound insulation. Published worked examples include typical ratings for poorly performing separating walls and floors. These ratings fall marginally short of the threshold for a Category 1 hazard leaving enforcement limited to the lower priority Category 2 Hazards. Poor acoustic conditions from anonymous transportation noise through the building envelope are however rated as an example of a Category 1 hazard. These examples may be prohibiting the HHSRS system being used to as an effective remedy for the most serious cases of poor sound insulation.

Recent research provides evidence based support to set objective thresholds to define "intolerable" levels of sound insulation. These could be used to assist in the definition of the likelihood of a Category 1 hazard. Such an approach has significant practical problems in implementation. A transparent and objective method of testing "problem" properties is likely to cost substantially more at inspection. The remedial works to treat substantial airborne sound insulation problems will be costly. As a result this may increase the likelihood of appeals/tribunals. There are clear benefits for the residents of these problem properties. Such an approach, if successful, could substantially improve living conditions for the worst affected properties. Such an approach could also reduce expensive legal disputes involving arguably unnecessary evictions and possession orders where normal domestic behavior is resulting in intolerable living conditions.

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Noise in the printing industry: then and now

By Emma Shanks, research scientist with the Noise and Vibration Team at the Health & Safety Laboratory

Hearing damage caused by exposure to noise is permanent and incurable. Just like other industries, workers go deaf in noisy workplaces. But the issue of noise in the workplace, any workplace, is often thought of as "dealt with". "Not so", says the regulator, the Health & Safety Executive (HSE).

In April 2006 the Control of Noise at Work Regulations (CoNaWR) 2005 came into force, updating the Noise at Work Regulations 1989. The CoNaWR 2005 were born of a European Union Directive requiring equivalent basic laws throughout the Union on protecting workers from the risks caused by noise.

Between 1985 and 1994, HSE collected and studied noise data from the printing industry, spanning the introduction of the 1989 regulations, to inform industry specific guidance. Following the introduction of the 2005 regulations, HSE set about revising its industry specific guidance, including that for the printing industry. Between March 2010 and July 2011, eight different printing premises volunteered their sites to HSE to allow workplace noise measurements to take place, via the British Printing Industries Federation (BPIF) and the Newspaper Publishers Association (NPA). These measurements included personal dosimetry (where microphones are fitted to workers and monitor noise exposures throughout the day), spot measurements (short duration measurements at fixed locations around a premises), discussions with employees and managers and investigating the machinery and its associated documentation. This article compares and discusses the actual noise levels, then, and now, identifies the noisy and quiet processes and also looks at some of the changes that have occurred in the industry that have affected the noise levels.

Brief overview of different printing processes

There are generally six main printing processes, distinguished by the method of image transfer and by the general type of image carrier employed. Image transfer can be direct or indirect (commonly known as "offset"). They are:

1. Lithography (off set/planographic)
2. Flexography (direct/relief)
3. Gravure (direct/intaglio) – also sometimes referred to as roto-gravure
4. Letterpress (direct/relief)
5. Screen printing (direct)
6. Digital printing.

Presses can be sheet fed (individual sheets of substrate) or web fed (reels of substrate). When direct printing, the image is transferred directly from the image carrier to the substrate. When indirect, or offset, printing, the image is first transferred from the image carrier to the blanket cylinder and then to the substrate. Image carriers (or plates) can generally be classified as one of four types:

1. Relief – the image or printing area is raised above the non-image areas
2. Planographic – the image and non-image areas are on the same plane, defined by differing physiochemical properties
3. Intaglio – the nonprinting area is at a common surface level with the substrate while the printing area, which consists of minute etched or engraved wells of differing depth and/or size, is recessed
4. Screen – the image is transferred to the substrate by pushing ink through a porous mesh which carries the pictorial or typographic image.

Data collection 2010 to 2011

Two methods of noise measurement were used during the eight site visits in 2010 to 2011:

1. Logging personal dosemeters/dose badge
2. Hand-held sound level meter with frequency analysis capabilities.

The dosimeters and dose badge were used for the personal dosimetry whilst the sound level meter was used for the spot measurements. All three devices logged two key information sets:

- A-weighted decibel values (L_{Aeq}), used to assess noise exposures over a full working day (L_{EPd})
- C-weighted decibel values (L_{Cpk}), used to assess risks from single noise events such as 'bangs' and 'crashes'.

The collected L_{Cpk} data showed no hazardous levels and was not is used in further analysis.

Data collection 1985 to1994

In the nine year period 1985 to 1994, data on noise levels in the printing industry were gathered through a combination of site visits, workplace noise measurements and company risk assessments. The data used in this article are extracted from HSE exposure databases of these measurements. It is worth noting

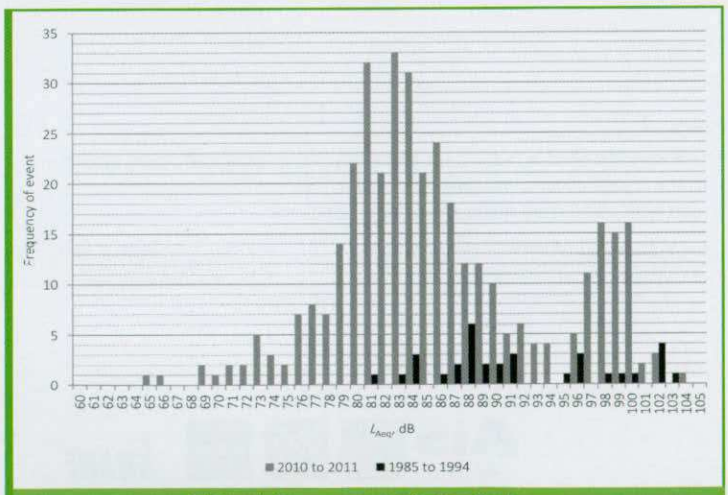


Figure 1. Frequency distribution for L_{Aeq}, 2010 to 2011 (379) vs 1985 to 1994 (33)

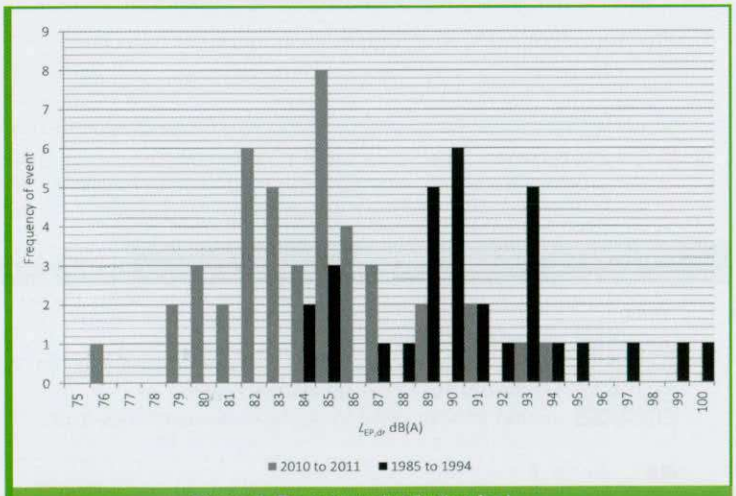


Figure 2. Frequency distribution for L_{EPd}, 2010 to 2011 (43) vs 1985 to 1994 (31)

◀ that during this period the Noise at Work Regulations 1989 were introduced.

What the numbers say

The data were split into L_{Aeq}'s and L_{EPd}'s. Comparisons were made for each parameter between the 1985 to 1994 data and the 2010 to 2011 data in the form of frequency distribution plots. The plots for each comparison are shown in Figures 1 and 2. The number of data points for each data set is shown in brackets.

From Figure 1 it is possible to see that for both data sets there are two separate areas where the frequency distribution is populated. Taking the median L_{Aeq} values, the data indicate that reductions of around 6dB have been achieved in the A-weighted noise levels, from 90dB to 84dB. For noise levels in the 95-105dB range, the 2010 to 2011 data are known to be attributable to just one of the eight sites visited. This particular site had an old printing press shoehorned into an inappropriate building where any noise generated by the machinery was reflected off the surfaces of the enclosed space occupied by the press, creating an excessively noisy work environment. The presence of data in the 95-105dB range for 1985 to 1994, from multiple sites, would suggest that high noise levels existed in the industry in the 1985 to 1994 period, but were not necessarily typical.

