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Dear Members

I hope that our members have had a good Christmas and New Year break, and I wish you all the best for 2017. What will it bring us in the world of acoustics? 2016 brought us the EU referendum outcome and the election of Donald Trump as US president and whether these events fill you with excitement or uncertainty, they will start to bring change soon.

Whilst changes in legislation resulting from the EU referendum outcome won’t occur until the UK leaves the EU, we can be certain that the discussions within the Government regarding what will happen to that legislation are already under way. As the professional body representing acousticians in the UK we should be proactive in offering our views. Our Parliamentary Liaison Group will be leading on this, with the help of a working group who will provide technical support. Further work is needed to set out the impact the EU has had on legislation on machinery noise and in underwater acoustics. If you’re interested in helping out with the group, or have specific knowledge in these two areas, please contact Head Office.

We held a successful one-day event which examined what the effect of the EU has been on sound and vibration. It was a great starting point in enabling us to understand where changes could occur (and thus have an impact on what we do and how we do it), particularly in the fields of noise mapping and environmental impact assessment.

2016 brought us the sad news of the passing of Leo Beranek, and of two of our former Institute presidents, Oahan Berktay and Roland Dobbs. Our thoughts go out to their families. I can’t recommend highly enough watching the two videos of Leo at our 40th anniversary conference:
- The keynote speech: https://goo.gl/1c98wa.
- The after dinner speech, talking about how he got into acoustics, and his early years in the profession: https://goo.gl/amu837.

Arrangements for the ICSV24 conference in London this summer are well under way. It’s a great opportunity for us to showcase the breadth and depth of acoustics in the UK, and to demonstrate the latest frontline research we’ve been carrying out. It’ll also be an opportunity for our practitioners and researchers to network with others from Europe and further afield to discuss possible future projects. UK researchers are keen to maintain existing relationships and forge new collaborations on research projects with our European colleagues, regardless of any unintended messages that Brexit might have given out.

Ahead of ICSV24 in the conference calendar will be Oceans 17, in Aberdeen. It’s a conference which brings together engineers, scientists, managers and policy makers from all aspects of the oceanic spectrum. There will be sessions focusing on underwater acoustics, and if this area is of interest to you I would encourage you to take a look at the programme.

The Reproduced Sound conference was, as always, great fun. The write-up will be included in the next Bulletin but as a sneak preview, Mark Dodd, winner of the Peter Barnett Memorial award, gave the plenary lecture. For me (as someone not working in the world of transducer design) it was a fascinating tour through the development of speaker design and what drives it. The conference title, Sound with pictures, accurately signposted the content. If like me you’ve ever complained about the excessive volume of soundtracks at the cinema, or struggled with the intelligibility of the dialogue, I’d urge you to read Philip Newell’s paper Cinema sound and the loudness issue: its origins and implications. There’s clearly a painful history associated with sound and pictures in the cinema which has resulted in the current situation, but there is momentum within the industry to seek a solution to the problem.

I’m particularly looking forward to April, when we will be taking an active part in the Edinburgh International Science Festival, as part of the Institute’s education outreach work. Watch out for further information in future editions of the Bulletin.

Here’s to an exciting and productive 2017.

Jo

Jo Webb, President

Acoustics Bulletin January/February 2017
Defra research – a synopsis of recent publications

By Hilary Notley

In December 2015/January 2016, the Department for Environment, Food and Rural Affairs (Defra) published a number of reports spanning research and evidence gathered across the environmental noise domain. A one-day meeting was held at the Royal Society in London to provide an opportunity for the researchers involved to present their key findings and update participants of any further developments since the reports were delivered to Defra. Around 50 delegates gathered including a welcome number from the public sector including local authorities and central government.

Hilary Notley from Defra, who chaired the meeting, opened by welcoming participants. She explained that the first part of meeting would focus on national surveys designed to provide a snapshot of the ambient environment and attitudes towards it.

The first speaker, Charlotte Clark from Queen Mary University of London, explained that in 2012 a National Noise Attitude Survey (NNAS) had been carried out. This was designed to be the third in a series which had been undertaken previously in 1990 and 2000. She then provided a quick overview of the NNAS2012 survey, sample and key results. The main area of Charlotte’s update focussed on some follow-up analysis as three additional work packages were subsequently undertaken on vast NNAS2012 dataset allowing consideration of questions not previously addressed in the NNAS series. The third work package identified various factors associated with being more or less noise sensitive. As many parents may have guessed, having children in the household results in a lower self-assessment of noise sensitivity from external noise sources, compared with the group without children in their own household!

Charlotte then moved seamlessly on to the second presentation of the day, the Survey of Noise Attitudes (SoNA) 2013. At first glance this social survey appeared very similar to the NNAS series previously described. However, Charlotte explained that it was a trial of a more agile survey designed to be carried out, if necessary, more frequently than the 10-yearly NNAS. As such, it was designed to be shorter, had an ability to focus on key policy topics of the day (in this case, entertainment noise) and importantly trialled the use of a revised key annoyance question, to bring the UK in line with international and ISO best practice. Key findings in terms of noise annoyance were similar to the NNAS2012 results – which was as expected as attitudes are unlikely to differ significantly at a national level in adjacent years – and proved the concept of SoNA for future use. The use of the revised ISO question would not result in significant loss in backward compatibility meaning that data in the UK can be collected in future to allow broader comparison with data from other international surveys.

Another 10-yearly assessment that often went hand-in-hand with the NNAS was the National Noise Incident Survey (NNIS). The next paper, presented by Heather Billin from AECOM, described a similar, but smaller, national measurement exercise (Focussed Noise Monitoring 2013) which aimed to understand how the design of future events. Considerable thanks are due, as always, to Linda Canty and the IOA HQ team for all their hard work to facilitate this and similar events to provide such professional events for us all to enjoy and learn from.
Acoustics Bulletin: a community to span all areas of sound

By Amy Beeston, Giulio Dolcetti and Mauro Nicolao

Aiming to build a community of interest that spans all areas of sound, our first “Acoustics Exchange” was held at the University of Sheffield (TUoS) in September. The day-long event was organised by the IOA Young Members’ Group (YMG) and a committee of 10 early career researchers and professionals from TUoS and from HRS Services.

The day began with presentations given by researchers from the Department of Mechanical Engineering and the Leonardo Centre of Tribology. Topics ranged from the acoustic properties of porous materials to the use of ultrasound for non-destructive testing. After coffee, acousticians from HRS Services gave a presentation about acoustic testing, modelling and design for buildings. Their tapping machine demonstration did not go unnoticed, at least in the offices below, and the ‘higher or lower’ game they played, where the audience had to guess whether the pictured room met current building regulations or not, granted the audience plenty of chocolate and the company a few job applications too!

After this, IOA and YMG representatives related their experiences and views of the field, followed by members of the Yorkshire Sound Women Network and YMG representatives related their experiences and views of the field, followed by members of the Yorkshire Sound Women Network and attended from London South Bank University and New Acoustics in Glasgow.

On the hottest day of the year, it was then time to get outside and tour the campus. Participants experienced the quietness of the semi-anechoic chamber of the School of Architecture; learned how acoustic materials are characterised with an impedance tube; and visited the labs of the Leonardo Centre. Following this, the exchange reconvened in the Speech and Hearing Research Group labs (Department of Computer Science) for an introduction to audio signal processing for speech recognition in adverse environments and in healthcare applications. Finally, in the Department of Music we were literally surrounded with electro-acoustic music composed from highly-processed live sound recordings. Wait, was that really the sound of a celery? It was! And so the Acoustics Exchange concluded with a very wide-ranging discussion...

The atmosphere throughout the day was informal and relaxed, and the conversation was always engaging, in spite of the supposed technicality of some topics. We went home with a greater awareness of the diversity of the field, with new friends and contacts, and with thoughts of future collaborations.

The full programme and abstracts are available at http://www.sheffield.ac.uk/acoustics-exchange. Plans are under way to organise more events in the region; please contact the YMG at youngmembers@ioa.org.uk if you would like to get involved. The YMG would like to thank the Acoustics Exchange organising committee, the University of Sheffield for financial support, and Linda Canty, Hazel Traynor and Charles Ellis (IOA) for their invaluable help.

When shall we three measure again?
In thunder, lightning or rain...

By John Shelton

A healthy turnout of 62 delegates arrived at the Fire Service College in Moreton-in-Marsh for the one day meeting organised by the Measurement and Instrumentation Group. This meeting continued the tradition in the group of “out there” titles, this time invoking the Scottish play.

The previous day’s weather looked promising for outdoor measurements, blowing dogs off chains, but on the day it was considerably calmer.

The programme consisted of presentations in the morning, followed by real practical measurements, with delegates bringing an array of different sound level meters.

The first presentation, from Martin Williams of Cirrus Research, looked at the effects of weather on the instrumentation itself, and started with condenser microphones, and how they can be damaged by exposure to the elements. Reference was made, of course, to the tolerances permitted in the BS EN 61672 standard, and how sound level meters are designed to minimise the effects of (local) climate change.

Some practical considerations for enclosures for outdoor monitoring followed, and how condensation can cause problems as the exterior temperature changes.

Lastly, the performance of batteries was discussed, and how we often take for granted that batteries will perform to published specification, when their capacity can be seriously degraded with temperature.

The next presentation, from John Shelton of AcSoft, looked specifically at the way your windscreen can affect the measurement. Despite the standard now including the performance of windshields, many bad habits have evolved with mixing up windshields, or using DIY windshields, on the assumption that performance is not significantly affected.

By means of a high risk live demonstration, including real measurements (and a bucket of water!), John was able to show the effects of e.g. water absorption, microphone orientation, and yes, even cling-film! Many delegates were surprised how much difference even small changes could make.

Common errors such as using the wrong windscreen or not applying documented corrections were also discussed.

After the break Professor David Waddington of the University of Salford looked at the effects of weather on the propagation on environmental sound, with an in-depth look at refraction effects in the surface layer of the atmosphere.

Different sound speed profiles were shown for various weather conditions, as well as absorption, turbulence and scattering...
A company that develops ground-breaking noise reduction technology scooped the IOA-sponsored innovation award in the 2016 noise “Oscars”. Sonobex was presented with the award at the Noise Abatement Society’s annual John Connell Awards held at the Houses of Parliament.

The innovation award aims to encourage the development of new schemes to resolve noise pollution and recognise a pioneering approach that addresses this issue from a unique standpoint.

Watford-based Sonobex uses acoustic metamaterials, artificially fabricated materials that control, direct and manipulate sound in the form of sonic, infrasonic or ultrasound waves.

Its SonoTEC panel has a completely galvanised steel construction that consists of coupled resonator elements that attenuate airborne noises; as such it does not rely on acoustic infill or lining materials to provide acoustic performance.

This technology enables far greater noise attenuation for middle and low frequencies than traditional passive noise control measures. Until now, low frequencies could only be attenuated using high masses. However, these require extensive construction and work he put into making the whole day a success.

In Pursuit of Silences: the award finalists were:• Quiet Logistics Technology Award: Pret A Manger for its high standard of noise mitigation and customer care• Quiet Mark Award of Distinction: Miele for its long standing commitment to deliver high performance, low noise products• Special Commendation: Patrick Shen for his film, In Pursuit of Silence.}

Due to the technology, panels can be designed with passive ventilation in mind in order to dissipate heat, renew ambient air in audio recording, especially when these are to be used for tonal recording and acoustic enclosure, in some cases removing the need for forced ventilation.

Sonobex has engineered a range of attenuating SonoTEC panels that allow air to pass through the apertures whilst reducing the noise transmission to the environment.

SonoTEC panels can be incorporated into a fully ventilated acoustic enclosure, in some cases removing the need for forced ventilation.

The John Connell Awards, named after the association’s founder, aim to recognise organisations and individuals who have made outstanding contributions to reducing noise nuisance.

Other winners were:

- Local authority: Royal Borough of Kensington and Chelsea for its code of practice
- Quiet Cities Collaboration: Transport for London for its Retiming Deliveries Consortium
- Soundscape: The City of London Corporation for its soundscape strategy
- Silent Approach: London Bridge Station redevelopment
- Quiet Logistics Technology Award: Pret A Manger for its high standard of noise mitigation and customer care
- Quiet Mark Award of Distinction: Miele for its long standing commitment to deliver high performance, low noise products
- Special Commendation: Patrick Shen for his film, In Pursuit of Silence.
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The impact of Brexit on noise management

By Stephen Turner

The notice for this meeting stated that “the Institute recognises that Brexit provides an opportunity to determine how we might improve noise management and this meeting is designed to give the profession a chance to develop some initial thoughts on this important issue and help inform the debate”.

Around 50 members took up that opportunity and heard from a variety of speakers. The meeting was chaired by IOA President, Jo Webb, and she introduced the first speaker, Martin Baxter, Chief Policy Advisor at the Institute of Environmental Management and Assessment. Martin provided a very informative background about our existing relationship with European law and what appeared, at the time of the meeting, to be the likely process that Brexit might follow. He also focussed on the Environmental Impact Assessment Directive, noting that the 2014 amendment had to be transposed to UK law by the middle of 2017. As we would still be in the EU then, it would appear that the transposition would have to occur. As this is a devolved matter, the transposition would occur separately in England, Wales, Scotland and Northern Ireland. Consultation on transposition had commenced in some of the Devolved Administrations but not yet in England.

Arguably the main piece of legislation that has come from Europe in connection with noise management is the Environmental Noise Directive (END). Stephen Turner of STAcoustics posed the question “What has the END done for us?” His presentation gave a history of the END’s development noting that its primary aim was to secure data to help inform the further development of the so-called source directives. He felt that there had been several benefits of the END, including helping to raise the profile of noise management, the generation of data enabling the impact of noise to be monetised and the extent of the health effects to be quantified. The END had also provided a systematic framework for action planning, which could be seen in Highways England’s Road Investment Strategy, and stimulated interest in quiet areas, tranquillity and soundscape.

He felt, however, that the END was not perfect and that there was scope for reducing the current burden imposed by the END without losing its effectiveness.

Xavier Oh, the Noise Strategy Manager for Heathrow Airport Limited (HAL), considered the END from the perspective of an airport operator. HAL supported the END, seeing a benefit in providing a consistent approach to assessing noise impact across European airports. It also has stimulated collaboration across different airport operators in Europe to address noise issues that are common to them all. The requirement to produce an Action Plan was helpful in that it provided a central document that describes all the various noise management measures that are in place. He also felt that the data generated by the END was useful in enabling aircraft noise impacts to be compared with those from road and rail traffic noise.

He was concerned that END risked creating unrealistic expectations regarding the change in noise impact that might occur, and was also concerned about how the END might evolve in relation to the World Health Organisation (WHO) guidelines. On balance, though, HAL welcomed the END.

Speaking on behalf of the Rail Safety and Standards Board, Rick Jones gave a presentation considering the END in the context of railway noise management. He mentioned how the END had stimulated the setting up of the Rail Noise Policy Working Group, a cross-industry forum chaired by the Department for Transport. He also mentioned how the END seemed to have helped encourage the development of the Technical Standards for Interoperability (TSIs) controlling the noise emissions from locomotives and other rolling stock. The END had also helped to bring into focus the noise benefits from railhead grinding and he explained how this effect had been incorporated into the first two rounds of noise mapping. In conclusion, Rick indicated that the rail industry felt that the END had been beneficial.

Dr Benjamin Fenech, Principal Noise and Health Specialist at Public Health England, concluded the morning session by showing how the data generated across Europe by the noise mapping had enabled the WHO to estimate the size of the burden of disease from environmental noise. He noted that the methodology developed by WHO had been adopted in this country as a means of not only quantifying the health impacts of noise but also monetising those impacts. He also reminded the audience how data from the mapping appears in the Public Health Outcomes Framework against which Directors of Public Health are held to account. The PHE view, therefore, was that the END was extremely valuable in helping us understand the extent of the noise impact that is occurring.

After lunch, Tony Clayton from the Environment Agency spoke about the interaction between Europe and the noise management of industry. He emphasised that he was speaking in a personal capacity and noted that the original concept of Pollution, Prevention and Control was a UK initiative that had subsequently been adopted by Europe. Thus, although the current law is based on European Directives he could see no reason why we should not simply take back ownership of it. On the END, Tony was of the view that industrial noise did not sit well in that directive. He would support removing industry from any future modification of the END law.

The final paper was prepared by Dani Fiumicelli of Temple. Unfortunately, at the last minute, public inquiry duties meant that Dani could not attend the meeting, so Stephen Turner gave the presentation instead. The main message was that there were vast tracts of our noise management legislation and policies that have no links with Europe whatsoever. These included statutory nuisance, the bulk of the planning law, including, in England, the National Planning Policy Framework, which implements the Noise Policy Statement for England, and the Planning Practice Guidance on noise. In addition, with regard to major infrastructure, the Planning Act 2008 and the associated National Policy Statements, and the Transport Works Act 1992 are independent of Europe. Furthermore, none of the law on construction noise management, on Licensing, the Noise Act 1996 and the Building Regulations are dependent on EU directives. So, overall, Brexit will not greatly affect our noise management.

A wide-ranging discussion followed covering various issues including how the IOA could help prevent any “undesirable” reduction in the regulation, assessment and management of noise. The view from the panel was that the IOA should endeavour to keep good links with Government.

That had been achieved with this meeting as two Defra officials were in attendance and Lewis Baker, Head of Noise Policy at Defra, said a few words in conclusion.

He complimented the IOA on being the first stakeholder institution to approach the department with a meaningful contribution. He said that it was very early days, but he confirmed that when the Great Repeal Bill comes into law (which would sever the link between EU law and ours), all the existing EU-based law would still be on the statute book. Then we could decide what to do with those various regulations. At the moment, three options were emerging: retain, repeal or reform.

The message he took from the meeting regarding the END was that the IOA felt it was a candidate for reform.

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New Chairman required to lead the Senior Members’ Group

By Ralph Weston

A s some of you are aware, I will be standing down as Chairman of the Senior Members’ Group (SMG) this year. Having served in the role since the group’s inception six years ago, I feel it is time for a new face at the helm, which means we need a volunteer to take over.

The SMG has developed a pattern whereby we meet twice a year, in the autumn and again in April for our AGM which usually takes place at IOA headquarters at St Albans. It enables retired members to gather and catch up on the past and present. These take the form of an afternoon meeting with one speaker so that members can use their discount rail travel. Most of our activities use email.

Since we started the SMG has helped Geoff Kerry with his history of the IOA, researching records and supplying their own memorabilia; assisting Membership Committee with CPD and offering to help with mentoring and the Young Members’ Group.

Our aims are to promote the IOA amongst the older members and allow them to keep in touch with colleagues. We now have our own page in the members’ section of the website that contains profiles of the Chairman and Secretary (Mike Forrest) and some of the committee. Please look at it and let Mike know what else we can include.

Despite the best efforts it has not been easy to find suitable speakers and venues. In the recent past we have relied on members I know but I am running out of contacts. In the near future – the date is subject to confirmation – we have the head of the Institute of Naval Medicine Acoustics, Gosport to talk about its work. We are now looking for anybody who would like to give a presentation. As a group we cover a wide spectrum of acoustics so subject matter is not important.

