Vol 35 No 6 NOVEMBER/DECEMBER 2010

ACOUSTICS BULLETIN

in this issue...

TRAPT: a tranquillity rating prediction tool

plus... **Acoustical background to the many varieties of birdsong**

Scale models to predict the acoustical performance of screens attached to vented facades

Institute of Acoustics

ACOUSTICS BULLETIN

Vol 35 No 6 NOVEMBER/DECEMBER 2010

Contacts

Editor:
I F Bennett CEng MIOA

Associate Editor:
J W Tyler FIOA

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

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

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

Designed and printed by:
Point One (UK) Ltd.,
Stonehills House, Stonehills,
Welwyn Garden City, Herts, AL8 6NH
e-mail: talk2us@point-one.co.uk
web site: www.point-one.co.uk

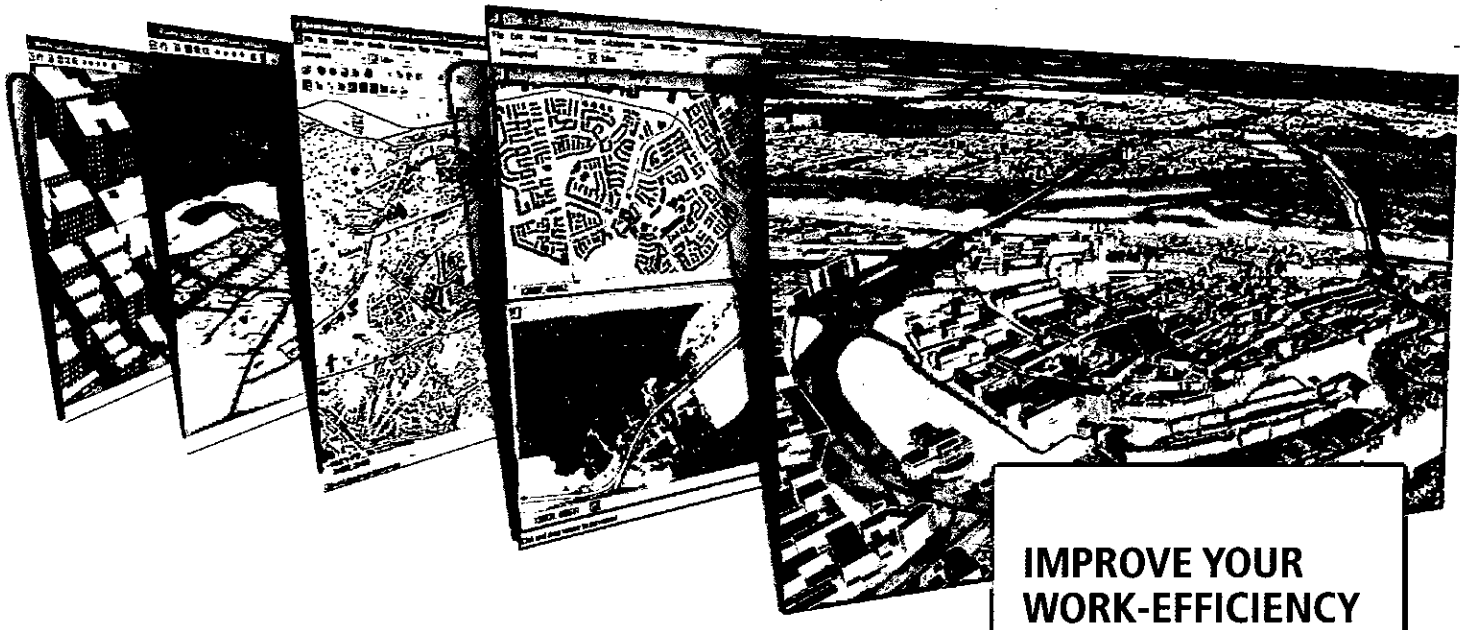
Annual subscription (6 issues) £120.00
Single copy £20.00

Contents

Front cover photograph: The cover picture is of a tranquil area! It is not easy to tell this from the image alone, although the fact that it is apparently a suburban park does give the reader a clue. The article by Rob Pheasant, Kirill Horoshenkov and Greg Watts in this issue presents a method of rating the tranquillity of a setting, by establishing a relationship between the subjective cues and objective measures that contribute to the tranquillity construct. In simpler language, it discusses a way in which a numerical rating can be found for a number of subjective features in a soundscape.

PREDICTOR™ – THE MARKET'S MOST EFFICIENT AND INTUITIVE SOFTWARE FOR

ENVIRONMENTAL NOISE CALCULATION



THE FASTEST CALCULATION

Predictor uses Lima™ calculation cores – identified by an independent study as the fastest on the market by far!

See the independent reports on our website www.bksv.com/predictor

THE EASIEST TO USE

Predictor's extremely user-friendly interface makes your work easier independent of whether you are new, an expert or an occasional user.

IMPROVE YOUR WORK-EFFICIENCY

- Fast learning curve – work efficiently
- Model real-life quickly, easily and accurately with advanced modelling functions
- Get results quickly – Predictor is the fastest noise calculation for CRTN
- Powerful result analysis for checking the model, identifying main sources and easy model comparisons with the intuitive and unique multi-model view
- An efficient solution – automated data and result management and one license

Predictor Version 7.10 is the latest addition to Brüel & Kjær's environmental noise calculation software portfolio, the broadest on the market. With Brüel & Kjær's seal of quality and support, you won't be disappointed.

www.bksv.com/predictor

BN 0884 – 11

United Kingdom: Bruel & Kjaer UK Ltd. · Jarman Way · Royston · Herts · SG8 5BQ
Telephone: +44 (0) 1763 255 780 · Fax: +44 (0) 1763 255 789 · www.bksv.co.uk · ukinfo@bksv.com
HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

creating sustainable value

Dear Members

Our goal is to synergistically generate intellectual capital, while underpinning our overarching strategy to leverage good acoustics following a people-centred and principle-centred approach.

Over the summer, the Institute started to write a business plan. In an effort to get inspiration for the Institute's Vision, I tried an automatic mission statement generator from the Internet. Surprisingly, the Institute has very little written down about its aims and objectives. The Institute's Memorandum and Articles of Association say 'To promote and advance the art, science and technology of acoustics in all their aspects' which is hard to disagree with, but is also rather vague and general. So a starting point for the plan has been to think about what might happen over the next few years while hoping our predictions are better than the Meteorological Office's barbeque summer.

There is much trepidation about what the Government will do as the public sector is cut and reorganised. Over the summer the Institute argued that the Royal Commission on Environmental Pollution should investigate environmental noise. Time was spent writing a beautifully argued case, but events overtook us when the Royal Commission was abolished in the bonfire of the quangos. The writing was not a complete waste of time, however, because much of the text will be re-used in replying to Defra's consultation on the new natural environment white paper. Defra's consultation makes no mention of noise, which is astonishing considering the importance of tranquillity to the rural tourist industry. The revision of the Building Regulations is also of great concern, especially sections concerned with schools, because the instinct of the government is to remove regulations. The Environmental Noise and Building Acoustics groups of the IOA have both been very active in responding to these issues.