From Figure 2, and using the median L_{EPd} values, the data indicate that reductions in personal noise exposure of around 6dB have been achieved, from 90dB to 84dB. In the period 1985 to 1994 a print industry worker was likely to have an L_{EPd} in the region of 90-93dB, whereas now it is more likely to be in the region of 82-85dB. This is still high, between the lower and upper exposure action values of the CoNaWR 2005 (80dB and 85dB L_{EPd} respectively), but nonetheless an improvement on 20 or so years earlier.

What's noisy, what's not – 1985 to 1994

The majority of A-weighted data (L_{Aeq}) were gathered in press halls either at operator consoles or between the print heads of the machines, all of which were of the web fed offset variety (lithographic). A number of different machine manufacturers were identified: Harris, Mueller, Fairchild, L&M, Goss, Baker Perkins, Crabtree/Vickers. The first two were most prevalent in the typical noise range of 85-91dB whilst the last three were most prevalent in the high noise range of 95-105dB. Operations associated with noise levels below 85dB, were guillotining or with print machines that had received some form of noise control, for example shielding of the noisy components.

The personal noise exposure data (L_{EPd}) came exclusively from press halls. Most noticeable was the inclusion of gravure presses, not seen at all in the LAeq data. The L_{EPd} range associated with gravure presses was 84-91dB. The rest of the L_{EPd} data was for web fed offset processes.

What's noisy, what's not – 2010 to 2011

The spot measurements reveal the particularly quiet places and processes (as well as the noisy ones of course), but also allow the identification of particular contributors to the general noise environment. The chief culprit of unnecessary additional noise in a work environment was compressed air leakage. Compressed air is used extensively in modern printing processes, and, unchecked, can add a large amount of high frequency noise to a work place. Several examples were encountered during the eight site visits, three shown in Figures 3, 4 and 5. L_{Aeq} data showed that the leaky air could add up to 5dB to the local working environment; an unnecessary addition.

A lack of simple maintenance was also a major contributor to extraneous noise in the work environment. One example, shown in Figures 6 and 7, was the cover of a waste chute on a press. The press was fully powered down and undergoing cleaning maintenance, but the waste chute was still powered. At ground level, a panel covering part of the chute was rattling; closer inspection of the panel revealed it was missing two fixing bolts. Replacing the missing bolts and fixing the panel in position would reduce the rattling from the panel. Moreover, turning off the waste chute when it is not in use would help reduce general noise levels.

The personal noise exposure data were generally split into three broad activities: press, reel hands, and all post-press processing (gluing, folding, cutting, laminating, despatch etc). Reel stand noise exposure was variable and appeared dependent on a number of factors including how the press had been installed within the building, how new the equipment was and any noise controls in place. For example, a relatively new installation, in a custom modified building with reel stands in acoustic enclosures (Figure 8), gave a reel hand an L_{EPd} of 76dB. However, an old press with no acoustic treatment, shoe-horned into an existing concrete and steel structure (Figure 9), gave a reel hand an L_{EPd} of 86dB.

L_{EPd}'s associated with post-press activities varied between 79dB to 87dB and it didn't seem to matter if the activities were part of a full cycle of virgin paper to finished product, or whether the sole specialist activity of a single premises. Exposures seemed to be dependent on particular machines being noisy, and their location within the work environment, rather than a particular process being noisy. The comment "oh, that machine's always been a bit noisier than the others" was often heard muttered in the post-press environment during the eight site visits. One post-press process that stood out from the rest, with an ear-splitting L_{EPd} of 93dB, was the jet washing of silk screens. This process was carried out in a tiny, enclosed room, by one person.

At seven of the eight sites visited, exposures due to the actual printing process ranged from 80dB to 87dB. The higher exposures were generally attributable to web fed tower presses, used for newspapers, telephone directories and the like. Exposures at the eighth site ranged from 89dB to 94dB, also a tower press, but in a totally unsuitable building, with poor noise control. P44 ▶

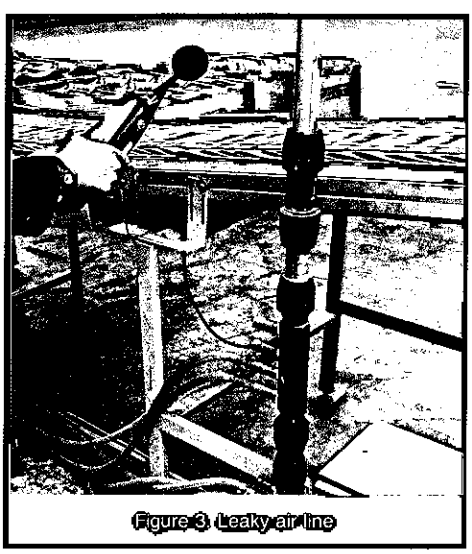


Figure 3 Leaky air line

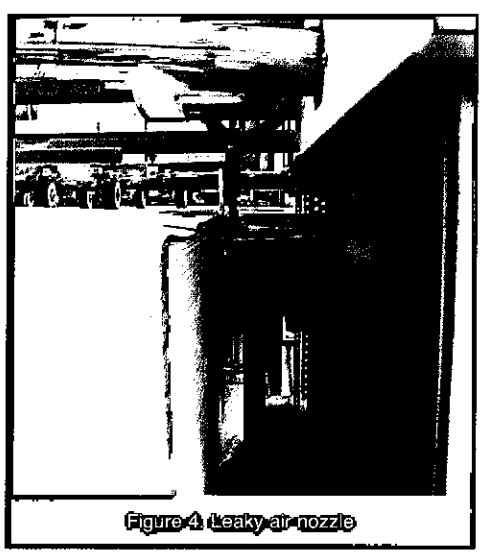


Figure 4 Leaky air nozzle

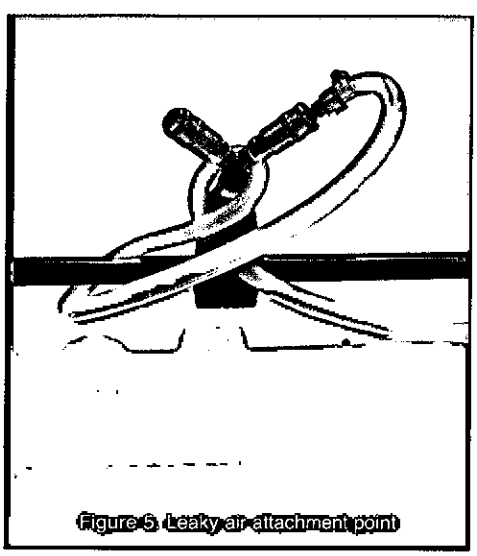


Figure 5 Leaky air attachment point

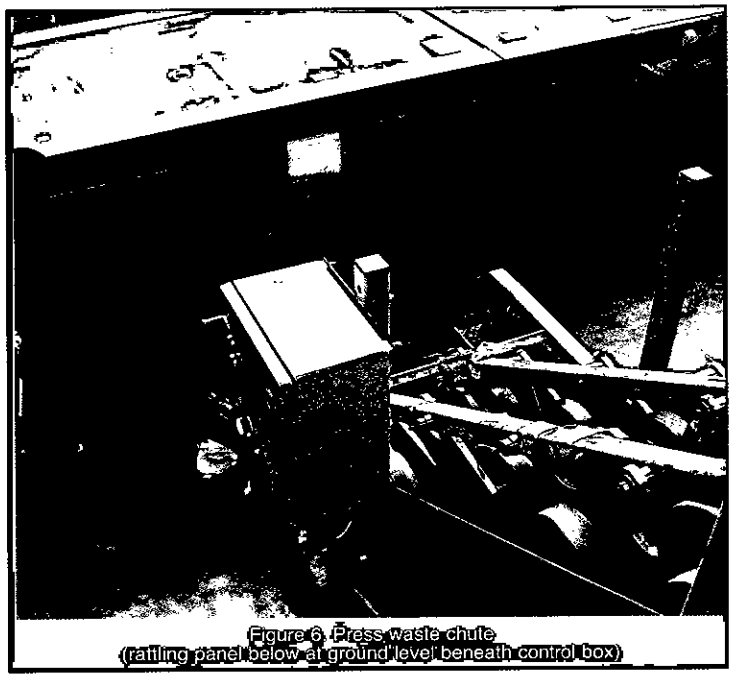


Figure 6. Press waste chute (rattling panel below at ground level beneath control box)