Now that it’s time to renew our Institute membership again it’s well worth remembering that retired members get a special deal. More importantly, if you are of retiring age or approaching it then please elect to join the SMG. We need you so that the group will continue to develop with the IOA.

Amplitude modulation and nuances in wind turbine noise

Irish Branch meeting

By Martin Lester

Jon Cooper from Resonate Acoustics presented to a packed room on a wet November evening at AWN Consulting, Dublin. Given the topic and status of Jon within the field of wind farm acoustics, members travelled considerable distances.

Jon opened with the basics of wind turbine noise, hitting all the key aspects of wind shear, standardisation, variation in SWL and backgrounds. Given the varied audience, both Irish and UK guidance was covered.

Next on the agenda was sources of wind turbine noise, with interesting consideration of directivity and wake turbulence which can increase noise levels of downwind turbines by up to 1-2dB at just the lower wind speeds. The merits of various propagation models was discussed with comparative data confirming the accuracy of the ISO9613-2 (G=0.5) methodology.

The major element of the presentation covered the various special characteristics commonly associated with wind turbine noise: amplitude modulation, tonality, low frequency, infrasound and impulsive sound.

Low frequency noise is becoming more frequently referenced in Australia, but Jon advised that levels are typically at a low level and difficult to measure at receptors. Infrasound has been a big issue in Australia/Canada but Jon caveated this with quotes from the Health Canada and Fiona Crichton studies, “While some individuals reported some of the health conditions above, the prevalence was not found to change in relation to WTN levels” and “You can make people feel sick by telling them infrasound is bad”.

Jon next provided an overview of the recently released IOA amplitude modulation methodology. He praised its simplicity in dealing with ultimately a complex issue and awaits to see how this rolls out.

Jon spent some time on detailing the various methods of assessing turbine tones highlighting how the methodologies can under predict the true impacts due to masking noise from the wind turbine itself. Examples were provided of IEC61400-11 compliant turbines that produced highly prominent tones in the crosswind directions.

A question and answer session followed with members thankful to Jon for sharing his knowledge prior to his return to Australia.
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**Noise prediction of moored cruise ships**

**London Branch report**

By Roslyn Andrews

Francesca Remigi, an acoustic engineer experienced in noise mapping and noise abatement plans, took to the stage at the September meeting to discuss the recent developments in the acoustic characterisation of moored cruise ships.

The noise emission evaluation of large vessels is often an underestimated issue. In recent years, the evolution of ship design has been characterised, both for commercial and cruise ships, by the growing tonnage and the increasing number of sound sources present on board. Consequently, the determination of acoustic emissions of sources so large and complex requires the development of measurement techniques that need to be always adapted to the specific context of analysis and operational procedures of the vessel.

The specificity of the problem has not been addressed exhaustively in Community Legislation (European Directive 2002/49/EC), which in fact is limited to associate the noise of port activities to environmental noise, complicating the analysis and management of critical situations where the noise is due mainly to moored ships.

Despite there being many references on technical standards, the majority of measurement methods are devoted to specific types of ships, mainly of small size, and it’s difficult to fit these evaluation procedures to large vessels. Francesca made a comparison between different measurement techniques and evaluation methods with reference to airborne noise emission in the external environment of large vessels during procedures of navigation, manoeuvring and mooring. She referred in particular to the following technical standards: ISO 8297:1994, ISO 3744:2010, ISO 3746:2010, ISO 2922:2000, ISO 14509-1:2008 and ISO 14509-2:2006.

The assessment of the impact of noise on the urban sound climate is mostly based on the calculation of noise maps, using a set of standard calculation schemes for the evaluation of the contribution of different sources. The acoustic properties of any source can be usually defined in terms of source type (point, line, areas) source height from the ground, sound power, and spatial distribution of the sound radiation (directivity). The main difficulties in the modelling of harbour areas are related to the particular geometry of the places and the complexity of the sources present in the area of interest. Moreover many of the sources present in site have acoustic characteristics similar to the noise sources under examination.

Finally Francesca presented the procedure for predicting noise of moored cruise ships in the harbour area performed by the University of Padova on behalf of Venice Port Authority. It consists in a reverse calculation process starting from experimental measurements carried out according to different standards for the evaluation of environmental noise. Starting from the determination of the acoustic contribution of a sound source data points is possible to have a reliable evaluation of the input data for acoustic model.

A new series of technical standards for the estimation of the total sound power emitted would be useful to properly characterise large ships. In fact, specific methodologies are required for large ships, due to the different sound emission characteristics during navigation, manoeuvring and mooring.

These methods could be, basically, an implementation of the ISO 8297 in order to take into account the particular geometry of the site and the size of the source. Alternatively, considering the result of recent researches, it is possible to imagine a hybrid method with measurements close to the moored ship and validation of the results through control and verification points in the surroundings of the port area. In both cases, it appears evident that is necessary to implement a variety of measurement and evaluation techniques for obtaining reliable assessments of the noise emission of large ships.

The growing use of qualitative assessment techniques (e.g. source localization, beamforming, etc.) can provide a useful support to carry out reliable sound pressure level measurements in unfavourable situations (e.g. high levels of background noise, not-stationary behaviour of the sound source, difficulty in the selection of the threshold sound level during pass-by measurements, etc.).

A big thanks to Francesca for her excellent presentation and to WSP for once again providing the venue. We look forward to seeing another packed crowd at our next evening meeting.

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**On the assessment of annoyance from road traffic and tramway noise**

**North West Branch report**

By Paul Francis

Arch Klein of Arup Acoustics gave a talk on a new proposal for modelling annoyance from urban transportation noise sources. Traditionally a simple energy-based index has been used to illustrate the likelihood of annoyance but studies have shown that this approach is not accurate. A new method was proposed which was based on the results of listening tests. During these tests the listeners were asked to rate the character of road vehicle pass-by noises on different scales and explain why they found the noise annoying.

Listeners described their annoyance judgments relating to the spectral content of the urban road vehicle pass-by noises by using the terms “shriill” and “sharp”. This spectral sensation “dull/shrill” correlated significantly with an index characterising the high frequency content of these sounds: the total energy of the tonal components within critical bands from 16 to 24 Barks (TETC). The Bark scale is an alternative psychoacoustic scale ranging from 1 to 24 barks: 16 barks correspond to a centre frequency of 2900Hz and 24 barks to 13500Hz.

However, there was also a strong link between the descriptive terms “sputtering” and “nasal” (think of a moped or small motorcycle accelerating or decelerating down through gear changes) and annoyance. The authors used the dBSONic software 01dB-Metravib to calculate fluctuation strength and roughness. The correlation of the sputtering and nasal sensations with these psychoacoustic indices was, however, unsatisfactory.

The next step in preparing the annoyance model was to derive indices that accurately represent the prominence of these modulation-related sensations. Two alternative indices were proposed: the sputtering index $m_{sput}$ and nasal index $m_{nas}$. Eventually an annoyance model based on mean loudness, total energy within critical bands from 16 to 24 Barks, the sputtering index and the nasal index was derived.

The model was then tested against listener results where tram noise was combined with urban road traffic noise. A strong correlation was found between the listener annoyance and the results of the model.

The next step? Simplifying the indices so they can be used in field conditions – anyone interested? 😊
Sound Masking is a cost effective solution to the problem of improving speech privacy in today’s modern office environment. Best installed during office fit out but often installed as retrofit, Sound Masking from AET has improved the office environment for many international companies throughout Europe over the last 20 years.

In today’s office speech privacy becomes a key aim and open plan offices can suffer from two speech problems:
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- Confidential conversations can be almost impossible to conduct

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Sound Masking is also known as sound conditioning or white noise systems
In 2015/2016 the IOA Diploma in Acoustics and Noise Control was delivered as a centre-based course at four institutions (Derby University, Leeds Beckett University, Southampton Solent University and London South Bank University) and in its tutored distance learning version through four centres (St. Albans, Trinity College Dublin, Bristol and Edinburgh Napier University).

There were 123 registered candidates (including four from overseas) for the General Principles of Acoustics (GPA) Module in 2016. This is higher than last year (113) but well below the peak of 216 in 2006. There were 19 candidates for examinations in Regulation and Assessment of Noise (RAN), 72 for Noise and Vibration Control Engineering (NVCE), 95 for Building Acoustics.

More than 90 successes in 2015/16 Diploma in Acoustics and Noise Control  
By Keith Attenborough, Education Manager

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IOA Diploma Results Table by centre for 2016
(BA) and 67 for Environmental Noise Measurement, Prediction and Control (EN). Of those registered for the Project Module, 29 Candidates are listed as having failed the project in the table of results, but 26 of these did not submit and will be required to repeat the project module next year.

General Principles of Acoustics written examination paper (GPA) questions on barriers, health effects of noise, outdoor sound and noise control at ports in the were answered consistently well. On the other hand questions on piezoelectric transducers and workplace noise were answered poorly. A question on vibration isolation was least popular but answered well, particularly by DL candidates.

GPA coursework assignment topics included (1) acoustic design of alarm sirens and deliberately introduced noise for electric vehicles and (2) assessment of noise from barking dogs and amusement parks. Both resulted in mean marks above 65%.

As in previous years, a merit threshold of 70% was applied to the written GPA paper and the conflated GPA mark. The examination scripts of candidates satisfying the conflated mark threshold but gaining between 67% and 69% on the written paper were examined at moderation, re-marked where appropriate, and judged individually as pass or merit. However, even if these criteria were satisfied, a merit was not awarded if the assignment mark was carried over from a previous year.

It was found necessary again to moderate some centre marks for the Laboratory Module to bring them into line with those for DL candidates.

The Specialist Module coursework topics this year included noise and vibration impacts from fitness suites (NVCE), 2014 changes in BS 8233 (BA), Good acoustic design (as set out in the draft IOA ProPG: Planning and Noise - RAN) and Construction Noise based on BS 5228 (EN). The mean marks for RAN coursework and examination were much lower than those for EN, those for BA and NVCE being in between.

A criterion based on the means and standard deviations from the previous eight years was used again to decide whether or not to moderate marks for the Specialist Modules. On this basis adjustments were made to RAN and EN examination marks. To obtain a merit grade on the Specialist Modules, candidates were required to have conflated mark and written examination marks of at least 70%. No merit was awarded if it depended on a deferred score.

The numbers of candidates who gained merits (M), passes (P) or fails (F) in each Module are shown for each centre in table of results (left). The “fails” include those who were absent from the written examinations. The result of one appeal (which was successful) is also included. Relatively high percentages of candidates obtained merits on the GPA and EN Modules this year (48% and 58% respectively).

The prize for best overall performance (based on the conflated marks awarded in gaining five merits for GPA, BA, EN, Project and Laboratory Modules) is to be awarded to Beth Paxton (DL Edinburgh). Special commendation letters, offering congratulations on also achieving five merits, have been sent to Neil Durham (Leeds Beckett), Anthony Gunner (Southampton Solent), Andrew Thomas (LSBU) Kenneth Mitchell (Derby), Charley Woodman (Derby), Claire McKeown (DL Edinburgh), Jonathan Olive (DL St Albans), Harout Taghilian (DL St Albans), Jennifer Wilkin (DL St Albans) and Sinead McAleer (DL Dublin). Sinead McAleer will also be receiving the prize for the best overall performance by an Irish student.

Two candidates received the best ANC Project award in 2015-16: Aoife Kelly (DL Dublin) candidate for her project “The measurement of speech intelligibility index from evacuation notices generated from public announcement (PA) systems in a public building” and Mateusz Garbala (LSBU) for his project, “Comparison of measured and predicted construction noise, good practice in modelling”.

I would like to express thanks to all tutors and examiners and to HansaParmar in the IOA office for their contributions during the 2015/2016 presentation year of the Diploma.
There were 45 candidates at three centres for the Certificate of Competence in Workplace Noise Risk Assessment (CCWPNRA) of whom 32 were successful. Unfortunately, the increase in recruitment (compared with 19 candidates in autumn 2015 and 21 in spring 2016), as a result of group bookings at Shorcontrol (Dublin) and EEF (Sheffield), has been accompanied by a poorer pass rate. Bob Beaman has been welcomed as the new examiner. An agreement between the IOA and the British Occupational Hygiene Society (BOHS) in respect of mutual recognition of courses for membership purposes is in place. We still seek a successor for the current chairman of the management committee (Dave Lewis). Expressions of interest should be sent to education@ioa.org.uk

The Certificate of Competence in Environmental Noise Measurement (CCENM) continues to be the most popular of IOA certificate courses. In autumn 2016 there were 92 candidates (including four resits) at nine centres, of whom 82 passed. Eleven candidates took the Certificate of Competence in Building Acoustics Measurements (CCBAM), including one resit, at Southampton Solent University and eight have passed. Sadly the lack of implementation of tester accreditation in Ireland has meant insufficient recruitment for CCIBAM in autumn 2016.

The Certificate of Proficiency in Antisocial Behaviour etc. (Scotland) Act 2004 Noise Measurements was delivered in autumn 2016 to a total of 10 candidates (including six resits from Strathclyde) and nine have passed.

Recruitment increases but pass rate falls for workplace noise certificate

By Keith Attenborough, Education Manager
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Sixty-seven more applications for membership approved by Council

Sixty-seven membership applications were approved by Council at its December meeting following recommendations by the Membership Committee. Of the total, 51 were new applications and reinstatements, the rest were upgrades.

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Navigating the British Standards for road traffic noise barriers

By Giles Parker

Overview
Historically the acoustic performance of noise barriers for highways would invariably be specified by their surface density (e.g. minimum 10kg/sqm) and little else. However, this idealised approach that ignored product durability and the potential of leakage at fixings often led to under-specified barriers being built, giving short term acoustic performance and negligible attenuation at low frequency.

Impact of CPR
Since 1 July 2013, under the Construction Products Regulation 2011 (CPR), it is mandatory for road traffic noise barrier manufacturers to provide a declaration of performance (DoP) and a CE mark for their products because they are covered by the harmonised product standard BSEN 14388:2005.

Harmonised product standard
(BS)EN 14388, 'Road traffic noise reducing devices – Specifications’, is the harmonised European Product Standard focussed on devices designed to reduce the propagation of traffic noise away from the road environment. As such it addresses noise barriers (devices that are a combination of acoustic and structural elements, which obstruct the direct transmission of airborne sound emanating from road traffic, as well as claddings, road covers and added devices (see the standard for the respective definitions).

BSEN 14388 identifies relevant performance characteristics together with corresponding methods of evaluation. It specifies provisions on evaluation of conformity and CE marking. It covers acoustic, non-acoustic and long term performance, but not aspects such as resistance to vandalism or requirements for visual appearance. Annex ZA of EN 14388:2005 define the essential characteristics set out within Mandate M/111.

The current version: 2005
A product standard is harmonised when it has been accepted by the European Commission and published in The Official Journal of the European Union. (BS)EN 14388:2005 is accepted, published and in current use in the UK and throughout the European Union. Although a new edition was published last year (BSEN 14388:2015), this has not yet been harmonised and cannot be legally applied at this time.

Test standards for noise barriers
BSEN 14388 contains the following test standards for noise barrier performance:
- **Acoustic performance**: BSEN 1793
  - BSEN 1793-1 for Airborne Sound Insulation: $D_L^a$
  - BSEN 1793-2 for Sound Absorption: $D_L^\gamma$
- **Non-acoustic performance**: BSEN 1794
  - BSEN 1794-1 for Mechanical and Stability Performance
  - BSEN 1794-2 for Environmental and Safety Performance
- **Durability (long term performance)**: BSEN 14389
  - BSEN 14389-1 for Acoustic Performance Durability
  - BSEN 14389-2 for Non-Acoustic Performance Durability

This article will be confined to the acoustic performance standards alone.

Acoustic test standards for noise barriers
EN 1793 Test standards all test a complete noise barrier “system” in the test laboratory, which in the majority of cases comprises both acoustic elements (panels) and “structural elements” (posts and fixings; although the posts may be hidden within the structure).

It is wholly accepted that laboratory testing a panel sample alone ignores the potential for leakage at the posts and fixings and can therefore over-predict a barrier’s insulating performance. Below are the acoustic test standards referenced in the current harmonised product standard: BSEN 14388:2005.

Airborne sound insulation: BSEN 1793-2
The current harmonised product standard refers to BSEN 1793-2:1997 as the test method for airborne sound insulation. This is required for all road noise barriers (reflective and absorptive). It categorises the airborne sound insulation using the following single number rating system:

<table>
<thead>
<tr>
<th>Category</th>
<th>$D_L^a$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>B0</td>
<td>Not determined</td>
</tr>
<tr>
<td>B1</td>
<td>$D_L^a &lt; 15$</td>
</tr>
<tr>
<td>B2</td>
<td>15 to 24</td>
</tr>
<tr>
<td>B3</td>
<td>&gt; 24</td>
</tr>
</tbody>
</table>

In normal conditions, a rating of B3 for airborne sound insulation would be considered a good performance in almost all road noise barrier scenarios.

A later version of the test standard has been published as BSEN 1793-2:2012 (but not yet included in the harmonised product standard). This includes for a higher rating of B4 for $D_L^a > 34$ dB for high diffraction applications such as tall barriers where high insulation levels might be required.

Sound absorption: BSEN 1793-1
The current harmonised product standard refers to BSEN 1793-1:1997 as the test method for sound absorption. This is required for absorptive road noise barriers. It categorises the sound absorption using the following single number rating system:

<table>
<thead>
<tr>
<th>Category</th>
<th>$D_L^\gamma$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>Not determined</td>
</tr>
<tr>
<td>A1</td>
<td>$D_L^\gamma &lt; 4$</td>
</tr>
<tr>
<td>A2</td>
<td>4 to 7</td>
</tr>
<tr>
<td>A3</td>
<td>8 to 11</td>
</tr>
<tr>
<td>A4</td>
<td>&gt; 11</td>
</tr>
</tbody>
</table>

In normal conditions, a rating of at least A3 for sound absorption would be considered a good performance for almost all absorptive road noise barrier scenarios.

A later version of the test standard has been published as BSEN 1793-1:2012 (but not yet included in the harmonised product standard). This includes for a higher rating of A5 for $D_L^\gamma > 15$ dB for very reverberant environments (cuttings, tunnels, high-sided barriers).

Coming soon to a noise barrier near you
The standards referred to above may already be very familiar to acoustic design engineers and specifiers of road traffic noise barriers. Precisely when a new version of the harmonised product standard will emerge is hard to gauge, however future versions will bring significant changes to the way that barriers are acoustically tested and specified.
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Airborne sound insulation: BSEN 1793-6
An external test method for determining the in-situ airborne sound insulation of a noise barrier has already been published – BSEN 1793-6:2012. Once this standard is included in a future version of the harmonised product standard it will replace BSEN 1793-2 for almost all road noise barrier schemes (apart from the most reverberant applications such as for high sided noise barriers, canopies or tunnels). In-situ airborne sound insulation is still an intrinsic characteristic of the barrier product and is determined as a single number rating: $D_{l,w}$.