I work within the public sector where job freezes and redundancies are inevitable or have already begun. Still, the show must go on, and so the Institute's research coordination committee has made nominations to the Research Excellence Framework (REF) panels – although personally I would be delighted to see the REF thrown into the same bonfire as the Royal Commission.

Another thing the Institute needs to plan for is the ageing population of acousticians (matching the general ageing of the UK population). The Senior Members' group is a very welcome addition to the Institute. Incidentally, Geoff Kerry is coordinating the preparation of a history of the Institute and wants information on the Society of Acoustic Technology and the British Acoustical Society. Please drop me an email if you want to get involved (president@ioa.org.uk).

I am very much looking forward to handing out my first Institute awards at the Autumn Conference in Birmingham and Reproduced Sound in Cardiff. It will be a delight to meet Leo Beranek again, who is the only acoustician who is followed by groupies at conferences. The first time I met him he recalled my work on measuring duck echoes – I was a little crestfallen that our first words were not about my more serious research. I wonder if our new publicity officer (Charles Ellis) is aware of his President's tendency to get involved in popularist news stories. Over the summer it was all about vuvuzelas – one of the items I wrote for New Scientist even got tweeted by the White House!

The business plan will also have to address our relations with international organisations. I am delighted that Colin English became a vice-president of the European Acoustic Association (EAA) in September. I think the recent tortuous and protracted negotiations with the EAA last year showed a need for the IOA to get more involved in the EAA. Plans for international conferences continue, with Auditorium Acoustics in Dublin and ICBEN in London in 2011.

And finally — don't worry, this isn't going to be an end-of-news story about roller skating ducks — On my way back through France this summer I visited the Cité des Sciences in Paris. This is the best hands-on sound exhibition I have ever seen, and is well worth a visit.

twitter.com/ioa_president

Trevor

Trevor Cox

PRESIDENT

Senior Members' group

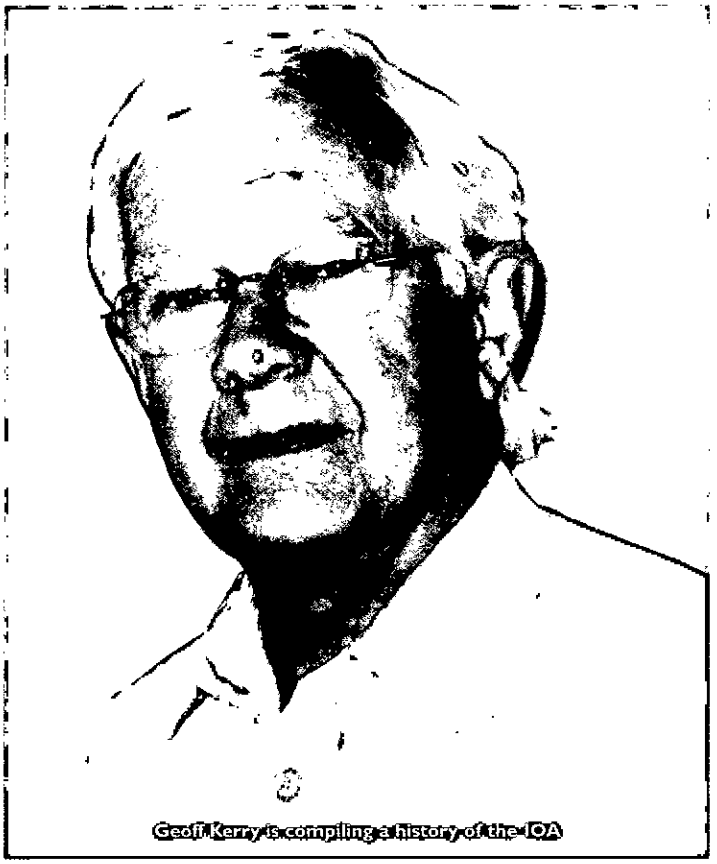
Geoff Kerry. Progress report

The task of canvassing the views of potential senior members which started with the questionnaire has yet to be completed. As hinted at by Ralph Weston in the last report in Acoustics Bulletin, the planned branch meetings have been a little difficult to organise, and although we expect at least three to have taken place by the time this report is published we have decided to postpone the inaugural meeting of the group, probably until some time in the New Year. The current plan is to hold an afternoon meeting at London South Bank University in January. Although the date and timings have yet to be finalised the meeting will be held in the early afternoon so that it will be finished no later than 4pm: this is to provide senior members with the opportunity of travelling to the event at an off-peak rate. It is planned to precede the meeting with a no-host lunch at a suitable hostelry close to the meeting room. I have asked Bridget Shield if she will give us a talk, but this will be preceded by the formal business of selecting a chairman, working committee and listening to your suggestions. We have already had positive responses from several members and look forward to as many senior members as possible attending this inaugural meeting.

The History Project

Some advances have been made with the plan to write up the history of the IOA. Council has indicated that it would welcome such a project taking place with a target date of 2014, in time for the fortieth anniversary of the formation of the IOA. The current plan is to cover not only the history of the IOA but also that of its predecessors, the British Acoustical Society, the Society of Acoustic Technology and, of course, the Acoustics group of the Institute of Physics, or should I say Physical Society. Well, you tell me, because although I am (or was) a member of all these organisations I do not know the full story, and I suspect that not many other members will know either. I hope that some will know most of it, some can add little anecdotes, and some may have pictures and other memorabilia to offer. The task of the Senior Members' group will be to bring it all together.

A number of senior members have already indicated their willingness to take part in this task and I will be writing to you all separately to outline the plan and to ask how you can help. I intend to form a small editorial committee to co-ordinate responses and to assess what can be done within the time and resources available. The committee will liaise with Council on the final format of the document to be produced. I have already been approached by the President who is keen



Geoff Kerry is compiling a history of the IOA

that we collect as many anecdotes as possible to make the history lively and readable. Much of the history of the IOA itself is contained within previous copies of Acoustics Bulletin and the annual reports which are held at St Albans. What will be lacking there will be an insight into the trials and tribulations of organising meetings, of running group and branch events, of the discussions that went on at Council over publications such as the 'Pubs and clubs guide'. However, although some reports of the activities of the IOA's forerunners are held in such places as early copies of the Journal of Sound and Vibration and the Proceedings of the British Acoustical Society, we will have to rely on members' recollections or copies of papers that they may have. Basically we need member to help bring together as much information as possible, including photographs. If you can assist in any way please let me know. (email: **geoffkerry@tiscali.co.uk**).