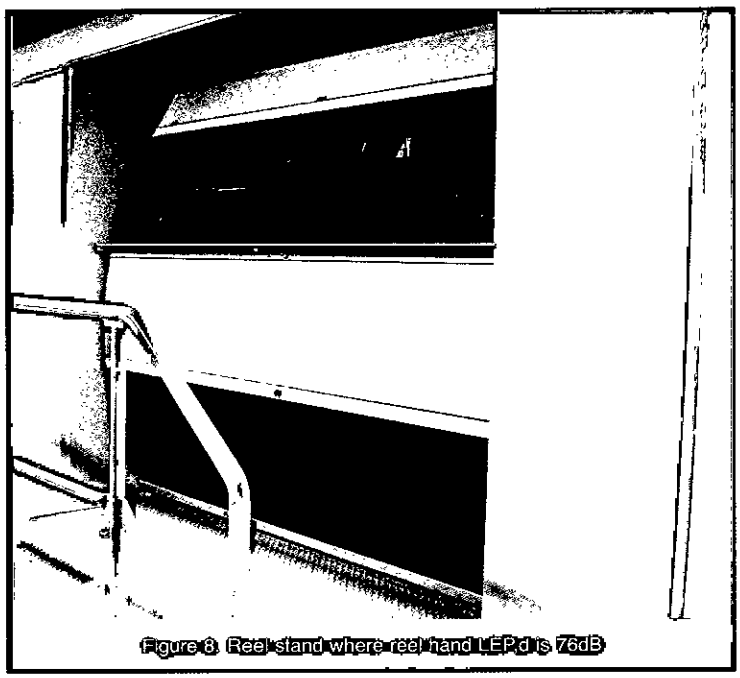


Figure 8. Reel stand where reel hand LEPd is 76dB

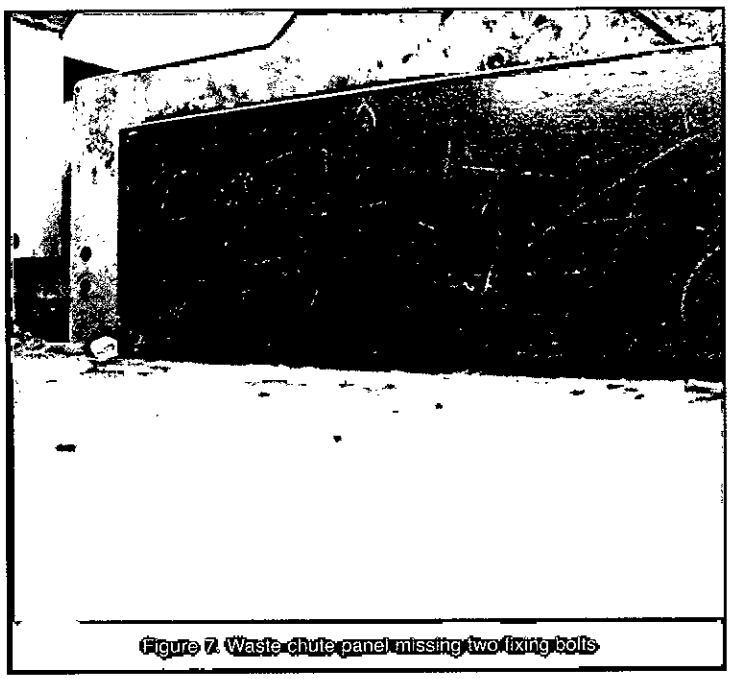


Figure 7. Waste chute panel missing two fixing bolts

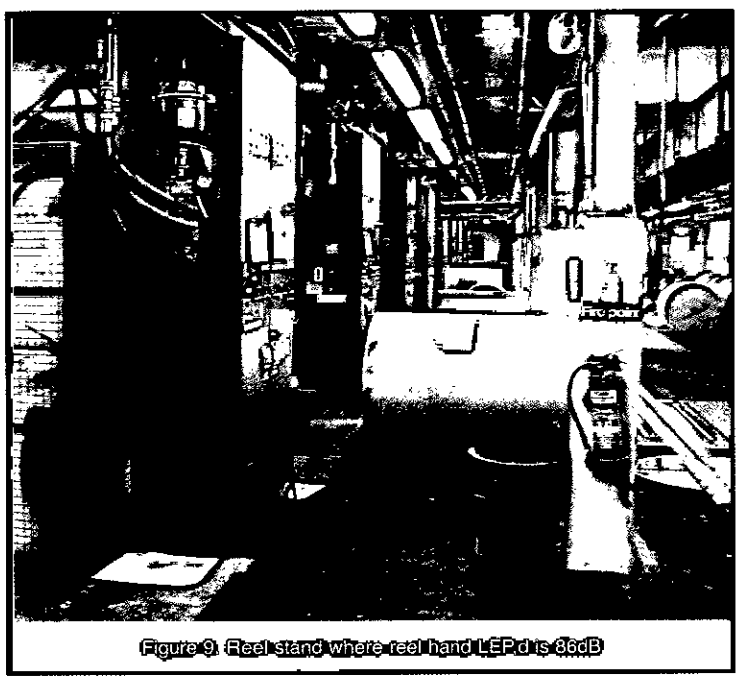


Figure 9. Reel stand where reel hand LEPd is 86dB

◀P43

Is it quieter in the printing industry?

Noise levels in general have been lowered since the 1985-1994 period; people's exposures appear to be lower now than they used to be. But is the numerical data a bit of a red herring?

Where people physically work is generally quieter. And some progress has been made to make machines quieter, either by design, which is preferable, or through some other noise control method. Some traditional pre-production processes are now electronic or computerised, instead of mechanical, meaning that some noisy processes have disappeared entirely.

But there has also been huge change in the printing industry since the 1980s and 1990s. The advent of direct mail has seen the growth of a whole new branch of the industry. Similarly, online form filling, for example, for passport applications, has also grown with the explosion of the internet. At the end of both of these processes, forms and advertising materials still need printing somewhere! And the machinery can still be noisy.

There seems to have been a shift in the popularity of certain print processes. Of the eight sites visited during 2010 to 2011, lithographic printing was by far the most prevalent method, whereas the 1985 to 1994 data suggests gravure printing was most prevalent.

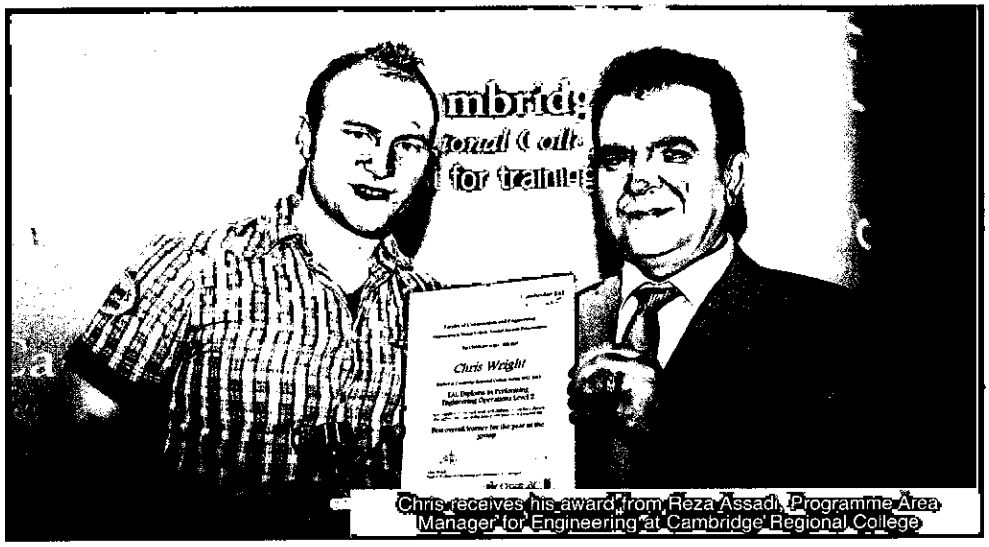
So, taken in context, the numerical data paints a rosier picture for noise in the printing industry today than it did a quarter of a century ago. But more can still be done. ■

This the first in a series of four reports from HSE about noise in the printing industry following the introduction of the Control of Noise at Work Regulations 2005, based on evidence gathered for the review of the print industry guidance on noise. The remaining three reports, *Noise levels: high and low, which processes; Noise control in the printing industry;* and *Printing industry equipment standards and noise: declaration and residual risk information,* are due to be published next year. All will be available for viewing in a new section on noise in the printing industry of the HSE website **www.hse.gov.uk**

It's Wright on for top apprentice Chris

Chris Wright, an apprentice at Acoustical Control Engineers, has been named as overall apprentice learner of the year at Cambridge Regional College, where he undertakes some of his studies together with further training at West Anglia Training Association.