Sound reflection: BSEN 1793-5
An external test method for determining the in-situ sound reflection of a noise barrier has already been published – BSEN 1793-5:2016. Once this standard is included in a future version of the harmonised product standard it will replace BSEN 1793-1 for almost all road noise barrier schemes (apart from the most reverberant applications such as for high sided noise barriers, canopies or tunnels). In-situ sound reflection is still an intrinsic characteristic of the barrier product and is determined as a single number rating: $D_{l,r}$.

Acoustic durability: BSEN 14389-1
The method for assessing the long term acoustic performance or acoustic durability of a noise barrier is provided in the published standard BSEN 14389-1:2015. Once this standard is included in a future version of the harmonised product standard, a manufacturer will declare the durability of his product in accordance with BSEN 1793-5 for in-situ sound reflection and BSEN 1793-6 for in-situ airborne sound insulation.

Removal of rating categories
In future versions of the harmonised product standard, the performance rating categories (A1, A2, A3... B1, B2, B3 etc) will be removed completely. Barrier performance will be specified on the basis of the single number rating values. This will include an estimated level of uncertainty. A manufacturer might therefore also specify the performance of a barrier product in a particular frequency range which will be useful for example where strong low frequency performance is required for a road barrier application.

CE marking of road traffic noise barriers
For noise barrier products to be CE marked, testing of performance characteristics shall be carried out by an accredited laboratory or test house (for example UKAS accredited). The test house/laboratory will be required to provide test report, certificates documenting the tests.

Owl-inspired wing design reduces wind turbine noise by 10 decibels
Researchers studying the acoustics of owl flight have succeeded in using the downy canopy of owl feathers as a model to inspire the design of a 3D printed, wing attachment that reduces wind turbine noise by 10 decibels – and without affecting aerodynamics.

By working to pinpoint the mechanisms owls use to suppress the noise they make when hunting, they also hope to improve the aerodynamic design of aircraft, ships and vehicles.

They have further investigated how the design of the wing attachment can reduce roughness and trailing-edge noise. In particular, trailing-edge noise is prevalent in low-speed applications and sets their minimum noise level. The ability to reduce wing noise has implications beyond wind turbines, as it can be applied to other aerodynamic situations such as the noise created by air seeping through vehicle door and window spaces. Their findings have been published in the *American Institute of Aeronautics and Astronautics Journal* and the *Journal of Sound and Vibration*.

The researchers, from Lehigh University, Virginia Tech, Florida Atlantic University and the University of Cambridge, specifically looked at the velvety down that makes up the upper wing surface of many large owls – a unique physical attribute, even among birds, that contributes to owls’ noiseless flight. As seen under a microscope, the down consists of hairs that form a structure similar to that of a forest. The hairs initially rise almost perpendicular to the feather surface but then bend over in the flow direction to form a canopy with interlocking barbs at their tops – cross-fibres.

Among their experiments: suspending mesh fabrics (their original design used welding veil material!) designed to mimic the effect of the canopy over sandpaper – to create the “roughness” – and simulated air flows using the Virginia Tech wall-jet wind tunnel.

References
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After realising that the use of a unidirectional canopy, with the cross-fibres removed, was the most effective as it did not produce high-frequency self-noise of the fabric canopies, but still suppressed the noise-producing surface pressure they created a 3D-printed, plastic attachment consisting of small “finlets” that can be attached to an airfoil (or, wing). The finlet invention may be retrofitted to an existing wing design and used in conjunction with other noise-reduction strategies to achieve even greater noise suppression.

“The most effective of our designs mimics the downy fibres of an owl’s wing, but with the cross-fibres removed,” said Justin W Jaworski assistant professor of mechanical engineering and mechanics at Lehigh. “The canopy of the owl wing surface pushes off the noisy flow. Our design mimics that but without the cross fibres, creating a unidirectional fence – essentially going one better than the owl.”

### Association of Noise Consultants’ Pre-Completion Testing workshop

By Robert Osborne

Many members will have attended the branch presentations in early 2016 where representatives from the ANC discussed sound insulation testing issues. As attendees were told at the time, it was intended to be a small part of, and taster for, a more comprehensive day meeting later in the year, and so it was that more than 100 delegates gathered in Birmingham in October for an informative and entertaining day at the ANC’s Pre-Completion Testing (PCT) workshop.

Russell Richardson (RBA Acoustics) welcomed delegates with an overview of pre-completion testing, explaining that the day’s events would (very approximately) follow the test process, from how to prepare, to undertaking testing, analysing results and common ANC Registration Scheme audit issues.

The day was intended to be very much a discussion and an opportunity for delegates to feed back their own experiences as well as the presenters passing on their own knowledge.

Brian Martin (Department of Communities and Local Government) kicked things off, discussing potential changes to Approved Document E (ADE) and latest Government policy.

Brian started by talking politics and its inextricable link with the house-building market, including how the Government endeavoured to cut red tape in 2010. He then gave an entertaining tour through the Housing Standards Review, energy standards, a “space” standard that can be adopted by planning authorities, “secured by design” and even a water efficiency option. Lastly, and perhaps most pertinent to the day, was the withdrawal of The Code for Sustainable Homes.

As members operating within consultancy will know, DCLG is looking at how ADE might be improved and simplified. Brian gave an overview of Approved Documents and talked about ambiguities and inconsistencies that have crept in over various revisions and differences in style with other Approved Documents.

Brian discussed initiatives such as the Accelerated Construction Scheme, the ambition being for one million homes by 2020 with a suitable kit checklist to avoid issues of examiners, many of whom were scattered throughout the audience to encourage and facilitate discussion between delegates throughout the day.

Rob Adnitt (Adnitt Acoustics) gave an overview of preparing for sound insulation testing. The first slide was entitled Before you leave the Office with a suitable kit checklist to avoid issues on site. He discussed the Registration Scheme documentation such as the ANC Pre-Completion Testing Registration Scheme handbook and the ANC new practice guide. Rob referenced both ISO16823 and standards from the BS EN ISO 140 series. He posed interesting questions such as with respect to suitable equipment, and clarified of common misconceptions regarding equipment calibration, what qualifies as a competent calibration laboratory and source stability.

He clarified that sound level meters should be calibrated every two years; however, calibrators should be calibrated every year unless cross calibrated with other equipment. Any in-house calibrations done should be documented and issued as part of ANC audit. Tapping machines require certificate of conformity every two years.

Russell Richardson and Phil Dunbavin (PDA) introduced Site Issues – when testing goes wrong as a double-act.

Phil began by raising some of the common problems testers face whilst on-site, many of which prompted knowing nods from many of the delegates, such as:

- Ready to test? Buildings with no doors or windows, despite confirmation from the site manager that “everything is ready for you”.
- Background noise levels very high on site. Patience is a virtue when you are required to wait for the rest of the site to finish noisy activities before you can start (or finish).
- Hygiene for carpets – Phil requests that he can wear slip-on shoes!
- Rooms full of boxes/fridges/doors/plasterboard where tests cannot be done.

Russell discussed other typical issues; for example, when the site has no power. Maybe 110V power on site so perhaps a step up transformer can be used if site allows? Portable generators are noisy and many sites prohibit their use. Many testers use battery packs normally sold to caravaners or have their own bespoke designs.

Russell and Phil then introduced the game “Name the Source Room”, which posed various scenarios e.g. room size, finishes, conflicting requirements etc. and asked each table to decide on...
which room would be the source room according to the standards and Scheme guidance documents. Each table was asked to indicate either ‘A’ or ‘B’. The answers were sometimes obvious, but on some occasions the responses from the delegates were far from unanimous, illustrating perfectly the major purpose of the exercise, that being that, sometimes, there is no clear right or wrong answer. However, the duty of the ANC tester is to report any deviations from the standard.

Iain Critchley (Peninsular Acoustics) discussed BS EN ISO 16823, which, although superseding the BS EN ISO 140 standards, is not used for residential testing due to the requirements of ADE.

Iain gave a brief history of some of the research in the UK that has informed the new standard, including an investigation into the effect of the tester being in the room and undertaking measures using the manual scanning technique. The study showed conclusively that the presence of a person makes no significant difference and sweep microphone technique actually helps reproducibility, particularly at low frequencies.

Differences in the new standard include the acceptance of the manual scanning method, source directivity requirements that will require omni-directional loudspeakers to be used and a low-frequency procedure for sound pressure level measurement. Despite BS EN ISO 140 still being the named standard for residential testing, BS EN ISO 16823 is seen as valuable additional guidance for residential pre-completion testing.

Iain then discussed differences in performance between various dodecahedron and semi-dodecahedron speakers from different manufacturers.

Iain gave an overview of SITRI (Sound Insulation Testing Register (Ireland)) which was introduced in January 2016 by the ANC and supported by DECLG (Department of the Environment, Community & Local Government). It was officially launched on 27 January 2016 by Paudie Coffey, Minister of State at the Department of the Environment with Special Responsibility for Housing, Planning and Coordination of the Construction 2020 Strategy. There are two routes to entry based on either training or experience. The training element is provided by the IOA in the form of the Certificate of Competence in Irish Building Acoustics Measurement (CCIBAM).

Iain finished by summarising the importance of background noise measurements and an overview of good testing, calibration and reporting techniques.

Richard Watson (Blue Tree Acoustics) started the afternoon proceedings. He advised that his main role within the Registration Scheme Committee and the panel of examiners was to review calculation procedures and he has produced a suite of tools for the examiners to streamline the audit process and to achieve greater consistency. He has also produced some rather unusual datasets which, when used in a calculation, can highlight the presence of some of the more typical problems in calculation procedures. These datasets have been provided to all Scheme members to aid them in testing the robustness of their in-house software.

Richard described some of the more common calculation errors the examiners see, such as rounding at the wrong stage, incorrect implementation of the background noise corrections described in the standards, and floating point errors. The examiners have had to learn significantly more about the inner workings of computers than they ever thought necessary or, indeed, desirable!

Dan Saunders (Clarke Saunders) took to the stage to review common audit problems or, as he termed them, “glitches”. Contrary to popular belief, the examiners do everything they can to be as consistent as possible. Rather than restricting himself to a top 10 of glitches, Dan’s list went up to 11:

1. Incomplete site information in the report
2. Source spectra not satisfying the “6dB rule”. Although there are various tricks than can be employed to achieve this, Dan made the point that, occasionally, it cannot be done and, in this situation, it must be reported.
3. 46% of reports have calculation errors. Normally these have no effect on the single number quantity but,
4. Limits of measurement not stated, which Dan explored through various examples.
Professor Cummer. “It makes it seem like the sound is coming from a more complicated source than it is.”

The team proved their sound mask works in two different ways. In the first test, they assembled a metamaterial wall that manipulated an incoming sound wave into a shape like the letter A about a foot away. In a second demonstration, they showed that the technique can focus sound waves into several “hot spots” – or loud spots – of sound, also a foot from the device.

There are existing technologies that can also produce this effect. Modern ultrasound imaging devices, for example, use phased arrays with many individual transducers that can each produce precisely controlled sound waves. But this approach has its drawbacks.

“If you’ve ever had an ultrasound done, you know there’s a small wand attached to a much bigger machine a few feet away,” said Professor Cummer. “It makes it seem like the sound is coming from a more complicated source than it is.”
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New sound lab mimics the acoustics of any environment

Researchers at Aalborg University in Denmark, in conjunction with Bang & Olufsen, have developed a sound laboratory that can reproduce the acoustics of any environment from cars to concert halls. One goal is better design of sound systems for cars.

In the basement beneath Aalborg University are 40 small speakers and three subwoofers placed around a narrow walkway with just enough room for a chair. The space is an anechoic chamber where the walls, ceiling and floor are covered with thick, pointed, foam plates that absorb sound that hits the walls.

The 43 speakers are set up so that along with a newly developed recording system and an advanced computer program they can reproduce the exact acoustic conditions from any other room. If you put a CD in the drive or start an audio file on a computer, it will sound entirely as it would in the space the laboratory is simulating.

The sound lab is the latest addition to the accurate reproduction of acoustic conditions. Years ago, Aalborg University along with Bruel & Kjaer, Delta Akustik and Bang & Olufsen developed an artificial head with built-in microphones that could record how the human ear perceives sounds coming from different places. The artificial head was later developed to turn to each side and accurately map how the acoustics of a room affect sound when you move.

By reproducing the sound in a pair of headphones with a head-tracker, you can make it sound as if you are in the room. The perceived acoustics are very close to those of the real room and thus you can simulate how speakers and sound systems will work in different rooms.

Recordings with artificial head technology have been used for a number of years to reproduce various acoustic conditions, but the problem has always been that we do not ordinarily experience the sounds of our surroundings through a pair of headphones on a daily basis. In order to more accurately reproduce an acoustic environment, you can enhance the experience considerably by using a loudspeaker setup in an anechoic environment to create a precise spatial illusion. The idea and the system were originally developed by researchers at Aalto University in Finland for studies on sound in concert halls. The system at AAU is an advance aimed at smaller spaces such as living rooms and automotive interiors.

"With headphones on, it often feels as if all sound is quite close to or inside the head. You do not have the feeling that something comes from farther away—the spatial element is very difficult to recreate," said PhD student Neo Kaplanis who developed the new sound reproduction system at AAU.

Professor Cummer. "Not only can this setup be cumbersome, it consumes an enormous amount of power. Our approach can help produce the same effect in a cheaper, smaller system."

For the metamaterial device to work in such applications, however, each cell must be smaller than the waves it is manipulating. And for ultrasound technologies that operate in the kilohertz range, this means the individual cells would have to be 100 times smaller than in the current demonstration blocks.

The team is now looking for industry partners to show that this sort of fabrication would be possible. It is also speaking to industries that work in the kilohertz range, such as aerial sensing and imaging technologies, and with sound companies to make a single speaker sound more like a live orchestra.

"The same goes for the experience of a powerful bass. It’s not something we just hear with our ears; it’s something that can be felt in the entire body. You simply cannot reproduce it with a pair of headphones. However, in the accurately positioned array of speakers in the new sound lab, you can. By using recordings made with the appropriate recording method we can recreate the sound of any room. If you wear a blindfold or turn off all the lights in the lab, your ears make you believe that you’re in a completely different place; in fact that’s how we run the experiments," said Neo Kaplanis.

Right now the lab is set up to reproduce the acoustic space in a car, and with good reason. The university’s partner, Bang & Olufsen, was until recently one of the world’s leading manufacturers of hi-fi audio for luxury cars. The automotive department was recently sold to American speaker manufacturer Harman, but their development department is now in Struer, next to B&O’s headquarters.

When you develop a sound system for a brand new car, it takes a very long time because you test the car with many different speaker systems that have to be changed along the way. It is a long and costly affair, but because the entire production of new cars is top-secret, audio system manufacturers typically only have a prototype of the car available for a few days.

"With the new system we will be able to map the car’s acoustic conditions, send the car back to the factory, and then adapt and adjust the audio system with measurements in the lab. It makes it possible to develop much higher quality sound," said Soren Bech, Director of Research at Bang & Olufsen, who divides his time between Struer and a professorship at AAU’s Department of Electronic Systems.

The possibilities in the sound lab are not limited to the best speaker solutions for luxury cars. With the new system, in principle we can reproduce the sound from all kinds of spaces, from concert halls to living rooms -- to buildings that are still on the drawing board. The setup will thus be an important tool in future research/development projects.
Engineers at the University of Salford are lending their expertise to boost growth and jobs at an acoustics company. Farrat Isolevel is one of three businesses that will benefit by the winning with Salford of Knowledge Transfer Partnerships (KTP) worth more than £480,000.

Part funded by Government, a KTP is an Innovate UK programme which helps companies to improve competitiveness and productivity through a three-way partnership between a business, a University and a recent graduate ‘KTP Associate’.

Professor Sunil Vadera, Dean of the School of Computing, Science and Engineering said: “To win not one but three bids is a huge vote of confidence in the research quality and the industry-focussed credentials of academics in the School.”

Professor Andy Moorhouse and Dr Andy Elliott of Salford’s Acoustics Research Group will work with engineers at Farrat Isolevel in a bid to develop, implement and validate a cutting edge methodology to predict the vibro-acoustic response of buildings that incorporate vibration control. This is particularly relevant for concert halls, apartments and buildings affected by train or underground noise.

Researchers in the Acoustics and Audio Group at the University of Edinburgh have been awarded up to €150,000 in funding through the European Research Council’s Proof of Concept Scheme for a new project entitled WRAM: Wave-based Room Acoustics Modelling.

It follows on from work under the ERC NESS project (Next Generation Sound Synthesis), a joint project running between the Edinburgh College of Art and the Edinburgh Parallel Computing Centre since 2012, and led by Dr Stefan Bilbao of the Reid School of Music.

The NESS project, also funded by European Research Council, has been concerned with large-scale simulation-based sound synthesis on parallel hardware. Part of this work, led by NESS Project member Dr Brian Hamilton, has been concerned with very large-scale simulations of room acoustics, with the goal of very high quality auralisation of virtual spaces in 3D.

Under WRAM, the joint work of Dr Hamilton and Dr Bilbao will be developed further with an eye towards commercialisation in the area of architectural acoustics and the auralisation of virtual spaces. The project, which began in December 2016, will run until June 2018.

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Study links blood pressure risk to road noise

People living near noisy roads could have a bigger risk of high blood pressure, a new study suggests.

Meanwhile, long-term exposure to air pollution can also increase a person’s risk, experts found.

The new study tracked 41,000 people in five different countries for up to nine years.

An extra adult per every 100 living in the most polluted areas will develop high blood pressure compared with those living in the less polluted areas, the research suggests.

The study, published in the *European Heart Journal*, also found that traffic noise is associated with an increase in cases of hypertension.

Researchers gathered information on 41,000 people from Norway, Sweden, Denmark, Germany and Spain at the start of the study and again during a follow-up examination between five and nine years later.

None suffered high blood pressure when they joined the study, but during the follow-up period 15% had developed hypertension or started to take blood pressure-lowering medications.

The researchers also measured air pollution during three separate two-week periods. And they assessed traffic density outside the homes of participants.

They found that people living in noisy streets, where there were average night-time noise levels of 50 decibels, had a 6% increased risk of developing hypertension compared to those living on quieter streets.

And those living in areas with higher concentrations of polluting particles were significantly more likely to have self-reported high blood pressure.

Lead author Barbara Hoffmann, Professor of environmental epidemiology at at Heinrich-Heine-University of Dusseldorf, Germany, said: “Exposure to traffic noise shares many of the same sources with air pollution and so has the potential to confound the estimates of the adverse effects of pollution on human health. However, this study controlled for traffic noise exposure and found that the associations of air pollution with hypertension did not vanish. This is important because preventive measures for air pollution and noise differ.”

Scientists create ‘floating pixels’ using soundwaves and force fields

A mid-air display of “floating pixels” has been created by scientists.

Researchers at the Universities of Sussex and Bristol have used soundwaves to lift many tiny objects at once before spinning and flipping them using electric force fields.

The technology – called JOLED – effectively turns tiny, multi-coloured spheres into real-life pixels, which can form into floating displays or bring computer game characters to life as physical objects.