Meeting report

Adam Lawrence. South-west branch

The South West branch met at Atkins offices in Exeter on 30 September 2010 to hear two presentations relating to schools. Firstly, Andrew Mitchell of Exeter University gave an overview of the causes of non-compliance with BB93, and described various shortcomings which he and his colleagues had encountered with the acoustic performance of schools. Secondly, Konca Saher of Atkins gave a demonstration of the value of using auralisation as an asessment tool to compare different design options within a school, and how these may also be perceived by the hearing impaired. The meeting was organised in conjunction with the South West branch of RIBA, and was attended by about 25 people.

Andrew presented a review of over 30 studies which had been analysed to identify any common difficulties encountered in meeting the requirements of Building Bulletin 93, Acoustics in Schools. His presentation covered the main elements of the requirements including indoor ambient noise levels, sound insulation of walls and floors, and reverberation times. Andrew identified various situations where difficult detailing or retro-fitting of additional systems resulted in failures to meet the requirements, including moveable walls and flanking transmission. He also discussed experiences with exposed soffits.

Konca gave an overview of the process for generating an auralisation from a computer model, and then demonstrated how the computer model could be used to check compliance with the requirements, but more importantly to allow the design team and any other stakeholders to be able to listen to the differences between different design options. Konca also provided auralisations as they might be heard by people with a hearing impairment, which additionally allows design decisions affecting rooms for the teaching of hearing-impaired students to be evaluated.

After each presentation questions were asked, raising a number of interesting topics including the longest reverberation time 'ever' measured (one member of the audience's sound level meter had 'given up' having found little after 13 seconds) and subjectively, how an auralisation would compare with a real room.

Meeting report

Nicky Shiers. London branch

On Wednesday 15 September 2010, Nicky Shiers gave a presentation to the London b wards. Nicky is a PhD research student from London South Bank University.

Research is currently being undertaken at London South Bank University to investigate the acoustic design of hospitals and its influence on the acoustical comfort of patients and staff. The project is focusing on general in-patient wards and consists of a comprehensive series of noise, acoustical and questionnaire surveys. A range of medical and surgical wards in three major hospitals is involved in the study. A number of topics are of particular interest including the effects of building design and materials used in construction, and the conflicts between design for acoustical comfort and infection control.

An initial overview of the research was given, followed by a discussion of the difficulties encountered in obtaining ethical approval for the work, and the practicalities of carrying out acoustics measurements in occupied wards. Preliminary results of the noise surveys were presented along with the identification of significant noise sources in occupied wards. The use of technology, including medical equipment, communication systems and personal entertainment systems accounted for much of the high level noise and sparked some debate. Noise levels in multi-bed and single bed patient accommodation were examined with some surprising initial results.

Outcomes of some staff and patient questionnaire surveys were also shown. These investigated noise annoyance and disturbance, and rated the different types of noise event. The use of certain technologies on the ward seemed to provoke negative responses from both staff and patients. Nicky also explained plans for future work, including a ceiling intervention study.

The research has another year to run until its completion. During this time further data collection and extensive analysis will be carried out. It is felt that the project will continue to yield extremely interesting data which can be positively used to influence noise control strategies in in-patient wards in the future.

The London branch would like to extend thanks to Nicky for taking time from her busy schedule to join members for the evening, and for her very interesting presentation, which proved to be extremely popular. The Committee would also like to extend thanks to WSP for providing the venue.

Topics and speakers for the London evening meetings are generally identified and organised by the London branch committee, but new ideas and suggestions for future presentations are always welcome. If you have any ideas or suggestions, or may even like to give a presentation yourself then please contact Nicola Stedman on **stedmann@rpsgroup.com** .

Membership

The following new members were admitted to the Institute at Council on 23 September 2010

Fellow

Hall, R

Member

Baggaley, J
Barlow, M
Baxter, A A J
Broadley, C A
Brosnan, D
Brown, G A
Byrne, G
Cand, M
Carter, A
Castro Llach, C A
Colder, R
Coulthard, A
Crossland, R M
Davis, M
Duncan, J A
Edwards, M
Hart, J P
Haseler, S P
Jakielaszek, L J
Jordan, P C
Lewis, P J
Lucas, B D
MacPhee, I C
McHugh, S J
Mendis, J J M
Robinson, E W F
Scherebnyj, K
Scrivener, B
Simcock, P P
Stead, M
Symons, B D
Taherzadeh, S
Tan, S W
Taylor, I
Watt, L
Watts, C F D
Yates, D
Zalberg, L

Associate Member

Anderson, L J
Athari, S
Batsikas, G
Best, A
Burrell, R
Crimp, M
Galikowski, T
Griffin, C
Hill, J M
Keane, A
Kim, S
Matheson, C
Parsons, D
Reilly, C
Reynolds, D
Szczepanczyk, N M
Thompson, M
Turner, C W
Wilson, D J
Woodward, R

Affiliate

Armstrong, J
Da Silva, T
Rundle, M
Smith, J

Technician

Bowden, L
Pickford, A R

Student

Doyle, P
Hill, A
Kardys, D
Niemann, J

Royal Commission on Environmental Pollution:

Professor Trevor Cox. Topics for a future study

The Institute of Acoustics wishes to express its strong support for the work of the Royal Commission on Environmental Pollution (RCEP) to investigate environmental noise. Although environmental noise has been shortlisted as a possible topic for an RCEP investigation a number of times, disappointingly it has not been previously selected, despite it ideally fitting the criteria for an investigation. Unfortunately, RCEP has been a recent casualty of the coalition government's spending cuts, and its responsibilities have passed to Defra.

Likely to involve general issues of principle

Environmental noise is an unintended consequence of human activity. A vital general principle to explore is how much disturbance from noise is acceptable.

Currently a large number of people are affected by environmental noise: the outline description in Appendix A fails to portray the scale of the problem. Approximately 54% of the UK population live in dwellings where the front façade exceeds the daytime sound levels recommended by the World Health Organisation (WHO) to prevent the majority of people being seriously annoyed[1], and regarding night-time noise, most (some estimates suggest as high as 95%) of the population live in areas where the Lowest Observable Adverse Effect Level recently identified in the WHO Night Noise Guidelines for Europe is exceeded.

Whilst many may choose to live in noisy locations because of ease of access to jobs, leisure and other resources, noise pollution can disproportionately affect poorer people who are less able to move to quieter areas[2]. Furthermore, people are increasingly dissatisfied with their noise environment, despite the fact that standard indicators for environmental noise are improving. Currently, about 30% of the UK population express dissatisfaction with their noise environment[3].

Extensive research[4,5,6,7,8] has shown that although average long-term effects eg annoyance, can be determined, these responses tend to be only weakly linked with the level of sound exposure. This modest correlation reflects very large differences between individuals' responses due to factors such as the attitude to the noise maker, personality traits, perception of control over the noise and noise sensitivity. Indeed, dissatisfaction with noise can increase where these factors worsen, despite noise levels remaining stable or even reducing. Conversely, there may be scope for improving satisfaction with noise by addressing these non-acoustic factors.