Chris, aged 21 is one of two apprentices at the company learning how to manufacture a wide range of noise and vibration control engineering products such as attenuators, louvres, enclosures and vibration isolators.



Chris receives his award from Reza Assadi, Programme Area Manager for Engineering at Cambridge Regional College

Richard Collman, Managing Director, said: "Congratulations to Chris on a great start to what we hope will be a long, stimulating and enjoyable career in acoustics."

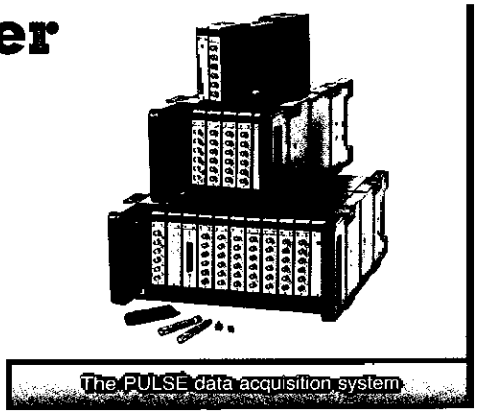
Airbus acquires Brüel & Kjær ramp noise test system

Airbus has acquired a 250-channel Brüel & Kjær PULSE data acquisition system for multi-purpose noise and vibration testing.

Airbus's first use of the system will be for ramp noise compliance testing of its jetliner family of aircraft. Ramp noise testing evaluates and reduces the noise exposure of maintenance personnel and passengers boarding/disembarking the aircraft. The primary noise sources arise from Auxiliary Power Units (APUs), air cycle machines (packs) and brake fans.

Airbus's new system will support many other activities within the noise and vibration evaluation processes. It is based on Brüel & Kjær's standard PULSE LAN-XI Data Acquisition Hardware and PULSE Reflex post-processing analysis platform – both commercial-off-the-shelf systems.

PULSE LAN-XI Data Acquisition Hardware is a modular system, which allows individual modules to be freely used as stand-alone front-ends or collected together into frame-based configurations. They can also be distributed throughout – or around – an aircraft and connected together with single LAN cables for synchronised results. More channels can be easily added as necessary – and systems can be divided into smaller ones of any size.



The PULSE data acquisition system

For more details visit **www.bksv.com**

Skyfold turns on the Style for Telefonica Digital

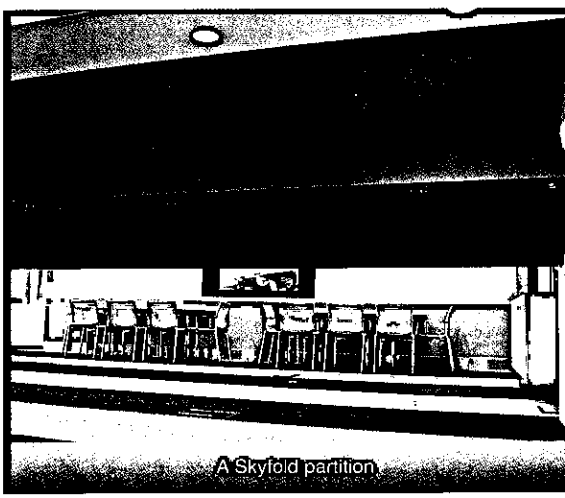
Partitioning specialist Style has completed the 100th installation of its Skyfold vertical-folding moveable wall, at Telefonica Digital's head office in central London.

A partitioning system that stores in the ceiling cavity, Skyfold boasts Rw56dB, which, Style says, allows people on one side of the partition to enjoy almost complete privacy once it is locked into place, even when a relatively noisy activity is taking place directly on the other side.

Unlike traditional folding walls, Skyfold has a dual-wall construction, providing a void space between the panel faces, allowing increased acoustic performance and not relying on mass to restrict the passage of sound.

Style is the sole UK supplier of Skyfold, which has been installed in a wide variety of locations including schools, commercial offices, hotels and universities.

For more details go to **www.style-partitions.co.uk** . email **sales@style-partitions.co.uk** or ring **01202 874044.**



A Skyfold partition

Is this the world's quietest wind turbine?

An Australian company has made the first commercial installation of what it says is the world's quietest wind turbine.

The Eco Whisper has a unique 30-blade design which, says Renewable Energy Solutions Australia (RESA), provides more surface to catch the wind than the traditional three-blade turbine.

This allows the turbine to extract more energy (up to 30 per cent) at lower rotational speeds, which party reduces the noise that it produces.

It has a cowl along the circumference to reduce blade tip noise and power loss caused by turbulence at the blade tips. Another cowl halfway between the blade tips and the hub improves mechanical stability.

The hub includes a direct-drive axial flux permanent magnet alternator; the lack of gear helps reduce costs, complexity and mechanical noise.

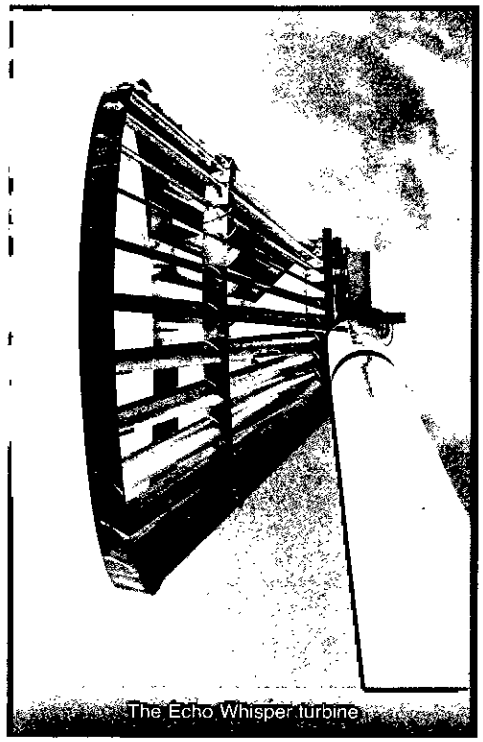
As an added bonus, the turbine has a lower start-up speed, allowing it to produce electricity at wind speeds as low as 1.7m/s (3.8mph), roughly half the start-up speed of a typical three blade small wind turbine.

The Eco Whisper comes in two sizes; a 6.5 metre diameter that generates up to 20 kW, and a 3.25 meter diameter that generates up to 5 kW. The former, intended for the commercial market, is 21 metres tall, the latter, which is intended for smaller or residential needs, is 18 metres tall.

Following two years of development and testing in Australia, RESA completed the first commercial installation in Tullmarine, Victoria.

Michael Le Mesurier, Business Development Manager, said: "This turbine is set to revolutionise small to medium-size renewable energy generation, and interest from industry is already overwhelming."

For more information go **www.resa.com.au**



The Echo Whisper turbine

Robots drive hearing aid improvements

Hearing aid manufacturer GN ReSound has chosen robot-controlled acoustics holography technology from Brüel & Kjær to drive forward improvements.

The technology, known as SONAH (Statistically Optimised Near-field Acoustic Holography), allows for measurements with arrays smaller than the source, without severe spatial windowing effects.

- It can operate with irregular arrays and still perform spatial FFT calculations
- It can perform conformal – 3D – mapping
- It allows mapping at lower frequencies than conventional holography methods.