The research opens up new possibilities for mobile and game designers, giving them a new way of representing digital information in a physical space.

Professor Sriram Subramanian, in the University of Sussex’s School of Engineering and Informatics, is the head of lab behind the research. He said: “We’ve created displays in mid-air that are free-floating, where each pixel in the display can be rotated on the spot to show different colours and images.

“This opens up a whole new design space, where computer and mobile displays extend into the 3D space above the screen.”

The pixels are levitated using a series of miniature ultrasound speakers that create high-pitched and high-intensity soundwaves that are inaudible but forceful enough to hold the spheres in place.

A thin coating of titanium dioxide gives the pixels an electrostatic charge, enabling them to be manipulated in mid-air by changes to an electric force field, created by tiny electrodes.

Dr Deepak Sahoo, Research Associate in Human-Computer Interaction at the University of Sussex, said: “The most exciting part of our project is that we can now demonstrate that it is possible to have a fully functioning display which is made of a large collection of small objects that are levitating in mid-air.

“JOLED could be like having a floating e-ink display that can also change its shape.”
Council fined £250,000 for failing to protect worker from HAVS

A local authority has been fined £250,000 after a worker was left with permanent injuries after being diagnosed with hand-arm vibration syndrome (HAVS).

Canterbury Crown Court heard how a worker from Thanet District Council was diagnosed with suffering from HAVS after visiting his GP. Symptoms of the condition can include tingling, pins and needles, numbness and pain in the hands.

An investigation by the Health and Safety Executive found that the worker would typically spend up to six hours a day using a range of powered equipment including mowers and hedge cutters, depending upon the season. He was not under any health surveillance or told how he should report his symptoms.

The council had not taken steps to eliminate or control the exposure of its workers to HAVS. It also failed to educate their workers on the risk and train them on how to control their exposure to the vibrations caused by the power tools.

At the time of the investigation the council was issued with an improvement notice, as soon as it started to rectify the problem and implement the appropriate health surveillance a further 15 cases of ill-health relating to vibration exposure were identified and reported to HSE.

The council pleaded guilty of breaching Regulations 6(2) and 7(1) of the Control of Vibration at Work Regulations 2005. In addition to a fine of £250,000 it was ordered to pay £18,325.84 in costs.

New underwater microphone 6,000 times more sensitive to sound

A merican and Chinese engineers have designed an underwater microphone 6,000 times more sensitive to sound than commercial counterparts.

The team from the University of Nebraska-Lincoln and Xi’an Jiaotong University developed the device by embedding a network of silver nanoparticles in hydrogel – a polymer-based material comprising about 90 per cent water – and sandwiching that gel between two electrodes.

When picking up the low-frequency sound waves, the team’s device produced a signal roughly 30 decibels stronger than commercial counterparts, the study published in Nature Communications reported. Its nanoparticle network also allowed the device to effectively detect airflow and touch.

“The design could bolster sonar applications ranging from communication to navigation to defence,” said co-author Li Tan, Associate Professor of mechanical and materials engineering at Nebraska.

Because water dissipates most of the electromagnetic waves that enable satellite-based GPS, submarines and other submersibles often rely on low-frequency bandwidths. But many existing underwater microphones are made from ceramics, Professor Tan said, which generally absorb and register only about 20 per cent of the low-frequency acoustic waves travelling through water. The other 80 per cent reflects from a ceramic, resulting in a weaker signal.

“When you emit low-frequency sound, it may be from hundreds or thousands of miles away,” said Professor Tan. “So when it arrives at a location, it’s already very weak. If you reflect 80 per cent of it, there’s (almost) nothing to measure. We want something that has 100 per cent reception.”

Those reflected waves can subsequently be picked up by others who might be listening, a problem for vessels designed with stealth in mind. The reduced signal also poses a challenge to the navigation and communication essential for underwater exploration, Professor Tan said. According to the National Oceanic and Atmospheric Administration, humans have explored a mere five percent of the world’s oceans. A 2012 study estimated that the other 95 percent hides at least several hundred thousand undiscovered species.

“Though the water content of the team’s hydrogel allows it to register most of the acoustic waves that strike it, its sensitivity also stems partly from a surface-level phenomenon known as an electrical double layer. This double layer of oppositely charged atoms naturally assembles between a conductive electrode on the hydrogel’s surface and sodium chloride dissolved into the hydrogel itself.

The two charged layers are themselves separated by a neutral layer of molecules just nanometers in width, a boundary much narrower than those found in traditional capacitors. This essentially gives the device extra room to build and hold an electric charge thousands of times larger than it otherwise could. Professor Tan and his colleagues demonstrated the ability to tune this capacitance by adjusting the concentration of sodium chloride in the hydrogel.

But the engineers faced a problem: Water and its cousin hydrogel respond only to pressures greater than those usually produced by sound waves. So the team devised a multistep process for embedding the hydrogel with a network of branching nanoparticles.

When the device received acoustic waves at a 90-degree angle, they compressed the hydrogel just enough to enlarge the distance between its branches and trap more of the electric charges conducted by electrodes on either side of the hydrogel. When acoustic waves instead struck the hydrogel at a more acute angle, the distance between branches closed and reduced its ability to hold the charges.

These variations make the device responsive to a relatively broad range of frequencies and sensitive to acoustic waves coming from multiple directions, Professor Tan said. And the natural conductivity of the hydrogel – especially when compared with ceramics, which are insulators – helps the device more efficiently transform those waves into an electronic signal.
Considerations in modelling freight rail noise (part 2)

By Christopher Schulten of Transport for NSW Infrastructure and Services, Chippendale, NSW, Australia; Conrad Weber of Renzo Tonin & Associates, Surry Hills, NSW, Australia; Briony Croft of SLR Consulting, Vancouver, Canada; and David Hanson of Transport for NSW Infrastructure and Services, Chippendale, NSW, Australia

This is the second part of a paper, part one of which appeared in the previous issue.

Geometry and terrain modelling
The issues that relate to geometry and terrain modelling are not necessarily specific to the problem of modelling rail freight noise. This paper therefore does not go into detail in the area of geometry and terrain modelling, except to highlight some particular areas where the results of a rail freight noise model might be affected by choices made by a consultant in representing the geometry and terrain.

Model extent
The extent of the model should extend some distance beyond the area of interest. For a project, often consultants will be provided with electronic geometry data within a defined project area. This area may not be sufficient for the purpose of railway noise modelling. Noise from trains travelling beyond the project boundaries will propagate back to the project area.

The extent of a model will sometimes be determined by local regulatory requirements. In the absence of such guidance, the model extent should consider the area potentially affected by noise, including an assessment of the terrain in the area of interest and its influence on the line of sight to the railway from nearby receivers.

Digital ground models
When developing a noise model, it is common to use digitised ground contour data or elevation lines to form a digital ground model. The accuracy, currency and resolution of this data are important in developing a rail noise model. Often, data will be provided with a resolution of 1 m or greater. This resolution may be sufficient to model a location with simple geometry or terrain, such as predominately flat areas where there is clear line of sight from all the noise sources to all the receivers. In complex geometry situations, more detailed terrain information may be required. For example, where a railway is transitioning into a cut, the accuracy of the terrain will determine which receivers benefit from shielding of the noise sources.

In some cases, it will be necessary to edit or refine ground contours supplied by others to create a realistic digital ground model close to the track. If the top of rail or track centrelines have been supplied in electronic 3D format, these can be used to generate ballast beds or elevation lines in the rail corridor. There are also tools available in some modelling software to create embankments and cuttings either side of rail strings. These tools should be tested and verified before use.

Source heights and number of sources
The Nordic Rail Prediction Method assumes an effective source height that is 0.5 m above the top of rail level and each track is modelled as a single source along the track centreline. This is an approximation, and other algorithms make different approximations in order to model rail noise.

When modelling freight trains, it will normally be necessary to model noise from diesel locomotives separately and at a different height above rail level than rolling noise sources. This is on the basis that noise from diesel engine and exhaust are generated towards the top of the locomotive, rather than at the wheel-rail interface. Further guidance in relation to the typical source heights applicable to freight train noise is provided in the RND.

Noise barriers
Specific issues relating to the modelling of railway noise barriers largely relate to geometry issues, when combined with the digital ground model and the noise modelling algorithm used. Calculation standards use different formulae to identify the benefit that would be achieved by a noise barrier.

For example, consider a noise model where the top of rail is at a relative height of 1 m above the local ground level. The Nordic Rail Prediction Method adds 0.5 m to source height to give an effective source height of 1.5 m above the local ground level. In practice, some noise will be radiated from the wheel (at heights between 0-1 m above rail level), and some from the rail. Since the Nordic Rail Prediction Method does not provide any barrier attenuation effect at grazing incidence (other algorithms give a 5 dB reduction at grazing incidence), this 0.5 m source height (above rail level) can lead to an under-prediction of the screening provided by the surrounding terrain and noise barriers. This will tend to over-predict the noise levels at receivers, which in some cases may be inappropriate where a conservative noise assessment is preferable.

Ground effects
Aside from geometric attenuation with distance and shielding from natural or man-made barriers, noise levels can also be affected by the ground conditions between the railway line and receivers. The ground effect (or ground absorption loss) is dependent on the source-receiver geometry, as well as the characteristics of the ground, terrain and other factors.

The Nordic Rail Prediction Method classifies the ground between the railway line and receivers as either hard ground (i.e. concrete, rock, asphalt and water) or soft ground (i.e. cultivated fields, grass covered ground). For hard ground conditions, zero ground absorption is assumed. For soft ground conditions, ground absorption is dependent on the source-receiver distance and the average propagation height.
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In relation to the results presented in the RND, the source noise levels are based on measurement results carried out at distances mostly between 7.5 m and 15 m from the track centreline. For these distances, an average propagation height of 1.0 m and ground conditions midway between hard and soft ground, the estimated ground effect would likely be less than 0.5 dB. At distances representative of sensitive receivers adjacent to railway lines with varying ground terrain, ground absorption assumptions can have a significant effect on the predicted noise levels. Noise modelling based on hard ground conditions will therefore provide a conservative assessment whereby predicted noise levels may be higher than measurement results for soft ground conditions.

Care must be taken when developing noise models to understand and verify how ground effects are implemented within software and calculation algorithms.

Buildings and receivers
Care is required when interpreting point receiver noise levels in railway noise models. Receivers may be attached to buildings or free from buildings, and all models have a number of options and settings such as the search range and facade reflections that effect the calculation of noise at a point receiver. If receivers are attached to buildings, they may automatically take on an elevation that is based on the building elevation. In sloping terrain, if the building elevation is defined at the point of the centre of the floor area, then the elevation above ground at the facade may be significantly different. In every model, it is worthwhile creating a few test receiver points to be confident of understanding whether the results include facade reflections or not. The preferred option for rail noise in NSW is to undertake point calculations at a height of 1.5 m above each floor level of sensitive buildings. Facade reflections should normally be included in the results. Where facade reflections are not automatically included in the noise model predictions, then a facade reflection factor of +2.5 dB can be manually applied to predictions where receiver points are located at 1 m from building facades.

Rail noise sources
Railway noise modeling is not a simple procedure as it involves the modeling of different source heights and a variety of corrections for train speeds, notch settings, track features, etc. If developing a model for freight traffic, consider setting up a spreadsheet showing all the inputs and speeds to document the model assumptions and to facilitate model review.

Wheel-rail noise sources
Specifications of freight wheel-rail noise sources are described in the RND, and are not reproduced here.

Diesel engine and exhaust noise sources
Diesel engine and exhaust noise sources are also described in the RND. One issue relating to diesel engine and exhaust noise sources is that it is not addressed (so far) in the RND is the influence of older locomotives.

In NSW, approval to operate locomotives on the rail network is granted to operators via Environment Protection Licences (EPLs), issued by the Environment Protection Authority (EPA). The EPL noise criteria (based on type testing) apply to new classes of locomotives. In NSW, approval to operate locomotives on the NSW rail network prior to the introduction of the rail systems was investigated to determine their potential influence on overall noise parameters relevant to freight noise modelling [13]. At locations where A-weighted maximum noise levels are dominated by locomotives, a reduction of between 0 dB and 3 dB might be achieved in the $L_{A,95\%,\text{max}}$ parameter by targeted mitigation measures directed towards high noise locomotives. This situation is most likely to occur at locations where trains travel at relatively low speeds, for example up or down steep grades where noise from the wheel-rail interface is less dominant than locomotive engine/exhaust noise.

At locations where A-weighted average noise levels are dominated by locomotives, a reduction of between 0 dB and 3 dB might be achieved in the $L_{Aeq,\text{period}}$ parameter by targeting high noise locomotives. However, in most situations noise from wagons (or from passenger trains) also contribute to the $L_{Aeq,\text{period}}$ noise levels, so a reduction in overall $L_{Aeq,\text{period}}$ noise levels would only be realized at low speed locations.

The low frequency content of locomotive noise means that the benefits of targeting high noise locomotives can be more readily seen in the C-weighted noise parameters than in A-weighted parameters. For locomotives, C-weighted maximum noise levels are thought to correlate better with annoyance than A-weighted parameters. At locations with steep uphill grades, a reduction of up to 7 dB might be expected in the $L_{C,95\%,\text{max}}$ parameter by targeting high noise locomotives.

In summary, the influence of older locomotives on A-weighted noise parameters is relatively small, and is likely to be negligible at many locations. These locomotives do influence the C-weighted or un-weighted noise levels in some situations, especially locations with steep uphill grades. However, in NSW most freight rail noise models consider only A-weighted parameters. In this situation, distinguishing between the source noise levels of older and newer locomotive classes in a freight noise model may not be warranted.

Targeting high noise locomotives as a mitigation measure would have subjective benefits, by reducing the number of higher noise level events (particularly at night-time) and by reducing noise that is perceived as unnecessary, since quieter alternatives to high noise locomotives are available. However, these benefits may not be well quantified by typical A-weighted noise parameters.

**Corrections to rail noise sources**

**Rail Surface Discontinuities**
Discontinuities in the rail running surface occur at turnouts, crossings, track defects, etc. In a noise model, the effect of these discontinuities is usually modelled over a discrete length of track such as 10 m, rather than at a single point, since the rail is normally modelled as a line source, with emission levels defined for each line segment [14].

Corrections for rail surface discontinuities are required to both the $L_{A,95\%,\text{max}}$ and $L_{Aeq,\text{period}}$ source levels, if both of these parameters are of interest. Table 1 shows common corrections to the source levels, applicable over a 10 m track length.

<table>
<thead>
<tr>
<th>Track Feature</th>
<th>$L_{A,95%,\text{max}}$ Noise Level Increase (dB)</th>
<th>$L_{Aeq,\text{period}}$ Noise Level Increase (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnout</td>
<td>+6</td>
<td></td>
</tr>
<tr>
<td>Mechanical Joint</td>
<td>+3</td>
<td></td>
</tr>
<tr>
<td>Diamond Crossing</td>
<td>+10</td>
<td></td>
</tr>
<tr>
<td>Glued Joint (uneven)</td>
<td>+3</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1 Increase in noise level due to rail surface discontinuities (10 m track segment)**
Flanging Noise and Curve Squeal

Flanging noise is the high frequency, broadband or multi-tonal (tish-tish) noise which is common on tight curves. A highly tonal squeal noise can also occur at some locations with tight curves. Traditionally in NSW, the following corrections to the $L_{pA,max}$ and $L_{A(eq,period)}$ source noise levels are commonly made within the modeling software [15]:

- Curves < 300 m radius: Add 8 dB to the $L_{pA,max}$ and $L_{A(eq,period)}$
- Curves ≥ 300m and < 500 m radius: Add 3 dB to the $L_{pA,max}$ and $L_{A(eq,period)}$

Recent analysis in NSW [16] has shown that these levels may not be conservative, especially for $L_{pA,max}$ noise level predictions. These new results suggest that reasonable corrections for curve noise would be 6 dB for energy average noise levels and 21 dB for $L_{pA(max)}$. Further, the delineation between curves of radius less than 300m may not be valid for NSW, and that these corrections may apply for curves of higher radius.

When modelling situations with existing curve squeal issues, comprehensive measurements are required to understand the noise emissions, the proportion of trains that squeal, and the noise level. Relying on “standard” corrections to model curve noise levels introduces the potential that impacts will be underestimated or overestimated. Depending on the site and the frequency of train movements, these measurements may include collecting several weeks of data, capturing audio recordings of passby events, and a detailed review of each passby event including identification of individual train types.

Brake Noise

Brake squeal is unpredictable, but is most likely to occur on track leading up to signals that are commonly used to hold freight trains. The following indicative corrections to the $L_{pA(max)}$ can be made where brake squeal is known to be a problem:

- Where the $L_{pA(max)}$ at 15 m is less than 90 dB, increase the level to 90 dB
- Where the $L_{pA(max)}$ at 15 m is greater than 90 dB, no change

As with curve squeal, the noise levels can be very variable, with $L_{pA(max)}$ levels occasionally reaching 100 dB at 15 m. When modelling situations with existing brake squeal issues, comprehensive measurements are required to understand the noise emissions, the proportion of trains that squeal, and the noise level.

Bridges and Viaducts

On bridges and viaducts, vibration from the trains is transmitted into the supporting structure, resulting in noise radiation from the bridge or viaduct. The level of increased noise is dependent on a variety of factors. To simplify the modeling process, the following table provides $L_{pA(max)}$ and $L_{A(eq,period)}$ corrections over the length of the bridge or viaduct. These increases apply to the wheel-rail component only.

<table>
<thead>
<tr>
<th>Description of bridge</th>
<th>$L_{pA(max)}$ and $L_{A(eq,period)}$ noise level increase (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open transom, fabricated steel web, no side screens</td>
<td>+10</td>
</tr>
<tr>
<td>Open transom, fabricated web forming side screens</td>
<td>+8</td>
</tr>
<tr>
<td>Ballasted, steel box girder, no side screens</td>
<td>+4</td>
</tr>
<tr>
<td>Ballasted, fabricated web forming side screens</td>
<td>+4</td>
</tr>
<tr>
<td>Concrete trackbed, concrete box girder, no side screens</td>
<td>+3</td>
</tr>
<tr>
<td>Ballasted, concrete span, no side screens</td>
<td>0</td>
</tr>
<tr>
<td>Concrete trackbed, concrete box girder, concrete side screens</td>
<td>-2</td>
</tr>
<tr>
<td>Ballasted, concrete span, concrete side screens</td>
<td>-5</td>
</tr>
</tbody>
</table>

Table 2 Increase in Noise Level at Bridges and Viaducts

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Miscellaneous – other sources
Where diesel engines are idling stationary for long periods of time (eg, at signals), a steady noise level will be emitted from the engine exhaust and potentially from the cooling fans. In some cases, the contribution of idling locomotives will need to be included in a rail freight noise model, if this source is significant at a particular location, or if a project will change the location, number, time of day or duration of idling events. These sources may be modelled as industrial point sources, with source levels determined with consideration of the proportion of time that the noise source is present for at a particular location. Source noise levels from idling locomotives are described in the RND.