Research into community annoyance shows there is no sound level above which noise clearly ceases to be 'acceptable' and instead becomes 'intolerable'. Thus current standards are a compromise between reducing the level of community annoyance, and the economic, social, historical and political constraints.

Need for rigorous analysis

A starting point for a rigorous analysis is to consider the remit of the investigation - to define clearly what sources of environmental noise and what types of impacts are to be considered. The investigation should not exclude important environmental noise issues.

The effect of noise beyond annoyance and health implications needs to be considered. There is a growing body of evidence that environmental noise, especially aircraft noise, affects children's reading comprehension and the performance of cognitive tasks by adults[9]. High noise levels make it more difficult for the hearing impaired to hold conversations, and disproportionally affects other vulnerable people.

The effects of environmental noise with relatively low sound levels need to be considered. In recent years there has been growing concern about annoyance caused by wind farms, with noise being one reason why many developments have been delayed. Another important example is low frequency noise, which although affecting a relatively small number of people, can cause a great deal of distress.

With the continuing policy emphasis for the re-generation of urban centres and utilisation of brownfield sites for housing, there can be conflicts with noise from leisure, commercial and industrial development. The policy and underlying evidence base upon which decisions are made is limited and ageing.

The study should also consider quiet areas, as there is a growing realisation that many of these are disappearing due to encroaching environmental noise. Tranquil places are important for well-being in urban environments[10] and are a crucial part of the European Noise Directive. A recent survey by the Campaign for the Rural Environment showed that tranquillity was important for nearly three-quarters of visitors to the countryside[11].

Should raise wide issues, both intellectually and organisationally

Environmental noise naturally cuts across academic discipline boundaries, with civil engineers, physicists, mechanical engineers, social scientists, acoustical engineers, transport engineers, geographers, neuroscientists, artists, medical professionals etc involved in studying the area.

Environmental noise also impacts across a wide range of industries and government departments concerned with environment, planning, architecture, energy, health, transportation, manufacturing etc. Furthermore, not only does it involve different government departments within the UK Parliament, it is also an important issue for other legislators: local governments, regional and national assemblies, and the EU.

Should not normally duplicate other studies already in progress or planned in the near future

We are unaware of any similar study in progress or planned within the near future.

A reasonable prospect that worthwhile conclusions can be produced within two years with the resources likely to be available

There has been considerable research into different aspects of environmental noise, and consequently there is a substantial body of evidence that can be drawn upon for the RCEP investigation. However, what is needed is a broad multi-disciplinary study which can draw together the threads of the research from the different specialities - this is what makes the proposal for an RCEP investigation an exciting prospect.

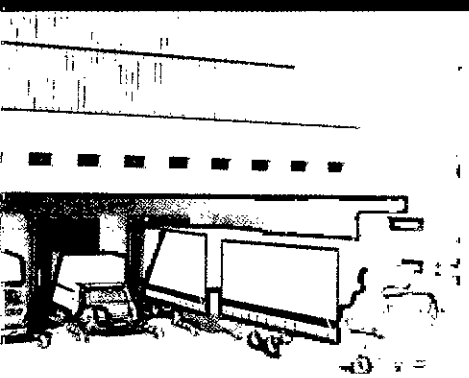
Recent government policy on environmental noise[12] makes clear that noise is to be managed in the context of sustainable development, but we lack a validated and robust cost-benefit framework to allow the advantages of development proposals to be properly weighed up against the adverse effects of noise. This sometimes causes delays or even prevent important schemes from proceeding. The RECP could provide a valuable service by highlight this as an urgent field for further research, and defining the aims, objectives and scope of such work.

There is concern about the effects of noise on animals both underwater and on land, because sound is used by animals for communication, to find mates, navigate and locate food. However, the long term effects of chronic noise exposure is currently unknown.

continued on page 10

Campbell Associates
5b Chelmsford Road
Industrial Estate
Great Dunmow
Essex CM6 1HD
f 01371 879106
e info@campbell-associates.co.uk
w www.acoustic-hire.com
w www.campbell-associates.co.uk