Hearing aid testing

Poul Kristensen, Senior Acoustic Engineer at GN ReSound, said: "The big challenge in hearing aids is to have high gain and to have that, you need to be able to control your feedback. It's a very small device for gain that is sometimes up to 80 dB, so you need many different tools to understand the feedback patterns."

In hearing aids there are different vibration-borne feedback patterns, meaning the small speaker inside generates high pressure sound that makes the whole device vibrate. This vibration generates sound and if the sound path from the speaker to the output is not insulated you can also have direct sound feedback. For development prototypes this is especially important.

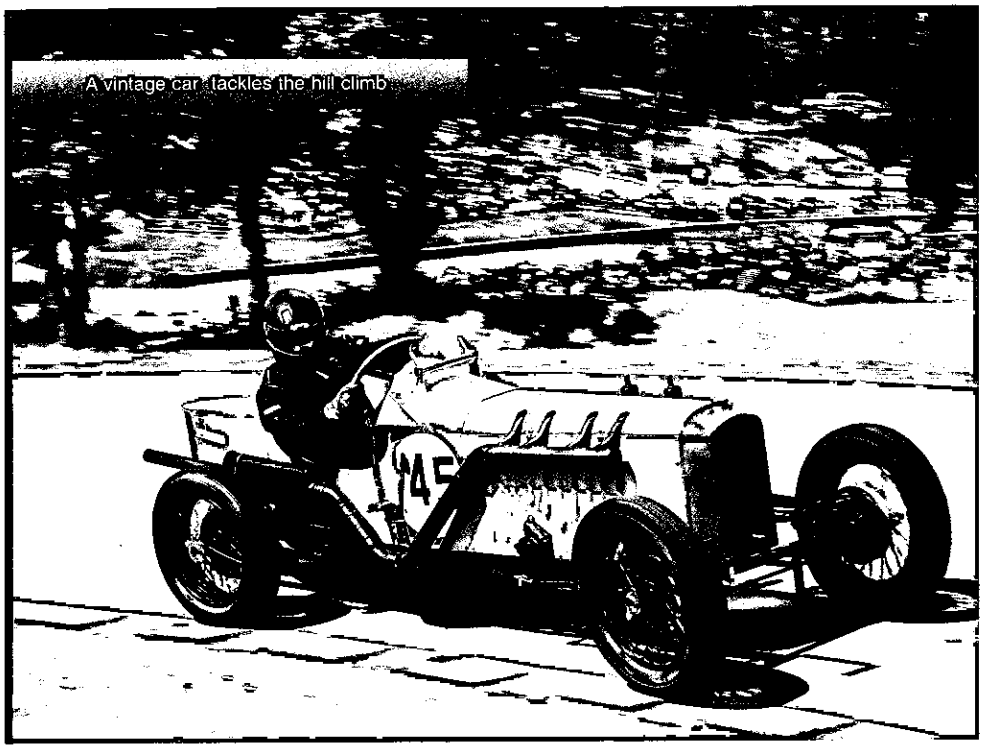
GN ReSound looked for a solution that could provide accurate conformal mapping on the small scale that it required – and do so automatically and unattended.

Mr Kristensen said: "At the time we were looking for a system it was taking an unpredictable amount of time in research and design to get the device performance and gain that we were looking for, because the feedback pattern is so difficult to understand.

"We had to do a lot of experiments without seeing the whole picture, so it took us a long time and the time taken wasn't predictable. We wanted to get into a situation where things were more predictable, with a better understanding, so we could be more professional with better tools. This was one of the tools to build up our simulation models and understanding."

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

Cirrus 'puts brakes on Bugatti noise'


A vintage car tackles the hill climb

Racing cars competing in hill climbs organised by a famous motoring club are being prevented from breaching strict noise controls – thanks to Cirrus Environmental.

The Bugatti Owners' Club uses a Cirrus CR:245/3 environmental noise monitor to record noise levels at the club's meetings at on Prescott Hill near Cheltenham.

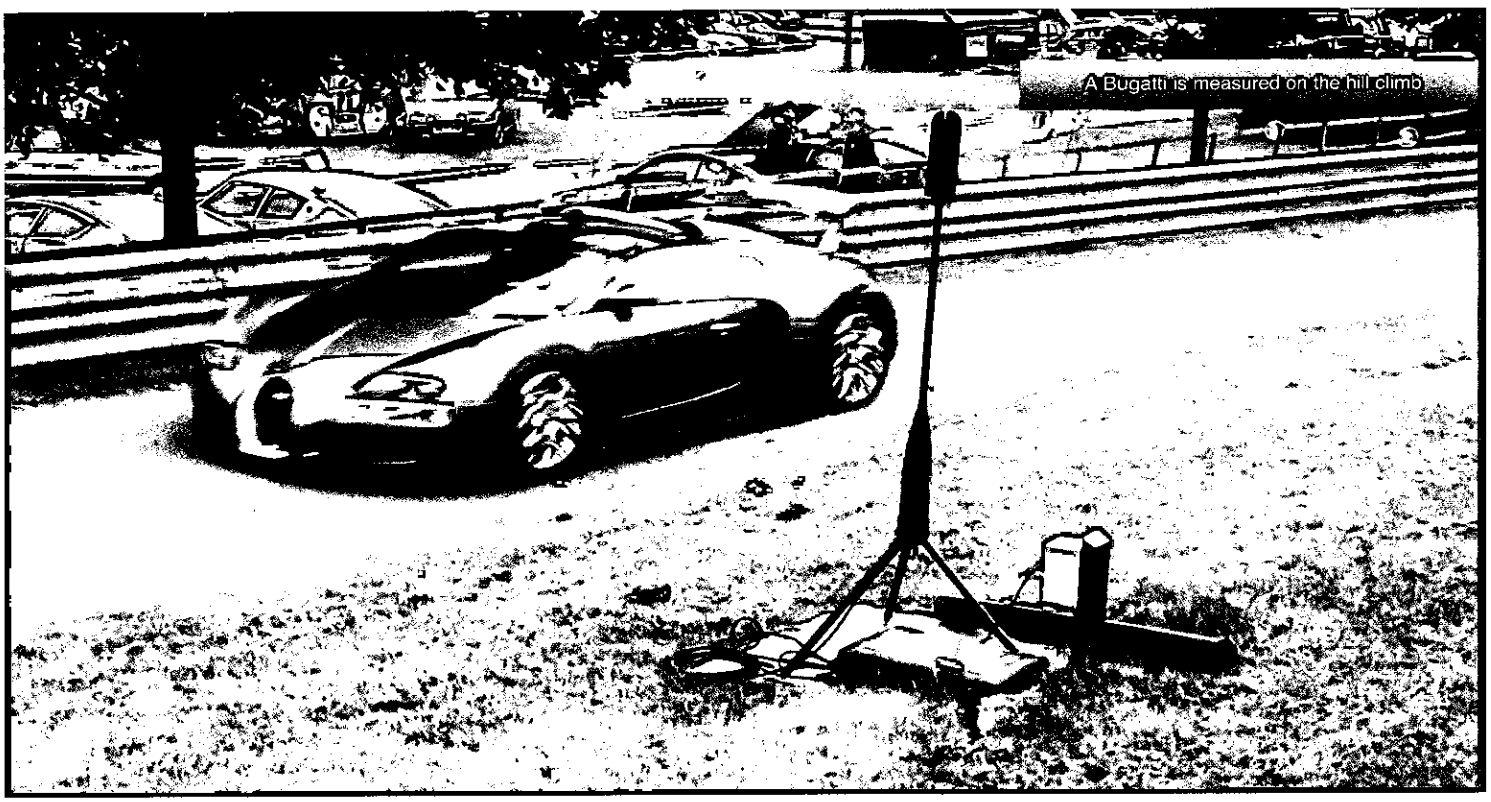
The monitor is positioned at the point where is there is likely to be the maximum acceleration – about 80 metres from the start. It is linked to the venue's timing software which automatically provides a noise measurement of each vehicle.

The club applies a "drive-by" limit of 104 dB(A). Any car breaching it is subjected to an individual static half-metre test, with failing vehicles banned from competing.

Justin Baker, Cirrus Environmental Sales Manager, said: "The club is very proactive about avoiding excessive noise levels. Any cars that exceed the limit don't get to race – it's as simple as that."