Bunching noise occurs near signals where coupling slack results in increased noise emission. It is a “clunking” noise generated by wagon couplings bumping into each other under freight train braking – a similar effect occurs when accelerating from stationary (“stretching”). This noise impact is often represented as an $L_{NN}$ effect only. The $L_{NN}$ value at 15 m is assumed to be independent of speed, with indicative levels being 90 dB for empty coal wagons and 88 dB for other wagons. This noise source is often not modelled, but it can be included if known to be a common feature in a particular area.

Establishing scenarios and naming conventions
When developing railway noise prediction models (or any other noise prediction model), it needs to be recognised that noise levels will vary on a day-to-day basis. Noise level changes will occur due to varying operating conditions (such as train speed or timetable changes), changes in the mix of trains operating on the line (i.e. different locomotive or wagon classes), and longer term changes may occur due to varying rail and/or wheel roughness levels.

A noise modelling scenario provides a snapshot of the railway noise levels that will occur as a result of a defined set of assumptions at a certain point in time. These assumptions (also called noise modelling scenarios), represent the most critical aspect influencing the predicted noise levels. A great deal of care therefore needs to be exercised in developing noise modelling scenarios that are representative of the rail operations to be assessed. Here, the old maxim of noise modelling applies – garbage in equals garbage out.

The choice of noise modelling scenarios is often dictated by the applicable rail noise criteria or guidelines. In NSW, the RING identifies a number of scenarios that must be modelled. These include ‘build’ and ‘no build’ scenarios for two timeframes: immediately after operations commence; and for a timeframe approximately 10 years after project opening. Modelling scenarios are required for the $L_{NN}$ and $L_{AE}$ noise assessment parameters.

In the special case of rail projects involving a mix of freight and passenger train operations, where there may be a range of different operators or infrastructure owners, additional noise modelling scenarios may be required to identify the relative noise contributions from different usages (i.e. passenger and freight) or different operators.

Guidelines may also dictate whether the noise modelling scenarios are to be based on ‘typical’ or ‘worst case’ assumptions. In NSW, the RING notes that for heavy rail projects, modelling is to be based on the worst-case typical projected volumes over an average seven day week. As a result, the likelihood that an individual location will be predicted to receive noise levels above the overall RING trigger levels is maximised. This requirement will lead to a conservative approach for all new rail line projects, since overall $L_{AE}$ noise levels are the only trigger to consider mitigation. However, this approach is not necessarily conservative if a freight line to be redeveloped is at or near capacity, or noise levels are already above the overall RING trigger levels.

For rail redevelopment projects, an increase in freight traffic might bring the train numbers on less busy days closer to the maximum typical daily train numbers. Since there may not be a change in the typical maximum daily train numbers, an increase in average train numbers may not lead to an increase in $L_{AE}$ noise levels. Since under RING both the overall and relative increase triggers need to be exceeded for rail redevelopment projects, in some cases the requirement to model worst-case train numbers rather than daily average numbers might mean consideration of noise mitigation is triggered at fewer residences than would have been the case if average daily train numbers were used.

Whilst multiple operating scenarios can complicate the overall assessment process, commercial noise modelling software include a number of features that enables the development of multiple scenarios in an efficient manner.

Increasingly, particularly for large rail projects in densely populated areas, client requirements dictate that noise models be peer reviewed by an independent noise consultant. In these circumstances, the peer review process will be much easier in cases where the noise modelling scenarios are clearly documented, set up in a logical manner and with clearly defined naming conventions. Such an approach will also assist in the checking and review process discussed in the following section.

Checking and review procedures
The ease with which results are generated by computer noise modelling software can easily provide a false sense of accuracy. In order to ensure accurate predictions, all aspects of the calculation process must be checked. A check list approach is the preferred method.

A critical component of the checking process will be the noise modelling scenarios. Normally, these will be developed on the basis of information gathered from a variety of different sources. Prior to performing the final calculations, the noise modelling scenarios should be reviewed by the project sponsor.
(or proponent) to confirm that all of the key assumptions are reasonable.

The checking process should then focus on the details contained within the noise model itself. It should examine aspects such as the ground terrain model, buildings, calculation areas, natural and man-made barriers, source levels, calculation standards and ground effects. A detailed check of each noise modelling scenario should be undertaken to confirm that the scenario includes all relevant components. Source files should be checked to confirm that train speeds have been modelled correctly, noise sources are at the correct heights above rail level, along with other track or operating features such as bridges, turnouts and changes in engine notch settings.

The checking process should also include evidence that all key aspects of the modelling calculations have been validated and documented (i.e. train speed corrections, hard/soft ground, number of reflections, calculation grid and calibration factors).

Model validation and compliance measurements

One of the requirements of the NSW RING is for the chosen noise model or calculation procedure to be validated for the project prior to local use.

Where the rail noise assessment is for a project which contains existing train operations, this requirement can be met by developing a noise model of the existing operations and comparing noise measurement results with noise model predictions at the same locations. When developing the noise modelling scenario for this situation, the operating conditions within the noise model should be as close as possible to the observed conditions. If there is a mix of freight and passenger train operations, the results of each noise source should be compared separately.

If the noise model predictions are within ± 2 dB (L_{Aeq(period)}) or ± 3 dB (L_{pAFmax}) of the measurement results, this would normally be regarded as being acceptable. A smaller variation in the L_{Aeq(period)} noise parameter is normally observed as a result of the averaging process associated with this noise parameter.

In some cases, noise predictions may be outside the above mentioned tolerances. This could be a result of random error, or in some cases there may be a clear trend of over- or under-prediction. In all cases, the source of the under- or over-prediction should be identified (via a detailed review of the noise model and/or noise measurement results and site conditions). This, however, may not always be possible as some features (such as rail roughness or wheel condition on freight wagons) cannot be quantified without detailed measurements.

Care should be exercised before applying any calibration factors to the noise modelling results as the requirement for calibration factors will generally indicate that there is something wrong with the source noise level assumptions and/ or assumed operating conditions. A simple example of this is presented below.

The source noise levels in the RND for passenger trains are based on relatively smooth track, consistent with the rail roughness requirements identified in International Standard ISO 3095:2005 [17]. If the RND source levels are utilised in a noise model and the prediction results are compared with measurement results, then there is a good chance that the measurement results will be higher than the prediction results. This is because the rail roughness levels at the measurement location may be comparatively rougher than the smooth track associated with the RND levels. In such situations, guidance should be sought from the project sponsor (or proponent) in relation to any calibration factors (or maintenance allowances) that should be included as part of the modelling predictions.

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rail corrugation analysis trolley (CAT) or other test equipment, can be used on a particularly critical rail section to determine the level of rail roughness of that track section. This can assist model calibration.

If the project proponent is a developer, then it may not be possible to gain access to the track to measure roughness. In this situation, making enquiries of the rail operator about track maintenance activities and the date of rail grinding may still give useful information. If no information is available from the rail operator, then use of judgement is required if the difference between model and measurements are outside of expected tolerances, and all other potential sources of variance have been eliminated. For a new development, the end objective of acoustic work is to enable a development design that achieves amenity for future occupants. Therefore, it is likely to be appropriate and conservative to use measured noise levels to assess noise impacts on a new development, if these measured levels are higher than predicted by modelling using standard RND source levels. If measured levels are lower than expected based on modelling using the RND, and the reason is not clear, then basing the assessment on the higher modelled values would be appropriate.

When assessing compliance with the project noise criteria (normally at the commencement of operations), attended noise measurements will usually be undertaken at several representative locations and compared with the noise model predictions made during the detailed design stage. At this stage, validation of modelling assumptions including train numbers, speeds and train type is required, in addition to measurements at representative locations.

Many of the above-mentioned factors relating to noise model validation are equally applicable to compliance measurements. Generally, if the noise model predictions are within ±2 dB (L10,eq) or ±3 dB (L10,annual) of the measurement results, this would normally be regarded as being acceptable. However, if there is clear trend of under-prediction (measurement results higher than prediction results), then further detailed analysis of the noise model and/or site conditions will likely be required to ascertain the reason for the under-prediction.

Summary

An environmental noise model is typically at the core of noise impact assessments for rail projects. These software packages include rail noise modules that account for such variables as train speed and length, and propagation algorithms that allow large scale models to reliably predict noise levels at thousands of receivers neighbouring the track. The ease with which results are generated by these software packages can easily provide a false sense of accuracy.

Freight rail operations involve complex noise sources. These include multiple moving noise sources, such as locomotive exhaust noise and rolling noise, that exhibit distinct relationships with train speed. There are also localised sources such as crossovers and curve noise which have a particularly annoying character. There are sources that exhibit different characteristics under different operational scenarios. For example, locomotive noise can be dominated by the engine exhaust under traction on an uphill grade and ruled by dynamic brake noise on a downhill grade.

In light of the complexity of rail freight noise models, it is critical to validate the noise model at each stage of its development, and to test the sensitivity of the model outputs to each assumption. When modelling an existing freight line, there is no substitute for measurements at multiple sites within the project area, in conjunction with understanding the operating conditions and testing the validity of all input data. Even if it appears that all the modelling inputs are clearly defined, and source noise levels are well documented in existing databases, comprehensive long term measurements of noise levels are often required to validate models.

Ongoing validation, updating and revisions of noise models may be required as the project proceeds. In some cases, project Conditions of Approval can require compliance monitoring and model updates several years after a project opens. Rail freight noise models should therefore be organised so that other acousticians can understand what has been done, review work and make adjustments in future if required.

For new freight lines in greenfield areas, it is accepted that assumptions will be required in the modelling process. In this case, compliance measurements after opening are used to confirm that rail freight noise impacts have been captured and that an equitable and consistent approach has been used to mitigate noise in accordance with the relevant guidelines.

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References

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- Whole body human vibration
- Hand-arm vibration
- Noise at work
- Environmental noise and vibration
- Building acoustics
- Noise nuisance
Investigations of noise and disturbance from vehicles crossing cattle grids and examination of options for mitigation

By Greg Watts and Amir Khan of the University of Bradford and Rob Pheasant of the University of Leeds

Abstract
Cattle grids are used on roads and tracks to prevent grazing animals from leaving an open space without fencing onto a more controlled area where access to the road from surrounded land is more limited. They are widely used in the UK at the entrances to common and moorland areas where animals are free to roam, but also on private drive entrances. Typically, they consist of a series of metal bars across the road that are spaced so that an animal’s legs would fall through the gaps if it attempted to cross. Below the grid is a shallow pit that is intended to further deter livestock from using that particular crossing point. The sound produced as vehicles cross these devices is a characteristic low frequency “brrrr” where the dominant frequencies relate to the bar passage frequency under the tyres. The sound can be disturbing to riders and their horses and walkers and residents living close by as evidenced by press reports and the need to consider noise aspects in planning for new installations. For this reason and due to the lack of available information on the size and nature of the problem measurements and recordings have been made at a number of sites in Yorkshire in the UK. In addition, questionnaire surveys of residents living close by and façade measurements have also been used to gauge impact. Results show that there is a wide variation in the maximum noise level produced by cattle grids of apparently similar design. This can be related to impact noise produced by the movement of all or part of the grid as the frame comes under impulsive loading as the vehicle crosses. It was further established that some residents living close to the cattle grids were disturbed by the noise, and in some cases vibration, and wanted them removed or suitably modified. Means of reducing the problem are proposed

Introduction
Cattle grids are widely used to prevent grazing animals from leaving unfenced farmland or moorland onto more controlled spaces where access to the road is prevented by walls, fences or hedges. Typically, they consist of a grid of regularly spaced metal bars with a shallow pit beneath. They are designed so that an animal’s leg would fall through the grid if attempts were made to cross. There is design guidance set out in BSI 4008 2006 [1]. This can be related to impact noise produced by the movement of all or part of the grid as the frame comes under impulsive loading as the vehicle crosses. It was further established that some residents living close to the cattle grids were disturbed by the noise, and in some cases vibration, and wanted them removed or suitably modified. Means of reducing the problem are proposed

Noise associated with vehicles crossing these installations, which is typically a low frequency ‘brrrr’ is often the main reason why people living in the vicinity of cattle grids complain to the planning or highway authorities. Within the United Kingdom cattle grids are often located in areas of public amenity, such as the urban-rural fringe, National Parks, ancient commons and Areas of Outstanding Natural Beauty (AONB), all of which attract large numbers of visitors on a daily basis. The perceived degradation of environmental quality caused by vehicles continually crossing cattle grids in these areas was partially assessed in a controlled laboratory study carried out by the University of Bradford in 2013 [2]. The study examined the extent to which the introduction of congruent mechanical and natural soundscape components into video recordings of a range of natural environments, influenced the perception of tranquillity and wildness. Cattle grid noise was introduced into a video clip of an ancient monument located in Dartmoor National Park (Horns Cross), which when rated for tranquillity by subjects using an 11 point scale (0-10), achieved a mean tranquillity rating of 4.2 This was significantly lower than the mean tranquillity rating of 8.3 awarded when the same environment was presented in its original, i.e. unedited state. In this example the 4.2 reduction in tranquillity rating points was accompanied by an 11.9dB increase in $L_{eq}$. The $L_{eq}$ values for the in-situ and edited soundscapes were 38.4dB and 50.3dB respectively.

Disturbance to peace and quiet and to the overall tranquillity of a location by the installation of a cattle grid, is a concern that is regularly reported in the press and articulated to the UK Government’s Department of Transport (DoT) inspectors. In 2007 a Public Enquiry was held following objection to the proposed installation of cattle grids in the ancient Stannery town of Chagford, which is situated at the heart of Dartmoor National Park. Here local residents complained that the noise would be “a jarring, metallic sounding disturbance in this tranquil area” that would “entirely change the nature and character of local heritage sites” [3]. In 2013 similar concerns were being raised on Chailey Common in East Sussex, where locals voiced concerns that the introduction of cattle grids on ancient common land would “blight the tranquillity of their homes” [4].

In both of these cases noise and the associated change to the localised acoustic environments was an important issue especially when it came to sleep disturbance. In the case of Chailey Common two residents reported being awakened by noise from the cattle grid, one of which claimed that “my sleep is now permanently disrupted because of the sound of cars clanking over cattle grids” [4]. Further evidence of concern about the noise impacts of cattle grids can be found in Dorset County Council’s 2010 Roads and Rights of Way Committee Report (Agenda Item 4), where objection to the installation of cattle grids in the Throop area was opposed by two of the local Parish Councils [5], and in written objections submitted to the Public Enquiry into the installation of cattle grids within Epping Forest, held by the Department of Transport in 2011 [6].

Evidence provided to Dorset County Council’s Roads and Rights of Way Committee [5] included a statement that said “at low speeds (about 10mph) there is no significant noise generated when travelling over a cattle grid, and it may even be less than on Tarmac (asphalt). At 20mph there is a slight increase but the noise at the nearest properties to the grid is not expected to be significantly higher than the noise of the vehicle itself”. Speed related increases in noise levels has been a concern in all of the examples discussed, however, a detailed review of the literature has not identified any scientific studies that support the claim that in terms of noise
levels, passing over a cattle grid at 10mph is quieter than transiting asphalt at the same speed.

Not all of the concerns about cattle grids raised in the examples presented were upheld at either the Local or Central Government levels. However, what they show is that health and quality of life issues are an important consideration when proposing, installing or maintaining cattle grids. This is supported by the press report that was instrumental in starting the present study, where very high sound pressure levels recorded by a complainant living within 50m of a cattle grid that is used by approximately 5800 vehicles a day had significantly compromised his family’s right to peace and quiet and a decent night’s sleep.

The aims of this preliminary study were to investigate the size and nature of the problem and evaluate effects on residents living nearby. It was expected that the findings would be of use in further more detailed studies leading to solutions.

**Method**

**Outline of approach**

Roadside measurements of vehicle noise were carried out at 2 sites near Baildon, 3 sites in Ilkley (both groups near Bradford) and at 2 sites on the A684 east of Sedbergh in the Yorkshire Dales. Vehicles were selected from the traffic passing ensuring they were freely moving and not in close proximity to other vehicles. In addition, measurements were carried out using a test vehicle at these and further locations at a fixed speed for accurate comparison of noise produced across sites. Finally, façade measurements at homes where residents were affected by the noise from cattle grids were also taken.

The approach adopted included roadside measurements of the maximum noise produced by vehicles crossing the cattle grids in both directions, where safe and practical to do so, and recordings of the sound produced by a test vehicle for later analysis. $L_{A\text{max}}$ was the preferred measure as the nature of the sound was less than a second in duration. All sites were on minor single carriageway roads where average vehicle speeds were generally in the range 40 to 50 km/h. For the purpose of characterising the noise produced a Bruel and Kjaer sound level meter type 2250 was used for capturing maximum A weighted levels using fast averaging $L_{A\text{max}}$ and additionally for recording a few seconds from a test vehicle cruise-by for post processing. Measurements were confined to light vehicles i.e. cars and vans as there were very few heavy vehicles on these minor single carriageway roads and it would have taken too long to obtain a valid sample.

**Measurement of noise selected from passing traffic**

The method employed was guided by the statistical pass-by standard of measurement method described in ISO 11819 - 1. Due to restricted level ground at the sites the distance to middle of the nearside lane was fixed at 5m and not 7.5m as given in this standard. At some sites far side measurements were also carried out and distance corrections made to enable comparisons with nearside measurements. The microphone height was 1.2m which conforms with ISO 11819 – 1. The method involved sampling vehicles that were freely moving and widely separated from other vehicles so that the noise of the selected vehicle was not contaminated by other vehicles on the road. The approach speed to the cattle grid was measured using a radar speed meter (Bushell Velocity speed gun) positioned close to the edge of the carriageway. A sample of between 60 and 110 vehicles were obtained on the higher flow roads but on roads carrying very little traffic it was only possible to sample between 10 and 40 vehicles and in some cases the samples were too small for statistical analysis. However, measurements with a test vehicle was made at all sites. All measurements were conducted with a wind speed less than 2m/s and background noise levels were low <55 dB(A). Where possible measurements were also made on adjoining road surfaces (i.e. without cattle grid) with the test vehicle.

**Measurements with a test vehicle**

For the purpose of making detailed comparisons of the noise...
produced from different installations a test vehicle was used and driven over each cattle grid at a speed of 40km/h. The test vehicle, a Toyota Yaris, was a front wheel drive compact and had a wheelbase of 2.44m and a kerb weight of 830kg. The crossing speed was chosen to be close to the average observed crossing speed across sites of vehicles in the traffic stream. Again the maximum A-weighted dB level on fast averaging was recorded on site and short recordings taken for post processing.

The effects of speed on \( L_{\text{Amax}} \) was also investigated at one site in Ilkley in order to determine if a low speed limit would produce a significant reduction in \( L_{\text{Amax}} \).

Measurement near homes of residents affected by noise
To determine the size and nature of the problem questionnaires were posted to homes within an approximate radius of 150m from two cattle grids located near to residential areas i.e. sites Baildon A and Ilkley A. The questionnaire was provided with a postage paid reply envelope. There was an invitation to allow measurements at their homes if they thought this was appropriate. In all measurements near the facades of four such homes were carried out. The distances from the cattle grids ranged from 7.7m to 122m. Figures 2 show maps of the cattle grid sites situated close to dwellings with concentric circles centred on the cattle grids to indicate distance. The four measurement positions are marked with asterisks.