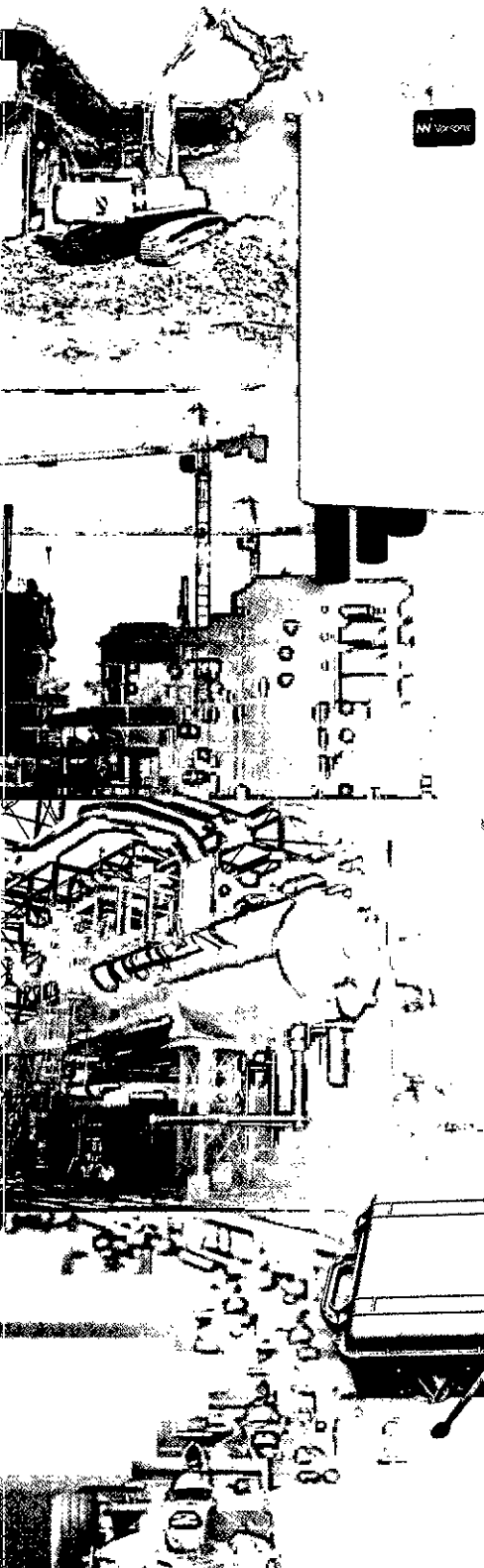
UKAS CALIBRATION
0789



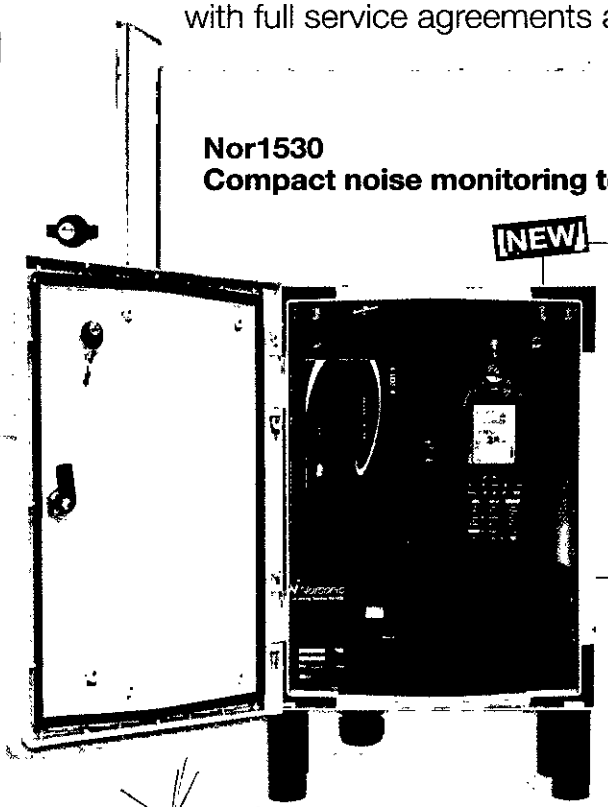
Environmental noise monitoring solutions

A full range of solutions from simple short term monitoring to fully automated permanent installations.

All systems available for hire, lease or purchase backed up with full service agreements and UKAS calibration.



Nor1530
Compact noise monitoring terminal



NEW!

- Compact, robust weather-protected system
- See your noise data online via the web
- Listen to recorded events!
- Use wireless technology (Bluetooth, Wifi, GPRS or 3G)
- Self check and calibration of microphone
- Integrated weather data (wind, rain and more)
- Get notified by email or SMS when set thresholds are reached!
- Battery or mains powered with solar option

Nor1214
Outdoor microphone

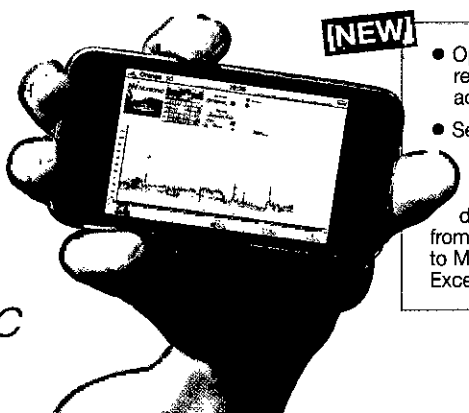
NEW!

- Protection class IP 55 (dust and water)
- Easy to calibrate with a normal ½" sound calibrator
- Powered from the sound level meter
- Microphone verification by SysCheck facility

CA-1317
Weather protected enclosure

- Low cost
- Very portable
- Long battery life
- Robust
- Optional GSM and 3G modems for remote access as with Nor1530 system

NorWeb
See real time levels via the Web



NEW!

- Optional restricted access
- See data from any day and export directly from Web page to Microsoft Excel

Norsonic

Royal Commission on... - *continued from page 8*

While studies have shown that animals can change behaviour when exposed to environmental noise (eg fish moving away from noise sources, birds singing louder), the long term effects on species are unknown. The most tangible evidence of harm probably comes from strandings of cetaceans caused by military naval sonar. Consequently, the most likely outcome of a RCEP investigation into the effects of noise on animals is to identify future avenues for research.

Should take into account trends in environmental policy at European and global levels which seem to have significant implications for the UK

Currently environmental noise policy in the UK is being greatly influenced by EU Directives and regulations, such as the European Noise Directive. Noise is a global problem. It could be argued that both aircraft noise and marine noise need international discussions if they are to be meaningfully tackled.

The Institute of Acoustics

The Institute of Acoustics is the leading professional body in the United Kingdom concerned with acoustics, noise and vibration and is active in research, educational, environmental and industrial organisations. A majority of the Institute members deal with the complex problems of environmental noise 'on the ground' working on behalf of both noise generators and sufferers. Members of the Institute are active in the development of UK, European and International Standards, and advising policy makers and implementers on noise. In recent years we have been increasingly involved in government consultations but have found that noise is too often poorly considered or overlooked in planning policy.

The Institute is a nominated body of the Engineering Council, a member of the International Institute of Noise Control Engineering and the International Commission on Acoustics and a founding member of the European Acoustics Association.

Members of the Institute would be delighted to support the Royal Commission if the study into environmental noise goes ahead.

Professor Trevor Cox
President of the Institute of Acoustics
For and on behalf of the Institute of Acoustics

References

1. Skinner, C J & Grimwood, C J, Applied Acoustics, vol 66 (2005), pp 231-243
2. Brainard, J S et al, Urban Studies, vol 41 (2004), pp 2581-2600
3. Environmental Noise and Health in the UK, Health Protection Agency, (2009).
4. Schultz, T J: Synthesis of Social Surveys on Noise Annoyance J Acoust Soc America, 64, 377-405, (1978).
5. Fidell, S, Barber, D S, Schultz, T J: Updating a Dosage-Effect Relationship for the Prevalence of Annoyance Due to General Transportation Noise. J Acoust Soc America, 89, 221 - 233 (1991).
6. Fidell, S (2003). The Schultz curve 25 years later: A research perspective. J Acoust Soc America 114(6), 3007-3015.
7. Fidell, S & Silvati, L (2004). Parsimonious alternative to regression analysis for characterizing prevalence rates of aircraft noise annoyance. Noise Control Engineering Journal, 5(2), March/April, 56-68.
8. Miedema, H M E, Vos, H (1998) Exposure response functions for transportation noise. J Acoust Soc America 104, 3432-3445.
9. Stansfeld, S A et al, The Lancet, vol 365 (2005), pp 1942-1949
10. Gidlof-Gunnarsson & Ohrstrom, Landscape and Urban Planning, vol 83 (2004), pp 115-126
11. http://www.cpre.org.uk/campaigns/landscape/tranquillity/tranquillity-what-is-the-problem accessed 7/2010
12. Noise policy Statement for England, Defra, March (2010)

Call for proposals:

Fund for promoting the charitable aims of the Institute of Acoustics

Deadline: 30 January 2011
Funds available in this call: £3500

The Institute of Acoustics has set aside a fund to support the development of acoustics. The fund aims are to promote the advancement of acoustics by:

- Stimulating general interest, disseminating knowledge and engaging in dialogues concerning acoustics;
- Promoting education, training and advancement in knowledge in matters relating to acoustics;
- Promote excellence and best practice in acoustics.