The club, which was formed in 1929 to promote motor sport and motoring, has been staging hill climbs at Prescott Hill since 1938.

For more information, go **www.cirrus-environmental.com**


A Bugatti is measured on the hill climb

Name change at Alan Saunders Associates

Clarke Saunders Associates is the new name of the acoustic consultancy practice previously known by the name of its founder, Alan Saunders.

Ed Clarke, Technical Director, said: "The change reflects the firm's gradual management transition to ensure continuity of service and excellence for our many, varied and highly valued clients."

Alan Saunders, a former chairman of the Association of Noise Consultants, who started the Winchester-based company nearly 20 years ago, continues to work full time at the practice and remains Managing Director.

For more information go to **www.clarke-saunders.com**

Atkins' 'sound walk' on the wild side

Atkins Acoustics Noise and Vibration celebrated World Listening Day on 18 July with a "sound walk" around Aztec West, Bristol. Starting out for Atkins' office, 10 Atkins employees and five members of South Gloucestershire Council's Environmental Protection team were guided around the vicinity by Dan Pope.

Following an introduction to the evolution of our auditory sense and some listening exercises, the natural soundscape of the nearby lake was sampled. Moving on to residential areas of Patchway and taking in a woodland walk that ran for a section alongside the M5 motorway, several stops were made to analyse what could be heard and to fill out questionnaires.

Although individual's views on highly trafficked areas were uniform, results in residential areas were more varied, with people showing different levels of tolerance for vehicle noise. Locations where there was a difference between participants assessments of the quality of visual and sonic environments were those most likely to be assessed as having an inappropriate soundscape. It was found that participants' analysis of the auditory environment were surprisingly consistent.

Urban planner Veronica Barbaro said: "When out on-site noise is always taken into account, but it is interesting to focus purely on the sound environment. You hear things that you may not necessarily have noticed before, or you might find things more annoying than you thought."

IAC signs partnership agreement with Amplivox

IAC Acoustics has signed a partnership agreement with audiometry equipment provider Amplivox.

The companies describe it as a strategic business move that will help to expand Amplivox's market presence and complete IAC Acoustics' offering of a comprehensive audiometric testing solution.

Under the agreement, Amplivox will supply audiometers to IAC Acoustics, for inclusion as a core component in their audiology booths.

Steve Sharp, Director of Third Party Channels at IAC Acoustics, said: "We believe that Amplivox's products perfectly complement those in our existing portfolio, and their inclusion will enable us to deliver more comprehensive and cost-effective solutions in the future."

Amplivox and IAC Acoustics have worked together for a number of years, cross-selling products to individual customers on an international scale. The new partnership formalises this arrangement.

For more details go to **www.iac-acoustics.com**

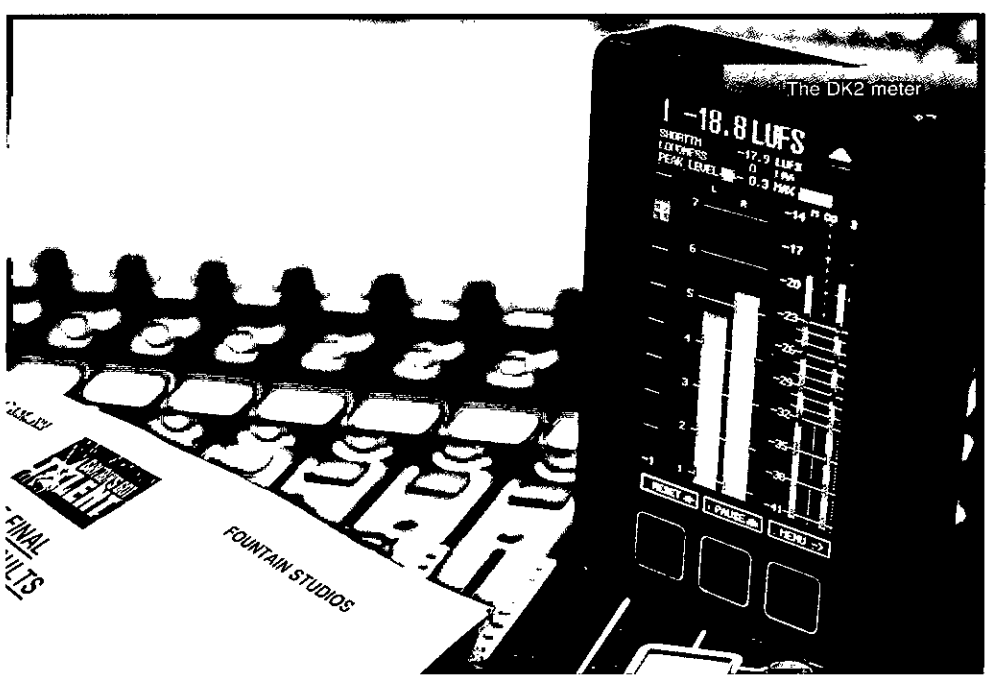
DK2 meter's 'Got Talent'

HHB Communications supplied *Britain's Got Talent* with a DK-Technologies DK2 audio and loudness meter that was used for the show's semi-final and final episodes.

Watched by over 11 million viewers, the 2013 final was one of the UK's most-watched programmes of the year. Sound director Robert Edwards entrusted the DK2 meter to measure the live broadcast stream to check the programme's integrated LUFS level (the EBU loudness criteria).

ITV maintains a dual acceptance policy for programme delivery, which means that programmes can be delivered with observance to the traditional +8dBm Peak level or to -23 LUFS (plus or minus 1 LUFS).

"It is vitally important to know where our programme sits in relation to these emerging standards," said Mr Edwards. "In the UK we have very strict delivery standards, and a correspondingly high level of compliance. Therefore, the development of practical skills, using accurate metering to deal with any new delivery constraints, is essential to stay ahead of the game."



The DK2 meter

Peter Brett acquires Hannah, Reed and Associates

Peter Brett Associates (PBA), an independent development and infrastructure consultancy, has acquired civil and structural engineering firm Hannah, Reed and Associates Limited (Hannah-Reed).

The acquisition creates one practice that provides a comprehensive range of services to support the planning, design and delivery of new infrastructure and buildings. It expands PBA's geographical reach across all UK regions, giving clients access to a broader network of multi-disciplinary teams. PBA now employs almost 500 people and has a turnover of £40 million.

PBA adds 85 employees, based in Hannah-Reed offices in Oxford, Cambridge, Doncaster and Glasgow, extending and strengthening PBA's civil and structural engineering teams. Henry Martin joins as a Partner of Peter Brett Associates LLP. Peter Woolley, Managing Director of Hannah-Reed, has been a director of the practice since 1979, and will continue to work with PBA as a consultant. Eight regional directors will continue to lead their office teams.

The two firms have worked side-by-side on a number of projects, including prestigious schemes such as Center Parcs in Woburn. Key clients of Hannah-Reed include University of Cambridge, Center Parcs, Henry Boot and Taylor Wimpey.

For more details go to **www.peterbrett.com**

Temple clinches £1.5 million HS2 contract

Temple, together with RSK, has been awarded a £1.5million contract to provide environmental services to HS2 Ltd.

As part of the contract, Temple/RSK will assist HS2 Ltd in the completion of the appraisal of sustainability for routes north from the West Midlands to Manchester and Leeds. This involves:

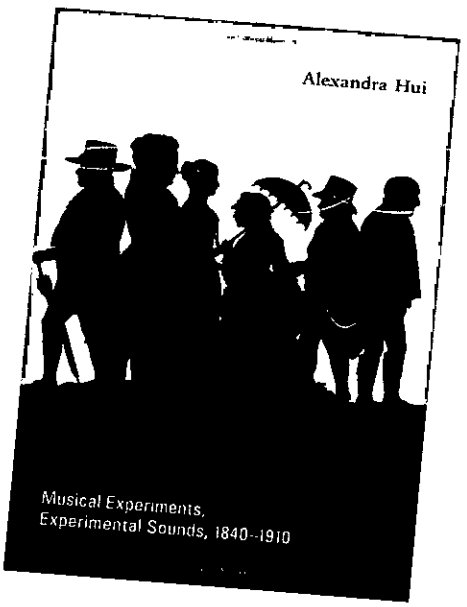
- Supporting HS2 Ltd during consultation events
- Logging consultation issues and responses
- Undertaking environmental appraisals of scheme refinements
- Supporting HS2 Ltd with activities post-consultation leading to final scheme selection.