Results and analysis

Passing traffic

Plots were made of the captured \( L_{\text{Amax}} \) against crossing speed for each installation. Measurements made to vehicles travelling in the far side lane were normalized to a distance of 5m for comparison purposes. For this purpose a simple correction based on hemi-spherical spreading was used i.e. \( 10 \log_{10} \left( \frac{5}{d} \right)^2 \) where \( d \) is the distance to the middle of the far side lane (in range 7.5 to 8m)

Figure 3 shows a plot of \( L_{\text{Amax}} \) against speed for the cattle grid at two contrasting sites, the entrance to Baildon Moor (Baildon A) and on the A684 in North Yorkshire east of Sedbergh (Sedbergh A). In both cases measurements were made in the nearside lane.

<table>
<thead>
<tr>
<th>Location</th>
<th>N</th>
<th>Av. speed*</th>
<th>R²</th>
<th>Av. ( L_{\text{Amax}} )</th>
<th>Conf. int.</th>
<th>( L_{\text{Amax}} ) at 40kmh crossing speed from passing light vehicles and test vehicle</th>
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</thead>
<tbody>
<tr>
<td>Baildon A (NS)</td>
<td>67</td>
<td>38.81</td>
<td>0.51</td>
<td>78.93</td>
<td>± 0.81</td>
<td>80.3</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>79.33 ± 1.48</td>
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<td>-</td>
<td>-</td>
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<td>80.37</td>
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<td>0.67</td>
<td>81.41</td>
<td>± 0.57</td>
<td>76.28 ± 1.25</td>
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<tr>
<td>Baildon B (FS)</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>77.93 ± 0.65</td>
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<tr>
<td>With distance correction</td>
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<td>-</td>
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<td>75.94 ± 1.32</td>
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<td>Ilkley C (NS)</td>
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<td>84.22 ± 1.48</td>
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<td>87.65</td>
<td>± 0.75</td>
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<td>-</td>
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<td>-</td>
<td>95.73</td>
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</tbody>
</table>

Table 1: Average \( L_{\text{Amax}} \) levels at 40km/h crossing speed from passing light vehicles and test vehicle
It can be observed from the fitted regression line that the predicted mean maximum levels at Sedbergh are significantly higher than is the case for the site at Baildon. Note that the correlation coefficients were similar whether the actual speed or logarithm of the measured speed were used and so it was decided to use the measured speed.

For comparison purposes a speed of 40 km/h (25 mile/h) was chosen across all sites as it was close to the overall average crossing speed (44 km/h). Regression analyses were carried out on the data for each site and the predicted mean $L_{A_{max}}$ at 40 km/h. Table 1 lists these predicted means together with the 95th percentile confidence intervals for the means, number of data pairs and the $R^2$ value. It can be seen that 2 sites produce significantly higher noise levels i.e. Sedbergh A and Sedbergh B.

**Test vehicle**
Test runs at 40 km/h over the cattle grids at each site were carried out with the test vehicle. For this purpose the vehicle speedometer was used. This was later checked at the test speed of 40 km/h by timing 8 runs over a measured mile (1.61 km) and it was found sufficiently accurate. The average speed was found to be 39.44 km/h with 95% confidence interval ±0.33 km/h. Using the test vehicle passing at constant indicated speed of 40 km/h it was found that the radar speed meter was reading low at an average value of 37.57 km/hr based on 23 readings (95% confidence interval of 0.65 km/h). Appropriate adjustments were therefore made when predicting the maximum $L_{A_{max}}$ from the data collected at each site.

At some sites it was relatively easy to find a suitable turning place close to the cattle grid to enable efficient testing in both directions but at other sites a suitable turning place could not be found close by and this delayed data collection and as a consequence the number of readings was reduced. Table 1 shows the average $L_{A_{max}}$ together with confidence intervals and number of readings.

A comparison was made at a crossing speed of 40 km/h between the average predicted $L_{A_{max}}$ values obtained from passing light traffic and those obtained from the corresponding mean value for the test vehicle as can be seen in Figure 4. The regression line indicates good agreement between the two sets of averages i.e. the difference ranged from 0.5 dB(A) at 95 dB(A) to 1.5 at 80 dB(A) with high $R^2$ value (0.84). This gives support for using the results for comparative purposes from the test vehicle at sites where it was not possible to collect sufficient data from passing traffic.

The control measurements were only possible at three sites due to the problem of finding suitable measurement sites on narrow roadside verges. However, at the sites where measurements were possible the test vehicle driven at 40 km/h on surfaces before or after the cattle grids showed a narrow range of recorded $L_{A_{max}}$ from 69.5 to 72.7 with average 70.8 dB(A). From Table 1 this indicates an increase in noise of at least 6.6 dB(A) and at Sedbergh B site an increase of 24.9 dB(A).

![Figure 4: Correlation between average $L_{A_{max}}$ at 40 km/h produced by test vehicle and the average predicted from sampled passing light vehicles](image)
Crossing speed and maximum noise levels

In order to investigate the effects of crossing speed on \( L_{\text{Amax}} \) in more detail a series of measurements were made with the test vehicle on a residential road, Ilkley C with little traffic. The purpose was to determine if significant speed restrictions down to as low as 8 km/h would have a significant effect on recorded maximum levels. It was considered that such traffic calming restrictions could be an option for controlling cattle grid noise in noise sensitive areas.

Measurements were conducted at crossing speeds between 8 km/h and 48 km/h (the maximum speed limit for this road) in 1.6 km/h (1 mile/h) increments. As a control measurements were also made on the road surface approximately 50 m from the cattle grid. Due to the wide speed range it was found that a logarithmic speed scale gave a slightly better fit with recorded \( L_{\text{Amax}} \) than did a linear scale. Figure 5 shows this relationship with speed for both the cattle grid and control measurement sites. The relationships are close with \( R^2 \) values of 0.91 and 0.89 for the cattle grid and control datasets.

Some of the scatter in values of \( L_{\text{Amax}} \), particularly at lower speeds may be due to variations in engine noise depending on the low gear selected and possibly the electric fan cutting in and out. Despite these scattered points it can be seen that the trend in the difference between maximum levels produced on this cattle grid and the control reduce steadily with speed. At 48 km/h this difference is 5.1 dB(A) while at 8 km/h there is no significant difference (< 1 dB(A)).

Measurements near buildings with test vehicle

A total of 13 questionnaires were received from the 26 that were delivered to the two cattle grid installations with houses close by. Ten were received from residents living close to Baildon A and 3 from Ilkley A. The questionnaire replies are summarized in Table 2 below. It can be seen that there is a tendency for ratings of annoyance to decrease with distance. Clearly the amount of screening of a property by other buildings or local topography would have a significant effect on the peak noise levels and consequently on the level of any annoyance caused so that a simple relationship was not expected. This is more easily seen in Figure 6 where for each level of annoyance on a scale 1 to 4 the average distance from home to cattle grid is given.

It is also shown in Table 2 that at 2 sites vibration was also felt in addition to noise. This can be seen to be associated with the highest rating of annoyance as would be expected.

A small number of residents allowed measurements to be taken close to the façade of their homes facing the cattle grid. There were 3 sites near site Baildon A and one site near Ilkley A. These measurements involved driving the test vehicles over the cattle grids at 40 km/h and recording the level \( L_{\text{Amax}} \) at a microphone set up near the building façade.
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at a height of 1.2m and at a distance of 1m from the nearest façade to the cattle grid.

These data are summarized in Table 3 below. Where N is the number of readings and Est. $L_{Amax}$ is the estimated level based on hemi-spherical spreading over a hard surface and average measured level at 5m. In the case of prediction at the closest site there is a noise barrier 2.4m tall extending 5m in each direction from the centre of the cattle grid that clearly has contributed to the 9.2 dB(A) difference between estimate and measured $L_{Amax}$. In the case of the site at 30.7m the property lies below the level of the road and the road shoulder provides a diffraacting edge that would contribute to the observed difference of 5.6 dB(A). At the remaining two sites the estimated and measured levels are close.

**Spectral analysis**

To understand the differences between the maximum noise levels observed at the noisiest cattle-grid and one of the quietest, short segments of sound recordings were analysed i.e. the portion when the test vehicle was on the cattle grid.

Figure 7 shows the time histories and FFT for two contrasting sites Ilkley C and Sedbergh B where average peak noise levels from several runs with the test vehicle were very different i.e. average $L_{Amax}$ of 79.3 and 95.7 dB(A) respectively. It can be seen from Fig 7 that at Ilkley C there is a very pronounced dominant frequency at 49.2 Hz close to the calculated bar passing frequency under the tyres at 40 km/h of 49.7 Hz based on the measured separation of the bars of 1400 mm. Several harmonics of the fundamental can also be observed. Table 4 gives details of bar geometry at each site and expected passage frequency at each site.

The passage of front and rear wheels is also clearly visible in Figure 7. In the case of Sedbergh B site although the passage of the two tyre sets can be seen there is no dominant frequency at the bar passage frequency of 78.1 Hz although the maximum in the FFT occurs at 75.0 Hz there is in fact a wide range of frequencies present. This is consistent with impact sounds as each tyre set loaded the grid. This also agrees with the subjective impression of a pronounced crash as the test vehicle reached the cattle grid.

**Discussion and conclusions**

The results indicate that there is considerable variation in the noise level and characteristics of the sounds generated by passing vehicles at the cattle grid sites examined. The construction of the cattle grids was essentially the same consisting of regularly spaced metal bars placed across the road above a shallow pit. However, there was some variation in design since the number of bars varied from 10 to 16 and each bar varied in width from 20 to 85mm with gaps between bars of between 140 – 120mm. The bars had a flat running surface with rounded corners except at Baildon A and Sedbergh B sites where the running surface was convex throughout. None of the designs encountered in this study conformed to the UK British Standard BS 4008:2006 [1]. The three Ilkley sites had the correct gap spacing but the bar width exceeded the standard i.e. 30 – 40mm. One site Sedbergh A had the correct bar width of 30mm but the gap width of 156mm was wider than specified (130 – 150 mm).

There was some variation in average peak levels obtained from passing traffic between sites at Baildon and Ilkley but differences were small. Some of this variation will be due to sampling errors as the variation observed with the test vehicle was much smaller as can be seen in Figure 3. Detailed differences in design would also have contributed but no conclusions can be drawn without further investigations. However, at the Sedbergh sites, levels were considerably higher and the character of the sound indicated considerable rattle noise from multiple impacts. Observations at this site revealed that the whole grid moved as the grid came under load from passing vehicles and it is likely that multiple impacts of the loose grid with supporting structures produced the observed high maximum levels. Figure 8 shows damage to the concrete frame supporting the grid that allowed significant movement during loading.

This was confirmed by an analysis of the sounds produced at two contrasting sites. There was a very clear dominant frequency at the quieter Ilkley site where the much lower $L_{Amax}$ recorded was consistent with the bar passage frequency of approximately 50 Hz. At the contrasting site with much higher $L_{Amax}$ the FFT revealed a much broader range of frequencies consistent with multiple impacts.

The survey of local residents living close to the cattle grids at Baildon and Ilkley sites was limited due to the poor response rate (50%) but for those who did reply it did indicate a significant problem due to noise and in some cases vibration. As expected those living further from the cattle grids tended to be less annoyed but individual sensitivities did mean that one resident living at a distance of 92m was very annoyed by the noise. The problem in this case appeared to be night-time disturbance. In this context the WHO guidelines for community noise exposure are relevant [10]. For outside bedroom windows the $L_{Amax}$ limit is set at 60 dB(A). From Table 3 it can be seen that properties at 7.7m and 3.2m had average $L_{Amax}$ levels > 5 dB(A) above this limit and one property at 30.7m was just over 2 dB(A) below the limit. The fourth property at 91.7 dB(A) was just over 6 dB(A) below. However, these levels were obtained from the test vehicle travelling at a constant speed of 40 km/h and so at greater speeds and with different vehicles greater maximum values are possible. As we have seen at the Baildon A site, an increase of $L_{Amax}$ with speed is on average 0.45 dB(A) per km/h increase. So with a crossing speed of 54 km/h on average we would expect the $L_{Amax}$ to increase by over 6 dB(A) and sufficient to exceed the recommended guideline value at night. A further consideration is that the sound produced is tonal in nature and this can add significantly to the disturbance caused. For example, in BS 4142 [11] in the case of industrial noise with tonal character affecting residential properties, a penalty of up to 6 dB(A) has been specified while for impulsive noise a 9dB(A) adjustment is possible. However, it is unclear to what extent these corrections apply to short duration sounds where $L_{Amax}$ levels are being recorded. There were two cases in the small sample of 13 where both noise and vibration produced by vehicles crossing the cattle grid was noticed. In these cases the assessed annoyance was at the highest i.e. rated as “very annoyed”. However, more generally it has been shown that where both noise and vibration are experienced both additive and interaction effects can occur, so there is the potential for these higher levels of annoyance [12].

Using an average value of $L_{Amax}$ of 80 dB(A) near the cattle grid and applying the distance attenuation relationship in section 3.1 it can be shown that at 50m the $L_{Amax}$ reaches the 60 dB(A) WHO guideline value. However, if crossing speeds were higher, levels may occasionally reach 90 dB(A) at the cattle grid and in that case properties located 150m away may experience the guideline value. Figure 2 shows a distance scale superimposed on maps of relevant sites and indicates the number of houses that might be affected in this way. For example, at Baildon A site it is likely that over 20
properties with line of sight of the cattle grid would experience this level of noise at a bedroom window. From Table 2 we have evidence of reported disturbance out to 115m from this cattle grid. Factoring in the disturbing quality of the generated noise, both impulsive and tonal, may further extend the zone of possible disturbance.

A number of solutions were suggested including reducing the speed of traffic by means of speed control humps on the approaches and redesign of the cattle grid itself. Reducing the speed of traffic would be expected to have some effect as can be seen from the scatterplots in Figure 2. For the Baildon site the slope of the regression line is 0.45 dB(A) per km/h. For this installation a reduction by 20 km/h in average speed might reasonably be expected to result in a 9 dB(A) reduction in noise. Subjectively this would be almost a halving of the apparent loudness of the noise. However, at the Sedbergh site the slope is much lower at 0.16 dB(A) per km/h such that a 20 km/h reduction might yield a reduction of only 3 dB(A) which may be barely noticeable. The difference may result from the different mechanisms involved for dominant noise generation as explained above. Averaged over 7 sites the average increase on L_Amax with speed was 0.25 dB(A)/km/h.

One solution proposed to the Dorset County Council Roads and Rights of Way commission was to limit crossing speeds to just 10 mile/hr (16.1 km/h) where it was claimed noise levels would be similar to the maximum noise levels observed without the presence of the cattle grid [5]. There is some evidence that this could be broadly correct at some sites since at 40 km/h the average recorded L_Amax at three sites before the test vehicle crossed the cattle grids was 70.8 dB(A). Using the regression equations in Figure 2 and entering a crossing speed of 16.1 km/h it was found that resulting L_Amax values at Baildon A and Sedbergh A sites were 69.0 dB(A) and 84.0 dB(A) respectively. So at Baildon A and ignoring the possibility that freely moving traffic without the cattle grid may be moving more quickly, there appears to be similar levels under these two conditions. However, at the Sedbergh site this is clearly not the case since there is over a 13 dB(A) increase compared with the control situation.

Further evidence for the benefits of reducing speed over the cattle grid comes from the speed versus level study carried out with the test vehicle at Ilkley C. Figure 5 shows that at a cattle grid crossing speed of 24 km/h the average level recorded is very similar to that found at a pass-by speed of 40 km/h on the road surface just before the cattle grid. For this site it appears that this more modest reductions in speed is all that is required. A solution to the noise problem that suggests itself would be to incorporate the cattle grid into a traffic calming hump widely used in urban areas [13]. If the cattle grid were raised 75mm above the road surface with ramps 1850mm long on either side then the profile would be similar to that recommended for a regular flat top speed control hump used in the UK. Such a hump produces an expected crossing speed for light vehicles in the region of 24 km/h. Figure 9 shows a suggested design in plan view.

In summary, the study has shown that:

- Noise and vibration from cattle grids can be a serious problem within 100m of the device and in some cases some annoyance can be created beyond this distance.
- Maximum noise levels reduce with crossing speed and a suggested noise mitigation measure is to incorporate the cattle grid into a flat top speed control hump similar in profile to that recommended for traffic calming on UK roads.
- Poorly secured cattle grids can produce very high noise levels as vehicles impact the loose grid. Regular maintenance may be necessary especially at heavily trafficked sites where deterioration in fixings can be expected.
- Noise barriers erected adjacent to the cattle grid to screen residential properties can be effective in reducing noise at some sites but the height, length and siting of such barriers would be crucial in producing a significant reduction. From a practical point of view it is unlikely that all properties could be protected in this way.

![Figure 8: Damage to concrete support frame at Sedbergh B site](image8)

![Figure 9: Plan view of proposed cattle grid hump](image9)
• It was not possible in a study of this nature to come to any conclusions concerning the importance of differences in detailed design of the cattle grid to the noise generated. Controlled trials would be required with a range of vehicles and crossing speeds before firm conclusions could be reached.

Acknowledgements

The assistance of residents in Baildon and Ilkley in West Yorkshire in completing the questionnaires, and in some cases allowing measurements on their property, is gratefully acknowledged. The work was funded by the Bradford Centre for Sustainable Environments, University of Bradford.

References


SIDERISE on song at major Scots entertainment venue

SIDERISE, the acoustic, fire and thermal insulation products manufacturer, has helped provide top-class acoustics at a £125 million entertainment venue in Glasgow. Forming part of the redevelopment of Glasgow’s former docks, the SSE Hydro is a 25,000m², 12,500 seat arena designed to stage both music and sports events.

SIDERISE used its acoustic barrier/damping mat solution SIDERISE BM/P5/BOAK and BM/P10/BOAK. Overlapping sheets were fitted from below through the structural framework. The SIDERISE BM/P5/BOAK and BM/P10/BOAK sheets were fixed and sealed to provide a continuous membrane which could be shaped and installed to suit the services and structural elements. The result was a fully compliant system.

Mike McLaughlin, Managing Director (Joint) of Roskel Contracts, which commissioned SIDERISE, said: “We came to SIDERISE as we had concerns that a buildable solution, which met the acoustic performance criteria, could not practically be achieved with an exclusively boarded solution.

On the road again with G.R.A.S.

G .R.A.S Sound & Vibration UK has completed another university road trip, presenting to students at Hull, Bournemouth, Southampton Solent, Derby and Cranfield Universities.

As before, each event consisted of an interactive seminar and presentation by Per Rasmussen, Technical Director at G.R.A.S in Denmark, and son of Gunnar Rasmussen, developer of the first reproducible one inch condenser microphone. The presentation examined the measurement microphone from a technical perspective and how it has evolved to suit specific applications.

Aidan Hubbard, Sales Engineer at G.R.A.S UK, said: “Our roadshows provide us with a fantastic opportunity to meet the people at the coalface and connect with the acoustics experts of the future. This latest one was a great success with good attendance at all five universities.”