The Institute does not want to be overly prescriptive about the aims of proposed projects. A project might aim to promote excellence and best practice in acoustics: in education, the public and private sectors. However, the fund is not aimed at supporting research into acoustics *per se*. Projects might aim to engage practitioners outside acoustics or the general public. This might be done to raise awareness of acoustics and so improve the aural environment. Alternatively, a project might seek to address inequality of opportunity to study or practice in acoustics.

This is not an exhaustive list of potential aims for projects, and the Institute is open to other suggestions.

Criteria for judging

- There is an identified need for the project;
- Success criteria have been identified;
- The project meets the charitable aims of the Institute and is not aimed at commercial or financial gain of companies and organisations;
- The likelihood of the project succeeding will be taken into account (considering timescales, funding available and proposed approach);
- The impact of the project in terms of the number of people reached, the quality of the interaction and the outcomes for the participants;
- The legacy of the project beyond the immediate funding by the Institute (where applicable);
- Dissemination routes for project, either publicising the work or disseminating the learning gained from running the projects (where applicable);
- The ability of the project to attract additional funding during or after the Institute's funding period (where applicable);
- The ability of the applicant to deliver the project.

Applying

A brief application is required which addresses the aims and criteria given above. No more than a single side of A4 paper is required. The application should be emailed to **president@ioa.org.uk**

Instrumentation corner

Angela Lamacraft. Comparison of instrumentation specified for the measurement of environmental noise

Environmental noise consists of many different noise sources, often with considerable differences in character. So how do you decide which method to use? The most robust way is to follow existing methodologies with widespread usage. This also ensures that measurements taken by one person can be repeated by another.

International, European and British Standards are a good way of finding such methodologies, and usually include guidance on the procedures as well as the instrumentation to use. This article looks at a few of the most commonly used standards and compares the instrumentation recommended in each.

BS 7445:2003, Description and measurement of environmental noise

This British Standard describes methods and procedures for the description of sounds from different sources, individually and in combination, which contribute to the total noise in community environments. It adopts the equivalent continuous A-weighted sound pressure level to express results. As well as describing basic procedures for the measurement of sound it also provides the minimum standard of instrumentation to be used, saying that sound level meters shall conform to those of at least type 2* but preferably type 1* as given in BS EN 61672:2003 (however, BS EN 61672 provides specifications for class 1 and class 2 meters).

Note that BS 61672 cancels and replaces BS EN 60804:1994 and BS EN 60651:1994, therefore the class 1 and class 2 terminology should be used. However, as the type 1 and type 2 specifications are not the same as class 1 and class 2, the older terminology as referred to in the relevant standards and guidance is retained where appropriate in this article.

The instrumentation system, which can be made up of separate components, should be designed to determine the L_{Aeq}, although this can be achieved indirectly. The standard also says that alternative instrumentation, if used, 'shall provide equivalent performance in respect of frequency and time weightings and tolerances' which allows for technical advances beyond those currently available.

The instrumentation may consist of:

1. Integrating-averaging sound level meter set to frequency weighting 'A';
2. Sound exposure level meter, for measurements of sound exposure of discrete events;
3. Sound level meter set to frequency weighting 'A' and time-weighting 'S';
4. Data logger for sampling the running value of the L_{pA} using time weighting 'F'; or
5. Statistical distribution analyser for sampling the running value of the L_{pA} using time weighting 'F'.

However, the first two instrumentation types are preferred.

BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas

BS 4142:1997 is used to assess whether noise of an industrial nature is likely to give rise to justifiable complaints from residents living nearby.

continued on page 12

Instrumentation corner... - *continued from page 11*

In order to do this the industrial noise is measured or calculated and compared with the measured background noise level. BS 4142 advocates the use of integrating-averaging sound level meter, or equivalent system, conforming to type 2* or better of BS EN 60804:1994 for the measurement of equivalent continuous noise levels ($L_{Aeq,T}$) and a measuring system conforming to type 2* or better of BS EN 60651:1994 for the measurement of background noise ($L_{A90,T}$). Note that BS EN 60804 and BS EN 60651 were withdrawn in 2002, on the publication of IEC 61672-1:2002. ETSU-R-97, *The assessment and rating of noise from wind farms* recommends that equipment as specified in BS 4142:1990 is used.

BS 8233:1999 Sound insulation and noise reduction for buildings - Code of practice

BS 8233:1999 provides recommendations for the control of noise in and around buildings and suggests noise criteria and limits for use when designing a building. It recommends measuring or estimating noise levels and says that when making measurements, equipment should conform to requirements given in the appropriate standard (for example, depending on the source of the noise to be measured). If no requirements for instrumentation are stated in the appropriate standard, it should conform 'to type 2* or better of BS EN 60804:1994, BS EN 60651:1994 or BS EN 60942:1998'. BS EN 60942 does not provide specifications for sound level meters, but rather for calibrators: these are, of course, essential equipment.

BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites - Part 1: Noise

This British Standard provides guidance on the prediction and measurement of noise on construction and open sites, and the assessment of its impact on those exposed to it, as well as basic methods of noise control. Annex G, a normative annex, advises that instrumentation systems should be designed to determine the $L_{Aeq,T}$ and that systems should conform to requirements of integrating-averaging sound level meters of at least type 2* as specified in BS 7580-2:1997 but preferably or type 1* as specified in BS 7580-1:1997. BS 7580:1997 parts 1 and 2 do not provide specifications for sound level meters, but are procedures for the periodic testing of type 1 and type 2 meters as specified in BS EN 60804:1994 (but not to BS EN 61672). Although BS 5228-1:2009 was published after BS EN 61672-1:2003 this method of specifying sound level meters was adopted as it enables continued use of integrating-averaging sound levels meters complying with the requirements of preceding standards. This was because it was thought unlikely that users would immediately replace equipment with new, in order to conform to the new standard. However, it is recommended that instrumentation conforming to class 1 or class 2 of BS 61672-1:2003 is used.

World Health Organisation Guidelines for Community Noise

The WHO *Guidelines for community noise* provide health-based guidance to environmental health authorities and professionals who are trying to protect people from the harmful effects of noise in non-industrial environments. Section 2 provides guidance on noise sources and their measurement, including basic explanation of the aspects of equipment that can be used. In particular, the guidelines refer to IEC 651:1979 (later renamed IEC 60651:1979), advising that unless measurements with extreme precision or of very low sound pressure levels are required, type 2* meters can be used, otherwise the more expensive type 1* meters are required. It also says that type 1 meters should be used if frequency analysis is necessary.

Calculation of Road Traffic Noise

The CRTN document dating from 1988 describes the method for calculating noise from road traffic, including measurement in cases where the noise level cannot be predicted, and provides a large amount of detail in its specification of measuring equipment. In particular, the measuring equipment should comply with type 1* meters as specified in BS 5969:1981 *Specification for sound level meters*, which according to CRTN is identical to IEC 651:1979. The British Standard was later renamed IEC 60651:1979 within the frequency range 63-5000 Hz for at least the following: A-weighting characteristics, accuracy requirements, sensitivity to environmental factors such as temperature, relative humidity, shock and vibration.