This is the fourth contract that has been awarded under the phase two framework agreement that was published on 24 December 2012.

The Psychophysical Ear: Musical Experiments, Experimental Sounds, 1840-1910 (Transformations: Studies in the History of Science and Technology)

by Alexandra Hui

Review by Michael Wright, Chairman of the Musical Acoustics Group



When I was asked to review this book, I was preparing a presentation on pitch, temperament and musical intervals for the Senior Members' AGM. This was driven by my long-standing views (also shared by many others in musical composition and performance) that the current musical conventions of twelve tone equal temperament form a severe impediment to musical creativity both inside and outside the Western classical convention. Getting a chance to review this book was like "manna from heaven" as I have been long aware of some of the historical arguments on this subject. These arguments which gathered ground in the 19th century continue to rage among musicians today. Whilst "equal temperament" was rarely if ever fully achieved until the advent of accurate measurements, it was promoted (almost politically, it seems) as a means overcome the problem of a twelve tone scale where the intervals were previously based upon pure harmonic ratios and repeated over many octaves. Whilst equal temperament promised freedoms of musical composition and performance, many highly regarded performers these days regard it as a total "cop out". To explain further, on the basis of a Pythagorean system, a twelve tone scale within an octave simply cannot be achieved without a microtonal discrepancy or "comma". It may surprise many people with interests in music and acoustics that equal temperament, as we understand it, did not become common practice on pianos and other fixed pitch instruments until the 20th century.

Alexandra Hui is a historian and classically trained musician. Her enlightening book provides a valuable insight into the research of 19th century physicists, psychologists and newly emerging musicologists. These learned people considered the musical aesthetics, acoustics and physics in a number of important psychophysical studies and experiments undertaken largely in 19th century Germany. This was during a period when the compositional trends of Western "classical" music (mostly heard by the more affluent liberal Austro-German audiences) was undergoing major developments in form with a new generation of composers such as Ludwig van Beethoven, Robert Schumann, Johannes Brahms, Franz Liszt and Richard Wagner. This was also at a time when the sounds of non-Western musical ensembles began to be heard by audiences. However, unlike today where we can hear all forms of music in broadcasts and recordings, music was only heard live at that time by the performers and audiences. She describes the work of a number of scientists, musicians, critics, musicologists and composers of the period and how they often worked together. This period of research drew to a close in the early 20th century with radical changes in music, experimental psychology and ethnomusicology, and saw the end of work on the aesthetic dimension of psychophysics.

Hui's book opens with an intriguing insight referring us to a public lecture psycho-physics and in sensory perception in 1871 by the physicist and philosopher, Ernst Mach. He was perhaps more well-known to physicists and acousticians for his work on spark shock-waves and later on ballistic shock-waves. Mach's lecture questioned whether there was any sonic equivalent to the pleasing effect of visual symmetry. However, after taking his audience through a series of melodies and chord progressions which were played from sheet music on a piano in various mirrored directions, he concluded that no symmetry exists. Hui then invites the reader to try out this experiment. Whilst an elementary knowledge of musical staff notation and access to a keyboard is a distinct advantage here and elsewhere in the book, much should be of interest to those without such facility. More importantly, a good background knowledge and appreciation of "classical" music over this, the so-called "romantic period", is essential in order to get the best out of this book. However, the musical examples described and illustrated can be found on published CDs or even via the internet on YouTube for those who may be less familiar with this genre of music and are keen to explore further.

This book is not for cursory reference. You need to carefully read through from the start to really appreciate the range of conflicts between science and idealism that went on at the time. Alexandra Hui delivers to the reader some real insight to a period when musical aesthetics and natural science came together in the psychophysical study of sound back in 19th century Germany. She also makes the important point that from the middle of the 19th century, the rising middle class brought about increasing numbers of German and Austrian concert goers. Audiences also began to hear the influences of new musical rhythms and harmonies as non-Western musical ensembles began to make their way to European cities and "classical" music introduced progressive compositional ideas. At the same time, leading physicists were preoccupied with understanding the sensory perception of sound from a psychophysical perspective. These included Ernst Mach, mentioned above, and importantly, Hermann Helmholtz, noted for his work in the physics of perception (which later influenced musicologists) along with musical theorists such as Adolf Bernhard Marx and Eduard Hanslick, philosophers such as Friedrich Wilhelm Nietzsche, and several important physiologists, and psychologists. These learned researchers were all trying to find direct and measurable relationships between physical stimulation and physical sensation. They incorporated specific sounds into their experiments. Alexandra Hui also describes the composers such as those indicated above along with performing musicians such as Josef Joachim, critics such as Eduard Hanslick, musicologists, and composers involved in this redefinition of listening. She identifies a source of tension for the psychophysicists: the seeming irreconcilability between the idealist, universalizing goals of their science and the increasingly undeniable historical and cultural contingency of musical aesthetics. In psychophysics, what is known as the Weber–Fechner law combines two different laws of human perception. Ernst Heinrich Weber states "the just-noticeable difference between two stimuli is proportional to the magnitude of the stimuli" and the later modification by Gustav Theodor Fechner states "that subjective sensation is proportional to the logarithm of the stimulus intensity".

This convergence of the respective projects of the psychophysical study of sound sensation and the aesthetics of music did not last long. By the beginning of the 20th century, with the professionalization of such fields as experimental psychology and ethnomusicology and the proliferation of new and different kinds of music, the aesthetic dimension of psychophysics began to disappear. I have no hesitation in recommending this book to all who hold interest in the history of Western European musical development of the period. Whilst this book is likely to be of interest to many who take interest in the IOA Musical Acoustics Group, I believe this book, which is very reasonably priced (£23.95), will also be of interest to quite a few other members too. ◘

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Why no notes yet for IOA guide?

I was very pleased to see the publication of the IOA Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. The guide should help to encourage a high standard of professionalism in renewable energy projects.

The GPG is already used by consultants to wind developers, by local planning authorities, and by wind energy opponents alike, and it has the official nod of approval, so it is a great pity that it was published before the whole issue had been decided.

Page 29 says that "more detailed information on topics covered within the guide can be found in the following separately-published guidance notes" – these topics being data collection, data processing and derivation of background curves, sound power level data, wind shear, post-completion measurements, and offshore wind. The notes do not yet officially exist. This means that people trying to follow the guidance today face the possibility of having to re-think their findings when the supplementary guidance notes eventually make their appearance.

It is simply not good enough to say that we should be following best practice anyway: we do not know exactly what we are supposed to know — yet.

Ian Bennett
Acacia Engineering Acoustics

Product News

Cirrus Research gains European type approval for Optimus meters

Cirrus Research has obtained Type Approval to the NF EN 61672-1:2003 standard from the LNE in France. The tests carried out on the Optimus are as specified in the NF EN 61672-2:2003 standard for the Class 1 versions of the Optimus Red and Optimus Green instruments.

The tests carried out by the LNE look to exam an instrument against a set of recognised and published standards to ensure that it meets the performance claims of the manufacturer. The process of Type Approval provides an independent verification from a recognised national testing organisation that the product meets the claimed specifications.

These new certifications in France are in addition to those already carried out by the Optimus from the PTB in Germany and Applus+ in Spain to ensure they are to the appropriate version of the latest standard for sound level meters.

The Optimus range of sound level meters features the Optimus Red and Optimus Green instruments which can be used for noise measurement in a variety of settings. The Optimus Red has been designed for the measurement of occupational and industrial hygiene noise, whilst the Optimus Green is ideal to be used for both environmental and occupational noise applications.