The SSE Hydro

“From concept, through mock-ups and the final site installation they provided us with good advice and back up on this extremely complex and challenging project.”

For further information visit www.siderise.com or call 01656 730833.
The first UK trial has been launched of a scaffolding system fitted with a “living wall” which it is hoped will cut noise on building sites by up to 10 decibels.

The structure has been installed on scaffolding at the St Mark’s building, a Grade I listed property in Mayfair, London undergoing conversion by Grosvenor into new retail and community space.

The wall, known as Living Wall Lite, spans 80m² and comprises a mixture of grasses, flowers and strawberries, reducing the visual impact of scaffolding on local residents. As well as reducing noise nuisance, it is predicted it will lower air pollution by 20 per cent.

The wall has been designed by Arup and manufactured by Swedish living wall specialist Green Fortune, and has been fitted with sensors to monitor its impact on noise, temperature and air pollution.

Alistair Law, Façade Engineer and the Living Wall Lite’s developer, Arup, said: “Living Wall Lite has the potential to transform scaffolding and hoardings into much more than just a cover up. By introducing plants and flowers, we can create a more attractive and healthier environment for local residents, businesses and workers on site.”

Mark Tredwell, Development Director, Grosvenor, said: “This is a great initiative and is in line with our long-term ambition to improve the environmental sustainability of the buildings across our London estate, reducing emissions by 50% by 2030. As the estate continues to adapt and evolve we want to ensure that the impact on the community is positive. As well as reducing air pollution, we hope the living wall will introduce a rich biodiversity to Mayfair and encourage people to linger in the area.”

Silent please: ‘Living Wall’ aims to cut building construction noise

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Scots university appoints WSP | Parsons Brinckerhoff for new music centre

WSP | Parsons Brinckerhoff has been appointed to provide acoustics consultancy and building services engineering for a new music centre at the University of St Andrews.

The university wants to create a world class music and performance facility, which will be located on the historic Queen’s Terrace, to attract the very best performers to the town, both for its regular concert series and for special events.

The music centre will offer a full range of practice, rehearsal and teaching spaces needed by student musicians. A dedicated rehearsal and performance studio, a music technology and recording suite and a library will also be included.

WSP | Parsons Brinckerhoff will work with project manager Gleeds and the project design team to achieve quality room acoustic conditions and very high levels of sound insulation

Martin Raisborough, head of WSP | Parsons Brinckerhoff acoustics, said: “We’re delighted to be appointed for what was a very competitive job at such a high profile institution.

This appointment is testament to the great work our acoustics team has done previously, particularly at the award winning Stowe Music School.

“Music and performing arts is a key sector for acoustics specialists and this project builds our portfolio and our profile. Projects of this nature give our consultants the opportunity to take more of a leading role in the design process and showcase our high specification acoustic design.”

Graeme Bruce, WSP | Parsons Brinckerhoff head of building services in Scotland, said: “The higher education sector in Scotland is providing considerable opportunities for world class engineering. Working with the university to create a new music centre marks another significant appointment for our Scottish building services team.”

Subject to planning permission and the final approval of University Court, it is anticipated the project will be completed in 2018.

Last year WSP | Parsons Brinckerhoff was appointed to work on a new learning and teaching hub and a research hub at the University of Glasgow, among other Scottish education projects.

Happy 25th birthday for Acoustics GRG as it looks to the future

Acoustic GRG Products has marked its 25th anniversary with the launch of a new website and a revamp of its branding.

The Kent-based business began in 1991 following the design and production of an acoustic diffuser for US acoustical company RPG Diffusor Systems, a project which involved Brian Moule working closely with RPG’s Dr Peter D’Antonio.

In 1994 it introduced the Skyline 2D Diffuser to the products manufactured here in the UK and exported worldwide, further cementing the relationship with RPG.

The collaboration with RPG has grown over the years and today Acoustic GRG, which has now 17 staff, maintains complete parallel manufacturing of the full RPG range for the UK and Europe.

As well as offering off-the-shelf products, it offers bespoke solutions for any space. This also applies to the finishing materials of the products, which include gypsum, timber, acrylics, engineered timbers and recycled polyester.

To complement the RPG product range, Acoustic GRG also supplies brands such as Clipso PVC Free Stretch Fabrics, Green Glue Soundproofing Compound, Lifeboard Powdercoated MDF, Spigo Akustik Timber products, DeAmp fibre-free absorbers and the new SAC Silent Acoustic Plaster.

Brian Moule was succeeded as Managing Director by his son, Matthew, three years ago but remains very much part of the business. Together they offer more than 50 years’ experience.

Mathew Moule said: “Our success has been down to working closely with our clients to find the right solution for them and investing in our staff, product design, development and equipment.”

For more information ring 01303 230944 or visit www.acousticgrg.co.uk

Cirrus Research celebrates largest order in its history

Cirrus Research has secured the biggest order in its 46-year history, supplying noise monitoring equipment to an Indian police force.

The Yorkshire-based noise monitoring specialist clinched two contracts almost simultaneously after an international tender process.

It is supplying the Maharashtra police with 627 Optimus Red sound level meters, which will be used to monitor noise pollution on the region’s cityscapes and roads, as well as at festivals and street celebrations.

Daren Wallis, Cirrus Research Managing Director, said: “This is a very significant order for us, the largest ever received in our history.

“The fact we had less than four weeks to send out the first consignment was challenging but we managed to turn it round, which led to the second order following on immediately.”

Daren Wallis (left), Cirrus Research Managing Director, and Jonathan Phillips, Export Sales Manager, oversee the dispatch of the meters.

Acoustics Bulletin January/February 2017
Industry Update

### Australian consultancy
**Resonate opens Dublin office**

A ustralia-based Resonate Acoustics has jumped hemispheres by opening an office in Dublin headed by Dr Emmet English. Resonate was formed in Adelaide by Matthew Stead in 2011 with offices in other Australian cities opening shortly afterwards. Emmet obtained a PhD from the ISVR before becoming a consultant specialising in structural dynamics, environmental noise and acoustic R&D.

The Resonate team has more than 200 years of combined experience, offering acoustic consultancy services including underwater acoustics, wind farms, vibration, specialist acoustic spaces and electro-magnetic interference assessments.

Associate Director Jon Cooper recently spoke to the IOA Irish Branch on amplitude modulation and other nuances in wind turbine noise (see page 12 for more details).

### WELL good: A Euro first for Cundall’s ‘green’ office

E ngineering company Cundall’s new London office is the first in Europe to achieve WELL Certification through the WELL Building Standard. The 15,400 sq ft office, at One Carter Lane in the City, earned the award based on seven categories of building performance – air, water, light, nourishment, fitness, comfort, which includes acoustics, and mind. Internal features include a specially developed active green wall, a planted trellis divider and acoustic baffles integrated within the tall shelving units.

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Sound Propagation through the Stochastic Ocean

By John A Colosi

Review by Peter Dobbins

Those of us of a certain age may well have first experienced signal fluctuations as the notorious fading associated with Radio Luxembourg. They could then have learnt that stars twinkle because of the effect on light propagation of turbulence in the Earth’s atmosphere. This book is about such phenomena applying to sound in the sea. As such, it will be of interest, not only to those who seek to model acoustic propagation in the ocean, but also those who design or assess the performance of sonar systems and underwater acoustic communication systems.

The book is set out in two parts. The first part, covering chapters 1 to 4, presents the important prerequisites in acoustics and internal waves as well as a qualitative discussion of acoustic fluctuations. The second part, chapters 5 to 8, is organised along the lines of propagation theories: ray theory, weak fluctuation theory, path integral methods and mode transport theory. There is no summary or conclusions chapter. There are, however, comprehensive references, a detailed index and a useful list of notation and symbols (which are generally in agreement with common usage in the literature – and this reviewer’s PhD thesis!).

Essential prerequisites for anyone considering this book include an understanding of mathematical physics, probability and statistics, signal processing and oceanography.

It is important to note that this work deals with long range, low frequency (below about 20 kHz) propagation, so relates primarily to Anti-Submarine Warfare (ASW) and related fields. There is little or no reference to higher frequencies that might apply, for instance, in sidescan, seabed mapping and Mine and Obstacle Avoidance Sonar (MOAS) systems. Because of this, the main source of fluctuations is considered to be internal waves, along with some fine scale “spice”, with a whole chapter being devoted to internal waves. Turbulence, a major contribution at high frequencies is hardly mentioned, except for being summarily dismissed in the foreword by Walter Munk. However, subject to these limitations, the work is comprehensive in its coverage of both theory and relevant experiments at lower frequencies.

Most of the content is familiar, which should not be surprising for one who has worked in the field on and off since the 1980s, although the discussion of ray chaos in chapter 5 is not. This is especially embarrassing because this reviewer was a joint author presented a paper on the subject (as cited in the book). The references are wide-ranging, although some may not be easy for the general reader to obtain. For example, the 2008 version of the APL-UW High-Frequency Ocean Environmental Acoustic Models Handbook is referenced, but the latest edition accessible on the Internet is 1994. It is likely that more recent versions are only available to those working in defence. The one other minor niggle is the use of the author-date (Harvard) referencing system, whereas from a reader’s point of view (but perhaps not an author’s) numbered references seem much easier to follow.

In summary, despite the minor reservations described above, this is a useful and well-written book. It should prove a useful reference for those with interests in the field of ocean sound propagation at low frequencies.
The Effects of Sound on People

By James P Cowan

Review by Michael Lottinga, WSP | Parsons Brinkerhoff

The Effects of Sound on People could be argued to be the most important topic in acoustics, and this effort to compile the state of the art comes at a time when public interest has perhaps never been greater. Research in this field increasingly drives the regulation and legislation that governs our relationship with the sounds that we have no direct control over, so an understanding of how and why sound affects us is essential. This book forms part of a wider series on acoustics by the publisher, and is aimed at students with no technical background, but with an interest in understanding the current established knowledge and its limits. To some extent the book achieves this goal, although at a slim 184 pages, it’s clear from the outset that this is by no means an exhaustive account.

The structure of the book is set out neatly: introductions to the physics of sound and measurement parameters in the first two chapters are followed by a description of the hearing mechanisms and perceptual phenomena in chapter 3. The next two chapters are probably of greatest potential interest for most readers, representing the core subject matter of the title: the physiological (chapter 4), and psychological (chapter 5) effects of exposure to sound. Chapter 6 then addresses aspects of the various sources of noises that generally affect people negatively. A welcome, and somewhat novel, inclusion is the section on potentially positive effects (chapter 7), something not often examined outside dedicated music and sound therapy literature. The final part of the book discusses controls on sound, both physical and regulatory, before outlining some suggestions for further research. There is a tendency towards North American guidelines (hardly surprising, given the author’s background), but some effort has been made to detail international approaches; thankfully the decision has been made to present SI units throughout, converting where necessary.

The book primarily represents an account of the evidence for the wide range of identified effects over which there is little debate. In so doing there is generally a strong emphasis on peer-reviewed journal literature (rather than a more magpie-like approach to sourcing, which could leave one doubtful of the material), and this is another strength of the work. The approach falts only slightly when entering some lesser-researched or recently-developed fields, such as soundscapes and potential healing effects of music. With regards to studies on the headline-grabbing negative effects (cardiovascular disease, sleep disturbance etc), the large-scale aircraft noise social surveys from recent times make their appearance, as would be expected (HYENA, NORAH, RANCH, FICAN... one sometimes wonders if epidemiologists lose sleep over selecting suitably catchy acronyms for their projects, for fear of otherwise falling into academic obscurity!).

Amongst the more predictable (but important) content, there are also some interesting and unusual titbits: for example, descriptions of misophonia (hatred of sound), and the phenomenon of electromagnetic hearing in chapter 2; chemical agent effects in chapter 4, and debunking of the infamous ‘brown note’ in chapter 6. More controversial content includes the sections on so-called ‘vibroacoustic disease’ and ‘wind turbine syndrome’, although the author points out that neither are proven conditions recognised by the wider scientific community.

There are a few questionable moments, and scrutiny of source material reveals occasional interpretative slips and somewhat confusing statements. An example is the assertion that a study on occupational low frequency noise exposure concluded that A-weighted levels correlated well with annoyance, despite workers finding noise with similar levels but increased low frequency content more annoying. This particular contradiction is explained by the fact that the ‘A-weighted’ levels in question are actually a filtered sum of weighted low-frequency bands, which explains the correlation; in fact the overall broadband A-weighted level showed poor correlation with low frequency noise annoyance in the study, as would be expected. Without studying the source directly, the casual reader could be left with an unsubstantiated misconception of the findings.

Regarding inclusions of material, the author states that over 1000 papers were reviewed, with around half making it into the final copy. However, at points it seems like this whittling may have gone a little far. An example is the single source reference selected as a basis for the evidence on wind turbine-related sleep disturbance – perhaps selected because the study was conducted in the US – disregarding some outputs from major European studies. The reader will also notice that the most recent references date from 2014, and in such a rapidly-developing field, there is inevitably some important recent work that does not feature. Of course, the author can hardly be criticised for the length of time it takes for editorial re-reviews and publishing checks, but one wonders if a short pre-print section could have been added to address this briefly in a paragraph or two.

Much more critically, there is an issue of content proportionality in this book: as mentioned, many readers will mainly be interested in the material in chapters 3, 4, 5 and 7 (ie addressing human perception and response), which together make up less than a third of the total content of an already relatively lightweight volume. The sections on acoustical and sound control principles, while clearly aimed at the stated target audience, contain a fair amount of superfluous material. Consequently one cannot help feeling as if a lot of this is padding. To illustrate, one can compare the five and a half pages describing sound transmission control between rooms (a largely irrelevant matter to any of the material concerning the effects of sound on people, and very much-covered elsewhere), to less than three and a half pages on noise-induced annoyance – by far the most prevalent negative effect of sound on humans (and arguably, the most pernicious, given its widespread extent, and pathway links to stress, sleep disturbance and heart disease).

In the preface Cowan refers to the classic related works by Kryter, and points out this is not meant as a replacement. But it is also acknowledged that the most recent of these major publications is over 20 years old, and so it does seem a shame that the effort to provide a more comprehensive update has not been attempted. Nonetheless, this is, notwithstanding aforementioned oversights, a good book, and well-written. It is difficult to recommend wholeheartedly however, considering the price and the overall value for money provided. It would probably make a reasonably convenient addition to generalist environmental health impact study courses, but is unlikely to currently be of great worth to specialists in the field. A second edition, aimed at rebalancing, expanding and updating the content would potentially be welcome.
Leo Beranek (1914-2016): Outstanding engineer who made an enormous contribution to acoustics as a consultant, researcher and teacher

By Bridget Shield

Members of the Institute will have been saddened to learn of the death of Leo Beranek, at the age of 102, on 10 October 2016. Leo was a good friend of the Institute during the time when he agreed to come and give the opening lecture at our 40th anniversary conference in 2014, shortly after his 100th birthday. Members who were lucky enough to hear him speak on that occasion will have heard him examining recent and current research in concert hall acoustics and validating it with his own and others’ data. As he said at the time, he found it hard to cope with the physical deterioration that came with age; nevertheless he remained active in acoustics until shortly before his death.

Leo’s first paper was published in JASA in 1939 (on the behaviour of sound in rooms) and the last one in April 2016 (on recent research in concert hall acoustics, an updated version of the paper he gave in Birmingham in 2014). He also published 12 text books, the first in 1948 and the last in 2014, and an autobiography Riding the Waves in 2008. As well as concert hall acoustics his many other interests over his long career included acoustic impedance of porous materials, duct acoustics, sound transmission properties of lightweight structures, speech intelligibility and noise criteria.

Leo was born on 15 September 1914 in Solon, Iowa. As a teenager he helped in his father’s hardware store in Mount Vernon, which sold radios, and did a correspondence course on radio technology and repair. He embarked on a degree course in physics and mathematics at Cornell College but had to interrupt his studies in order to earn enough, through radio repairs and other electrical work, to cover his tuition and living expenses.

Leo’s life in acoustics was due to a chance meeting in the summer of 1935, when he was almost at the end of his degree course. Having spent the morning in the Cornell library he was walking along the street when he came across a Cadillac with a flat tyre. He offered to help and the car’s grateful owner revealed himself to be Glenn Browning, a radio pioneer and former lecturer at Harvard, and the author of a paper that Leo had been reading in the library that very morning. Browning suggested that Leo should apply for a scholarship at Harvard with himself as a referee. His application was successful and he embarked on a degree on radio technology and repair. He offered to help and the car’s grateful owner revealed himself to be Glenn Browning, a radio pioneer and former lecturer at Harvard, and the author of a paper that Leo had been reading in the library that very morning. Browning suggested that Leo should apply for a scholarship at Harvard with himself as a referee. His application was successful and he enrolled for a doctorate under Professor E.V. Hunt, on the properties of commercial acoustical materials.

After completing his doctorate in 1940 Leo became director of the newly formed electro-acoustic laboratory at Harvard, set up by President Roosevelt to carry out research in support of the war effort. Early work on military aircraft involved the development of materials for reducing noise levels, and instrumentation to enable voice communication, in cockpits. Further work for the US Army, which required testing large scale loudspeakers to simulate a “fake” army, led to Leo, assisted by a Harvard student, designing the world’s first anechoic chamber. The chamber walls were lined with glass fibre wedges, the familiar design still in use today. Leo also coined the term “anechoic” to describe the space.

After the war Leo became an assistant professor and co-director of the acoustics laboratory at Massachusetts Institute of Technology. In 1949 he and two other MIT professors, Richard Bolt and Robert Newman, set up the acoustic consultancy firm Bolt, Beranek and Newman, whose first major commission was the United Nations building in New York. Subsequent work, in the early 1950s, involved the reduction of noise of jet aircraft.

But it is probably for his interest in the design of opera houses and concert halls that Leo will be most remembered in the acoustics world.

BBN’s first foray into auditorium acoustics was the highly successful redesign of the Tanglewood Music Shed in Boston, which opened in 1959. Shortly afterwards BBN were appointed as acoustic consultants for the new Philharmonic Hall at the Lincoln Centre in New York. In preparation for this Leo undertook the first of his surveys of concert halls around the world, also interviewing leading conductors and music critics, which formed the basis of his 1962 book Music, Acoustics and Architecture. Unfortunately, the opening of the Philharmonic Hall in 1962 was an acoustic disaster, for many reasons beyond BBN’s control, and led to several years of negative publicity for Leo. As he says in his autobiography, following the opening “My dream of a great hall and my reputation as an acoustician both appeared to be going up in smoke”. It was more than 20 years, during which time he headed a broadcasting company running the Boston WCVB TV station, before he returned to concert hall acoustics. In the late 1980s he again visited halls around the world, evaluating their acoustics, and in 1989 was appointed as acoustic consultant for a new concert hall and opera house in Tokyo, both of which opened to great acclaim in 1997. He continued to act as consultant to many concert hall projects in Japan, as well as publishing papers and books on concert hall and opera house design.

Reflecting his love of music and the arts, Leo was also chair of the board of trustees of the Boston Symphony Orchestra from 1968 to 1988, as well as being a generous benefactor.