Environmental noise measurement

Secured equipment for unattended noise monitoring

Calculation of Railway Noise

CRN provides procedures for the calculation of railway noise and also includes methods of measurement for situations when the noise cannot be predicted, including the instrumentation to be used, stating that equipment used for the measurement of L_{Aeq} shall meet the specification to type 1* for integrating averaging sound level meters given in BS 6698:1986. The cited Standard, *Specification for integrating-averaging sound level meters* later became BS EN 60804:2001.

It is obvious that improvements in the technology of sound level meters require that the standards used to define their performance are often updated or replaced. This means that standards and guidance used for the measurement and assessment of noise from different sources usually refer to whichever standard was the most recent at the time of their writing, and therefore the references may be to outdated standards. It is therefore essential to ensure that the equipment used for the measurement of sound conforms to at least the specification provided in the guidance being used, that it has been subject to pattern evaluation tests and that the exact equipment used is thoroughly documented. Equipment should always be calibrated at the recommended intervals!

Angela Lamacraft BSc(Hons) MIOA is with Peter Brett Associates LLP

Meeting report

Michael Ainslie.
Validation of sonar performance assessment tools: A workshop held in memory of David E Weston

In April 2010, a group of 29 delegates from Europe, North America and Australasia gathered in Gillespie Centre at Clare College, Cambridge to honour the memory of David E Weston. But who was David Weston and why were these people prepared to travel such a long way to get here?

Simply put, David made a unique contribution to our understanding of underwater acoustics and to our ability to model sonar performance. He spent most of his career at government research laboratories in the UK, with extended stays in the USA, resulting in fruitful international collaborations with fellow scientists like Chris Tindle from New Zealand, one of the invited speakers at the workshop. In retirement, David worked as a consultant for the defence industry, passing on his valuable knowledge to others, and it was during this phase of his career that he worked most closely with Chris Harrison, the keynote speaker of the April symposium.

David's hallmark was his ability to identify and explain trends in apparently random behaviour, enabling him to separate out effects in his measurements of wind, fish, season, tides and waves. He is perhaps best known for his discovery and promulgation of the extraordinary effect that fish can sometimes have on the absorption and scattering of underwater sound. This aspect of David's work lives on through the research of Orest Diachok, the third invited speaker.

Through his written publications, David remains an inspiring teacher and will continue to do so long after his death. He was president of the Institute and a recipient of its prestigious Rayleigh Silver Medal as well as of the Helmholtz-Rayleigh Interdisciplinary Silver Medal of the Acoustical Society of America.

The opening address was given by Michael Ainslie of TNO, who reminded the audience of Weston's achievements and unique ability to shed light on the most difficult of problems and (to use one of his own favourite phrases) to 'see the wood despite all the trees'.

David's career was devoted to improving our understanding of sonar performance in a time when computer power was limited. Today we take computers and computer models for granted to support decision making both in the long term (sonar design, strategic planning) and short term (sonar deployment, tactical planning), but on what to do we justify our faith in these models? The symposium on the validation of sonar performance assessment tools, or Weston memorial workshop, was designed to address this question by defining some well specified sonar scenarios. Participants were invited to run a sonar performance model of their choice on one or more of these problems with a view to comparing their outputs for the same set of inputs.

Two generic sonar problems were specified. The first (known to participants as problem A1) was a bio-sonar problem inspired by the work of Whitlow Au and co-workers, involving a killer whale hunting its prey of Pacific salmon. The second (problem A2) involved a low-frequency active sonar (LFAS), with source centre frequency between 250Hz and 3.5kHz and a 65 element horizontal receiving array. Problem A2 was based on 'Problem T' of the Second Reverberation Modelling Workshop held at ARL Texas in May 2008 [ftp://ftp.ccs.nrl.navy.mil/pub/ram/RevModWkshp_II/].

Proceedings of the Weston memorial workshop are available on CD from the Institute of Acoustics (email linda.canty@ioa.org.uk). Work on A1 and A2 continues at research establishments around the world (for example, at BWB/FWG in Germany, the Defence Research and Development Canada (DRDC), NATO Undersea Research Centre (NURC) in Italy, Penn State University in the US, and the Netherlands Organisation for Applied Scientific Research (TNO)). New participants interested in either test case are encouraged to contact the workshop organisers. The test problems are available from ftp://bobbie.fel.tno.nl : contact the organisers for login details. An opportunity for researchers to compare notes again will arise on 20-24

continued on page 14

Meeting report - *continued from page 13*

June 2011, at Underwater acoustic measurements: Technologies and results (UAM 2011), to be held on the island of Kos, Greece.

The meeting was a truly international one, with invited speakers travelling from Italy, USA and New Zealand. Workshop problem solutions were submitted by participants from Canada, USA, Germany, Italy and the Netherlands.

Opening address by Michael Ainslie

Ladies and gentlemen, welcome first of all to this marvellous venue. Thank you for coming, especially those who have travelled from other continents. I thank also the Institute of Acoustics for giving me the honour and unique opportunity to commemorate the work of David Weston, who can safely be described as the mainstay of research on underwater acoustics in the United Kingdom during the second half of the 20th century. Thanks also to my fellow organisers Linda Canty, Peter Dobbins and Barry Uscinski and to the members of the Scientific Committee.

David was a prolific writer. His work spanned five decades, during which he wrote 67 papers with 24 co-authors in 11 different journals. But David's true attributes cannot be measured in numbers. His nature was to strive always for the most elegant and insightful solutions to even the most complicated problems, inspiring his fellow researchers, many of whom are in the audience today, by his example. I am confident that this will be illustrated amply by the three invited talks given by Chris Harrison, from NURC, Chris Tindle, from the University of Auckland and Orest Diachok, from Johns Hopkins University, as well as by the contributed papers scheduled for tomorrow morning.

An additional purpose of this meeting is to find ways of testing our sonar performance models. Thanks to all those who have taken the trouble to solve the test problems specified in advance of the workshop. I am especially looking forward to the discussion periods this afternoon and on Friday morning, which Kevin Macan-Lind, Chief Executive of the Institute of Acoustics, has kindly agreed to chair.

The meeting closes with an awards ceremony, including the A B Wood Medal Lecture by Mario Zampolli, with whom it has been a pleasure to work since he joined TNO from NURC a year ago. This is followed by the IOA Best Diploma Student Award for Neil McBride, and by a special Weston Award, the winner of which will be announced just before lunchtime on Friday. The nature of the prize will be announced at the same time.

The mathematicians amongst you will know of the Hungarian mathematician Paul Erdős, whose name is immortalised by the so-called 'Erdős number', which measures the proximity of his fellow researchers to Erdős's own work in a very simple way: Erdős himself has an Erdős number of 0, by definition. His immediate co-authors have an Erdős number of 1, their co-authors have an Erdős number of 2, and so on.