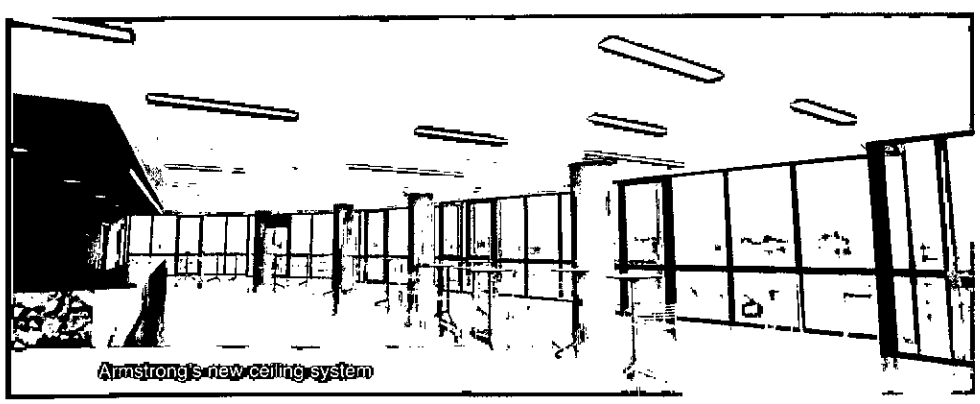
For more information go to **www.cirrusresearch.co.uk**


An Optimus Red sound level meter

New recyclable ceiling system from Armstrong

Armstrong Ceilings has launched an all-in-one ceiling system which it says has the highest recycled content available on the UK market.

All the tiles perform acoustically up to Class A and to ISO 5 for indoor air quality, as well as featuring up to 87% light reflectance to minimise the requirement for artificial light.


Armstrong's new ceiling system

The HRC (High Recycled Content) system comprises its unique Interlude 15 XL² HRC grid, which contains up to 63% recycled content) with MicroLook Dune, Perla and Optima mineral tiles (containing up to 65% recycled content). All are already 100% recyclable.

The 15mm Interlude grid is part of Armstrong's designer range and is manufactured using steel with high levels of recycled content. The tiles, a total of 10 in the three product types, include Perla OP 0.95 which recently became the first mineral tile in the world to win Cradle to Cradle certification.

Armstrong has also extended its portfolio of canopy ceilings with the launch of a unique curved system which can be used either convexly or concavely.

Manufactured from 82% recycled content, the Optima curved canopy is also highly light reflective at 87%. It is acoustically designed to Sound Absorption Class A.

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

The microphone that 'listens with light'

A sensor developed by scientists at SINTEF's MiNaLab in Norway gives microphones hyper-acute hearing and a sense of direction.

ICT researcher Matthieu Lacolle, who emphasised that acoustics scientists had also contributed to this innovative solution, explained: "Think of traditional videoconference equipment. Several people are sitting around the table, but the microphone has been placed where its sound reception is less than optimal. With technology of this sort, a microphone will be able to 'see' where the sound comes from, pick up the voice of the person speaking, and filter out other sources of noise in the room."

The microphone is packed full of microelectronics. What makes it special, however, is an optical position sensor that is no more than a millimetre in diameter.

The reason for giving a position sensor such an important role is that a microphone is completely dependent on a membrane, which picks up the pressure waves produced by the sound.

"In principle, a microphone acts like a drum. You have a membrane that vibrates when it is impacted by a sound – which is just a series of pressure waves. And then you have a reference surface in the background. The distance between these two surfaces registers the sound. We do this by measuring light waves from a microscopically small laser, so we can say that the sensor in microphones actually sees the sound," explained Mr Lacolle.

Production takes place in a highly controlled environment in MiNaLab's clean room

The sensor can measure incredibly small movements, and thus also extremely quiet sounds. If we make the membrane light enough, and let it oscillate freely in the air, the microphone also becomes directionally sensitive. "That also tells us where the sound is coming from," he said, adding that the membrane is only 100 nanometres thick, almost 1,000 times thinner than a human hair.

The technology that makes the microphone so sensitive is based on a combination of two optical phenomena; interference and diffraction, both of which are due to the wave character of light.

"If we hold up a CD to the light, we see the play of colours where it reflects the light. This happens because light consists of a spectrum of wavelengths that the naked eye perceives as colours, and these wavelengths are diffracted in different directions," he said.

Another phenomenon that can be utilised to measure sound is interference, which occurs when a number of waves are superimposed on each other. You can observe this when you stand in a harbour where incoming waves are reflected by a pier and are superimposed on top of the waves that follow them into the harbour. Complex, apparently chaotic wave patterns can occur, but so do standing waves, which don't appear to move at all."

'New breakthrough in hearing protection'

Insta-Mold is a new type of direct-moulded custom hearing protection that can be supplied within hours and at "a fraction of the cost of lab-moulded products".

Rob Shaddick, Director of Soundguard Acoustics, the sole UK and Ireland distributor, said: "The versatility of Insta-Mold determines that the NHS can supply 'swimplugs' or custom hearing protection in as little as two hours. The industrial sector can manage their own in-house custom hearing protection programmes and fit all their employees at a fraction of the price and custom hearing protection can be made on site at private weekend shooting events, festivals or motorcycle meetings.

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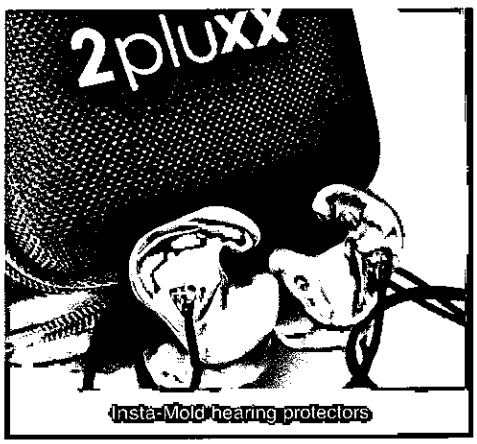

Insta-Mold hearing protectors

For more details ring **0845 653 0233** or visit **www.InstaMold.co.uk** or **www.soundguard.co.uk**

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Committee meetings 2013

DAY	DATE	TIME	MEETING
Thursday	5 September	11.00	Executive
Thursday	**26 September**	**11.00**	**Council**
Monday	30 September	11.00	Research Co-ordination
Thursday	3 October	10.30	Diploma Tutors and Examiners
Thursday	3 October	1.30	Education
Thursday	10 October	10.30	Engineering Division
Thursday	17 October	11.00	Publications
Thursday	31 October	10.30	Membership
Thursday	7 November	11.30	Meetings
Thursday	14 November	11.00	Executive
Wednesday	20 November	9.30	CCBAM Committee
Wednesday	20 November	10.30	CCENM Examiners
Wednesday	20 November	1.30	CCENM Committee
Tuesday	3 December	10.30	CCWPNA Examiners
Tuesday	3 December	1.30	CCWPNA Committee
Thursday	**5 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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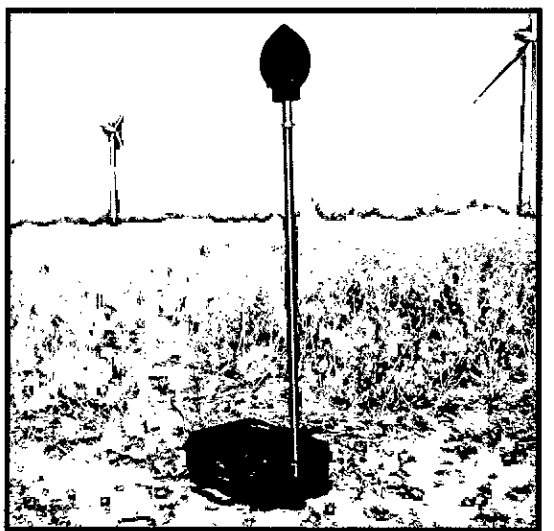

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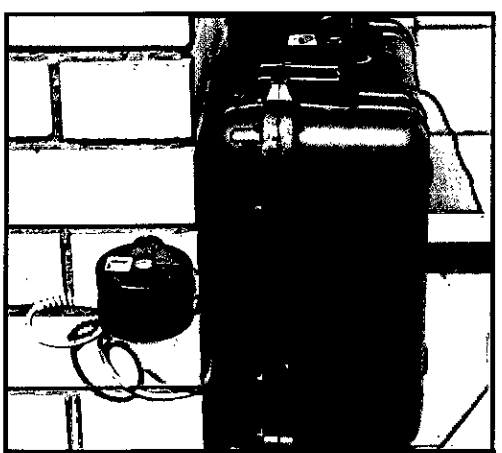

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