Throughout his career Leo was a great supporter of the UK acoustics community. He first visited this country in 1948 as part of a European tour to learn about acoustics research carried out during the war, and while here represented the ASA at the international Summer Symposium on Noise and Sound Transmission organised by the Acoustics Group of the Physical Society of London (now IOP). He gave the opening paper on sound transmission through partitions, and reported on the meeting in a JASA paper in 1949. At the conference he made many friends among the European acoustics community including Peter Parkin and Bill Allen. In 1951 he visited London again to attend an opening concert at the Royal Festival Hall, and there met Hope Bagenal, who also became a good friend. He subsequently visited the UK many times including, in the winter of 1959-60, a visit in which he attended concerts around the country as part of his concert hall survey.

In the 1960s, Leo was offered the directorship of ISVR, which he declined because, as he says in his autobiography “I did not care to live in England and my salary would have been half of what I was getting from my consulting work”.

Leo has attended several IOA conferences. He was made an Honorary Fellow in 2004 and received the Peter Barnett Award in 2010. In 2014 we presented him with a special issue of the Rayleigh Medal to celebrate his 100th birthday and in recognition of his enormous contribution to acoustics as consultant, researcher and teacher.

The Institute offers its condolences to Leo’s wife Gabriella and their family. He will be sadly missed and fondly remembered by acousticians the world over.

Leo Beranek delivering the opening lecture at Acoustics 2014
Since 2004, MSA has provided a bespoke recruitment service to clients and candidates working in Acoustics, Noise and Vibration. We are the UK’s niche recruiter within this sector, and as a result we have developed a comprehensive understanding of the industry. We pride ourselves on specialist market knowledge and an honest approach - we are focused on getting the job done and providing best advice to clients and candidates alike.

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For a confidential discussion call Jim on 0121 421 2975, or e-mail: j.mcnaughton@msacareers.co.uk
Rob Harris returns to ISVR as visiting professor

Rob Harris has been appointed a Royal Academy of Engineering Visiting Professor in auditorium and building acoustics at the Institute of Sound and Vibration Research at the University of Southampton.

An important part of the role is to bring the worlds of industry, consulting and academia together, and he will be pleased to talk to fellow professionals who would like to know more about ISVR and employment of ISVR students and graduates.

He will also work on inter-disciplinary collaboration, teaching the importance of holistic, integrated engineering and building design.

The appointment represent a completion of a circle for Rob for 34 years earlier he was a student at ISVR. A key moment in his career came when Peter Parkin, a visiting professor and his MSc project supervisor, recommended that he join the newly formed Arup Acoustics.

In addition to his new duties at the ISVR, he will continue his consulting work with Rob Harris Design, and its primary client, Theatre Projects.

Obituary

Orhan Berktay (1926-2016): Former IOA President who influenced a generation of underwater acousticians

By Victor Humphrey

Orhan was an excellent mathematician. The Handbook of Mathematical Functions, at more than 1,000 pages, was always by his side. Those who worked with him knew that after discussing any problem he was likely to appear the following morning with many pages covered in neat mathematical derivations of alternative formulae.

He was a genuinely inquisitive and insightful scientist. He encouraged those around him to explore other areas of acoustics. For example, he encouraged researchers in the School of Physics from 1987 to 1990. Orhan was an excellent mathematician. The Handbook of Mathematical Functions, at more than 1,000 pages, was always by his side. Those who worked with him knew that after discussing any problem he was likely to appear the following morning with many pages covered in neat mathematical derivations of alternative formulae.

He was a genuinely inquisitive and insightful scientist. He encouraged those around him to explore other areas of acoustics. For example, he encouraged researchers in the School of Physics from 1987 to 1990.

Orhan had a direct influence on the development of a whole generation of underwater acousticians in the UK and served as IOA President from 1986-88.

He died on 20th October 2016 after a short illness. We offer our sincere condolences to his children, Yalcin and Ayla, granddaughters and great grandchildren.
Tony Argyrou to drive Pliteq sales in the South West

Noise isolating materials maker Pliteq has appointed Tony Argyrou as Project Manager to drive sales in the South West. He previously worked at Industrial Acoustics Company for 30 years in a wide variety of roles. His new job involves raising awareness of Pliteq products among acoustic consultants, architects and main contractors.

Queen presents Sue Bird with MBE for services to engineering

Sue Bird is pictured with her MBE which was presented by the Queen at Windsor Castle. A long-standing IOA member, she was awarded the honour for “services to engineering and to women in engineering both in the UK and abroad”. Sue has twice been President of the Women’s Engineering Society and is a former Chairman and President of the Association of Noise Consultants. A member of the Institute since 1974, she played a key role in setting up its first CPD scheme.

Bustling night life on its doorstep; Ham Yard Hotel still offers a peaceful night’s sleep with Selectaglaze

Ham Yard hotel is positioned in a vibrant part of London, built on a plot that has been vacant for a number of years; it has everything guests could desire on its doorstep, from lively bars to charming shops and cafes.

Numerous plans had been put forward over the years to develop the site, all were rejected until permission was granted for Firmdale hotels to redevelop the area. They went on to create 91 individually designed hotel bedrooms and 24 apartments, along with a 1950s style bowling alley, theatre and restaurant. However, building a hotel in the centre of an area with such vibrant night life does come with its drawbacks.

Although new double glazed windows were installed throughout the building, the corner of the hotel on Great Windmill Street still suffered high exterior noise levels. The introduction of secondary glazing is one of the most effective ways of combating outside sound. A reduction of 45dB is possible when there is a gap of at least 100mm.

A total of 37 openings have been treated in three different unit styles. The secondary glazing was finished in a dark grey colour to match the existing primary windows, making them as unobtrusive as possible. Acoustic laminated glass was also used, which absorbs the external noise levels, to support in creating a peaceful and tranquil atmosphere.

As testament to the detailed planning throughout the design and build phases, Firmdale’s efforts were rewarded with the hotel gaining a BREEAM ‘Excellent’ rating.

Established in 1966 and Royal Warrant Holder since 2004, Selectaglaze has a wealth of experience working on many building types, from new build to grade I Listed buildings. Selectaglaze offers a comprehensive free advisory service to help with any specification queries, as well as a RIBA approved CPD and factory tour.

For further information contact us on: 01727 837271, marketing@selectaglaze.co.uk or visit www.selectaglaze.co.uk
We are very sad to report the death of Professor Edwin Roland Dobbs on 24 October 2016. He died peacefully at the age of 91 in the care of a nursing home in Dorset close by his son, Jeremy, a GP. We would like to remember and celebrate his life.

Roland gave a lifetime of service, over 60 professional years, to physics, physical acoustics and especially to experimental low temperature and liquid helium physics. He made many research contributions, founded the new Physics Department at Lancaster University, established two world-renowned low temperature laboratories, and played a leading role in the Institute of Acoustics, the Institute of Physics and other organisations. He was born in 1924 in Leeds, but the family lived in Ilford and later in Barnet, North London, where he went to the Queen Elizabeth Grammar School and later to University College London (in Bangor) where he graduated with first class honours in physics at the age of 19.

He joined the Admiralty in 1943 to work on radar and microwaves. After the war, as a PhD student at University College, London, he measured the viscosity of liquid alkali metals. Appointed to a lectureship in physics at Queen Mary College, he commenced his lifelong scientific interest in the condensed inert gases, with liquid and solid argon, and in the application of physical acoustics as a powerful experimental probe. During a Fulbright Fellowship at Brown University, USA, he worked with Bruce Chick, founder of the famous Matec and Ritec ultrasonic companies, measuring ultrasonic attenuation in germanium at microwave frequencies at low temperatures. He returned in 1960 to an AEI Fellowship at the Cavendish laboratory in Cambridge, using these new techniques and instruments to study microwave ultrasonics in superconductors.

Probably the most significant event in Roland’s career was his appointment to the founding chair of the Department of Physics at the new University of Lancaster, which opened in 1964. Roland established his first, of five, low temperature laboratories, with an initial emphasis on ultrasonics in metals and superconductors. His seminal work on liquid helium was complemented by his initial emphasis on ultrasonics in metals. Appointed to a lectureship in physics at Queen Mary College, he commenced his lifelong scientific interest in the condensed inert gases, with liquid and solid argon, and in the application of physical acoustics as a powerful experimental probe. During a Fulbright Fellowship at Brown University, USA, he worked with Bruce Chick, founder of the famous Matec and Ritec ultrasonic companies, measuring ultrasonic attenuation in germanium at microwave frequencies at low temperatures. He returned in 1960 to an AEI Fellowship at the Cavendish laboratory in Cambridge, using these new techniques and instruments to study microwave ultrasonics in superconductors.

Rolland’s career was his appointment to the then green fields of Bailrigg. Having put Lancaster on a firm foundation, he moved back south in 1973 to Bedford College, University of London, in Regent’s Park, as Hildred Carlisle Professor, carrying out his first ultrasonic experiments in liquid ‘He, on zero-sound. During his tenure there, the University of London reorganised, and Roland moved his department to join Physics at Royal Holloway, where in 1986 he established the London Low Temperature Laboratory and appointed a highly successful research team. During the same period, he also ran an ultra-low temperature laboratory at the University of Sussex, carrying out tour-de-force experiments on ultrasonic attenuation in the superfluid phases of liquid ‘He. In his spare time, he wrote undergraduate textbooks on Electricity and Magnetism, Electromagnetic Waves and Basic Electromagnetism (Springer, 1984, 1985, 1993).

Roland retired from London in 1990 as Emeritus Professor of Physics but continued as a visiting professor at Sussex until 2003. He could then indulge in his scientific love of the inert gases and in 2000 published his magnificent and definitive 1000-page book on the liquid, superfluid, and solid phases of Helium 3 (OUP). He was deeply involved in the birth of the Institute of Acoustics in 1974, formed by amalgamation of the British Acoustical Society and the Physical Acoustics Group of the Institute of Physics. He served as a member of Council from 1974 to 1980 and as President from 1976 to 1978, skilfully guiding the Institute’s rapid development as a professional body. He was made an Honorary Fellow in 2007 for his services to low temperature physical acoustics and to the Institute. He was Honorary Secretary of the Institute of Physics from 1976 to 1984.

Roland was also very active in both University and Science administration. He was Vice-Principal, Bedford College (1981-2) and Dean of the Faculty of Science (1980-2); Chairman of the Board of Studies in Physics, University of London (1982-5); Vice-Dean (1986-8) and Dean (1988-90), Faculty of Science, University of London. He served on the Physics Committee of the then Science Research Council (1970-73) and subsequently Science and Engineering Research Council (1983-86). He was Convenor, through the Institute of Physics, of the UK Standing Conference of Professors of Physics (1983-88).

Roland (often known as ERD, though few knew his first name) combined great charm with political astuteness, vision and good judgement. He was extremely effective in getting things done and very supportive of his scientific colleagues and students. He has left a lasting legacy in his research output, in the Departments of Physics he founded and developed, and by establishing ultralow temperature physics groups in the UK. Both Lancaster and Royal Holloway are members of the European Micrkelvin Platform, established in 1994.

He was supported throughout by his wife Dorothy, who was Head of English at the City of London Girls School. Following the move to London, they shared their time between a flat in the Barbican and a farmhouse in the Sussex village of Ripe.

Roland was a committed Christian and lay reader who contributed to local Church life wherever he lived. He and his life-long friends Professor Donald Mackay, Dr Oliver Barclay, and his brother-in-law Professor Malcolm Jeeves gave presentations at the first International Conference of The Research Scientists Christian Fellowship in 1965. During 1992/3 Roland and Oliver Barclay, hosted the UK and European John Templeton Foundation Lectures: “Christians in Science”.

Roland suffered a stroke in 2004, the year his wife died. He courageously adjusted to the resulting limitations in speech and mobility, enabling him to take some part in social and professional activities. However, further strokes limited these activities and the Institute’s Honorary Fellowship was, unusually, conferred on him in his own home in Sussex, in the presence of his family.

He is survived by his three children, Jane, Richard and Jeremy, eight grandchildren and two great grandchildren.
Ramboll Acoustics has recruited four new members to its team. Simon Taylor has come from SRL where he managed its London office for a number of years. A building acoustics specialist, he has worked on many large scale education, healthcare, residential and infrastructure schemes.

Paul Malpas has joined after seven years running his own consultancy, Engineered Acoustic Designs. His career started in 1990 at Arup Acoustics, where he specialised in speech intelligibility and mass communication technologies. A former Chairman of the IOA’s Electroacoustics Group, he was responsible for the organisation of Reproduced Sound for several years.

Joseph Mendis is as an environmental noise and vibration specialist with 12 years’ post-graduate experience. He is involved in the assessment of environmental noise and vibration impacts within transportation, utilities and urban development projects.

Christina Ioannidou has joined as an acoustics consultant with experience on environmental and buildings acoustics projects. Her background is in electrical and computer engineering with specialisation in telecommunications. She is also a graduate of the acoustics engineering department at the Technical University of Denmark (DTU).
Brüel & Kjær launches updated version of Predictor-LimA Type 7810

Brüel & Kjær has launched an updated version of its environmental mapping software, Predictor-LimA Type 7810 version 11.2.

Predictor-LimA Type 7810 version 11.2 responds to customer input and resolves some issues to provide more robust software that enables calculations in line with latest agreements on standard interpretation (ISO 17534). Other enhancements include feature importation from open street map in LimA to create models more quickly, Chinese calculation methods and – in Predictor – enhanced results presentation.

The basic version supports British Standard Code of Practice BS 5228:2009 and ISO 9613, making it suitable for consultants and local authorities investigating noise complaints as it ensures measurements can be used as legal evidence. Other packages are available that expand the capabilities and calculation methods, including calculation of railway noise (CRN) and calculation of road traffic noise (CRTN).

The LimA software allows integration with external data sets and calculation components from other systems. It includes powerful macro functionality with automated data manipulation and advanced geometric handling for modelling without the need to use other software, such as a geographical information system (GIS).

These combined tools provide users with environmental noise calculation and analysis for many different applications, ranging from small-scale impact assessments, such as neighbour noise, to mapping large, built up areas in big towns or cities.

More information is available at www.bksv.com.

Noise monitoring system for airports in Demand

Brüel & Kjær has launched Airport Noise Monitoring On Demand, a system that enables airports to temporarily increase noise monitoring when needs arise.

This system helps airports measure before and after operational changes, investigate complaints, show compliance and communicate with the community.

Airport Noise Monitoring On Demand works with the company’s airport noise and operations monitoring system, ANOMS and NoiseDesk noise management tool.

It comes with portable noise monitoring terminals, which includes a tripod, batteries, chargers, security cables, calibrator, mobile modem and a prepaid communications service.

The units are tested, calibrated and shipped within days of ordering. Users simply deploy the equipment and begin recording real-time sound levels.


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World first for XL2-TA as it gets multiple configurations

The XL2-TA is the first sound level meter in the world to receive Type approval for multiple configurations according to the IEC 61672-1:2014 standard.

The meter allows customers to carry out precision-grade, Class 1 measurements with the microphone attached or using a 5m, 10m or 20m lengths of microphone extension cable. In addition, the new XL2 firmware V3.11 offers functionality enhancements, such as the integration of the XL2 into the NoiseScout system for environmental noise monitoring.

The PTB Approval certifies the XL2-TA as fully meeting the requirements of the revised sound level meter standard ISO 61672:2014 with the new firmware V3.11 and a number of accessories. This makes the XL2-TA the first sound level meter able to be operated in multiple configuration modes according to the new, and more stringent, IEC61672-1:2014 standard. The measurement microphone can be attached directly to the XL2 with the protection shroud MXA01, or alternatively can be operated remote from the meter via an ASD cable of length 5, 10 or 20 meters. This gives the operator a high degree of flexibility to adapt the system to the conditions and to carry out precision-grade measurements that are valid in a court of law.

The latest firmware V3.11 offers new functionality: including a sliding LCeq in parallel to the L.Aeq, which is useful in noise management at live venues. Also available is the facility for data files to be protected by a checksum code, preventing data tampering. In addition, reverberation time measurement also now includes the T30 method for more reliable measurement results in quiet environments.

The new firmware also supports the integration of the XL2 Sound Level Meter via a NetBox into the NoiseScout system. This platform provides comprehensive environmental noise monitoring where the levels recorded by the XL2 are transferred to a cloud network by LAN, Wi-Fi or a mobile data modem. In this way, the operator can monitor noise levels via the web at remote measuring stations and deliver reliable and resilient data for a noise compliant operation.
Svantek UK has launched a more compact and lighter version of SV 258 PRO, an outdoor noise and vibration monitoring station. Developed for construction site, tunnelling and blasting applications, the new model weighs 10kg and is available with 3G modem, solar panel support, advanced alarms and METEO.

The SV 258 PRO can be used for a wide range of outdoor industrial monitoring applications where measurements are required over a period of time, ranging from days to months, and where a hand-held sound level meter taking on-the-spot recordings would not be suitable. It can be set up to send email or SMS messages when threshold levels are exceeded.

It incorporates a SVAN 958A Class 1 four-channel sound and vibration analyser for applications that require simultaneous Class 1 sound and vibration assessment. Each of four input channels can be independently configured for sound or vibration detection with different filters and RMS detector time constants giving users significant measurement flexibility.

The SV 258 PRO is protected by an IP 65-rated case containing a lead-acid battery and operating time can be extended by connecting an external battery or small solar panel. The intelligent charging unit enables use of a solar panel without expensive controllers and heavy batteries.

The case is fitted with waterproof connectors (military standard) and has an IP 65 external power supply. The system uses a low noise, hermetically sealed tri-axial piezoelectric accelerometer enabling the outdoor use without additional enclosures. The accelerometers’ signal ground is insulated from the mounting surface and outer case to prevent ground loops. All accessories fit conveniently into a second carrying case.

The release of XV-2P has enabled ANV to add Live VDV to the LivEnviro Web Platform. LivEnviro is a single web platform for noise (including audio), vibration, dust and weather but until now LivEnviro’s vibration capability has been limited to PPV, Displacement and Dominant Frequency. ANV will now offer both the Rion XV-2P and the Profound Vibra+, both as self-standing instruments and as part of the LivEnviro system. The two solutions have their own advantages. A Vibra+, for example, as part of a Live PPV system can operate on batteries for around 50 days.

For further details ring 01908 642846 or email info@noise-and-vibration.co.uk.

For more information contact: Paul Rubens at 01234 639551 or visit www.svantek.co.uk twitter: @Svantek_UK

Rion has developed a new vibration meter, the Rion XV-2P, which enables simultaneous measurement of PPV, Dominant Frequency, Displacement and VDV covering the requirements of both BS 5228: Part 2 and BS 6472.

The XV-2P has simple user interface, very like the Rion NL-52 Sound Level Meter, and a colour display. In typical Rion fashion the data is stored as a Comma Delimited Text File to an SD card so it can be opened straight into Excel.

The XV-2P is equally suited to attended measurements and, by using accessories supplied by ANV Measurement Systems, live-to-web and/or long-term unattended measurements.
Committee meetings 2017

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