Defining the 'Weston number' in the same way, I have calculated this number for a few prominent scientists. For example, Lord Rutherford's Weston number is 2, and Einstein's is 6. To help you calculate your own Weston number, I give you a list of his 24 co-authors. If your name is on this list, you have a Weston number of 1. If not, but you recognise one of the names as your co-author, then your Weston number is 2. What is your Weston number? With this light-hearted question I hand over to Kevin Macan-Lind, who has some administrative announcements to make before the keynote speech.

Technical sessions

Wednesday 7 April

Chris Harrison gave the invited keynote address and set the conference scene with a presentation entitled 'Seeing the wood for the trees'. He emphasised that while SONAR performance is assessed using the SONAR equation, it is important to be aware of the underlying physics and that the various terms in the equation are not independent. He noted that David Weston was renowned for taking an overview of problems without getting lost in the detail. David's flux methods and waveguide invariants have led to practical and useful results in propagation, signal processing and sonar performance. Kevin LePage (NURC) summarised results from two reverberation modelling workshops sponsored by ONR and the establishment of benchmark reverberation problems. There has been some good agreement of results from different models but there are still some issues in some treatments of reverberation which impact on sonar performance modelling. Mario Zampolli (TNO) outlined the way the scenarios for the LFAS test problems (scenario A2) for the symposium were developed. They are intended to represent low frequency active sonar with source frequencies from 250Hz to 3.5kHz in shallow coastal waters. The test cases are progressively more complicated as they consider range dependence, summer sound speed profiles, surface roughness, bottom layering and the presence of solitary waves. He showed preliminary comparisons between predictions from different participants using the models ALMOST (TNO), INSIGHT (BAE SYSTEMS) and MOCASSIN (FWG).

Solutions to the A2 test problems were presented after lunch by Dale Ellis (DRDC), Pieter Schippers (TNO), Charles Holland (Penn State University), Kevin LePage (NURC) and Jan Ehrlich (BWB). Dale Ellis presented normal mode and ray theory predictions of reverberation and echo level for problem A2.1 (a shallow water Pekeris waveguide), including comparisons with a flux model. Pieter Schippers presented solutions of reverberation and echo level, noise level and signal to background ratio for all A2 test problems using the ALMOST sonar performance model. Charles Holland presented energy flux predictions for A2.1, including comparisons with a normal mode model.

Kevin LePage spoke about the development of a sonar simulator to deliver element level time series in order to test control and navigation algorithms for an AUV and demonstrated the results from the simulator's propagation, echo and reverberation engine applied to the A2 scenario. Jan Ehrlich described the assumptions of the Mocassin and MSM models and discussed the capabilities of Mocassin relative to the requirements of the A2 scenario. He described the results of applying it to the scenario. It was noted in discussion that it includes mode diffusion and this was recommended for other modellers to consider.

Thursday 8 April

Chris Tindle described the concept of beam displacement, and the pioneering work in collaboration with David Weston that led to the development of low frequency ray propagation models. He described how the same ideas lead to a ray theory of wavefronts and illustrated the application of these to surface reflection and scattering problems.

Charles Holland described the effects of lateral variation and uncertainty in seabed properties, showing how by using Weston's energy flux methods that the field can be simply described in terms of the geometric mean of the reflection coefficient and the arithmetic mean of cycle distance.

Daniel Rouseff (APL UW, Seattle) described the insights afforded by Weston's early work on Moiré fringes, sound focusing and beaming and their relevance to Chuprov's waveguide invariant. He described more recent work showing how these ideas, developed originally for passive sonar can be extended to active sonar, working at a higher acoustic frequency.

Jean-Pierre Sessarego (LMA CNRS, Marseille) described tank measurements at hundreds of kilohertz of scattering from a shell near the air-water boundary. The measurements were compared with a theory that generally compared very favourably. The theory is sufficiently general that it can handle arbitrary boundary conditions (eg seabed). In the context of the conference, the measurement capability strongly suggested conducting such tank measurements as one way of validating the sonar models. The tank is sufficiently large to do waveguide problems.

Alex Tolstoy (A Tolstoy Scientific Inc) examined some of the difficulties in matched-field geoacoustic inversion including significant uniqueness problems. Alex showed a method to reduce uniqueness problems by an exhaustive search method in a multi-stage process using short-range low frequency data first and then moving up in frequency and range. A main conclusion was that the geoacoustic inversion problem is far from solved and a recommendation was made that a focused workshop would help the community go forward.

The honour of presenting the first talk of the afternoon again fell to Dale Ellis, who presented results for short-time reverberation associated with multiple surface-bottom, known as 'fathometer' reflections, for Problem XI

of the first ONR reverberation modelling workshop for frequencies between 250Hz and 3.5kHz.

D J Tang (APL UW, Seattle) described a novel mechanism by which clutter can be introduced in shallow water reverberation: Steep ray paths are generated by a non-Gaussian sediment ripple field, reflected from the sea surface, and then backscattered at the next seabed interaction. The backscattering strength is enhanced due to the steep paths, creating clutter in the reverberation.

Chris Strode (NURC, La Spezia) compared results from the multi static tactical planning aid (MSTPA) model with predictions using the CASS model. In addition to signal to noise ratio, the MSTPA model considers metrics such as 'mean time to track' and localisation error. He also described optimisation problems involving evasion (best path through sonar field) and detection (maximise area coverage).

Four more papers followed after the tea break. Yong Zhang (DSTO, Australia) described various degradations to processing gain such as scalloping loss and correlation loss, including methods to calculate these for situations involving rough surface scattering, target motion, multipaths and finite target size. Xavier Cristol (Thales Underwater Systems, France) described degradations to sonar processing resulting from the sea surface and compared calculations using the AMOS, Saxton-Baker and Weston-Ching empirical models, showing that available measurements could be explained by a combination of bubble attenuation and rough surface scattering. Kevin Heaney (OASIS Inc, USA) described research on optimising sonar deployment by maximising the total detection area for multiple receivers. He presented optimisation results for the Phillipine Sea tomography experiment PhilSea 2009. Alan Fenwick (University of Aberdeen, UK) described the problems associated with modelling of trans-ocean sound propagation over thousands of kilometres using ray theory, for which an irregular ray pattern leads to exponential growth in the number of ray paths. He described an alternative method to solve this problem, derived from the parabolic equation, analogous to the Hamiltonian of classical mechanics, and showed how the alternative method could be tested.

The drinks reception and conference dinner took place in the evening of Thursday 8 April.

Friday 9 April

Orest Diachok took the audience down memory lane with a history of David Weston's contributions to bio-acoustical oceanography, starting with his pioneering experiments with long range active sonar in the 1960s that were '45 years ahead of their time'. Anomalous propagation measurements made during these experiments were attributed by David to the absorption of sound by large schools of fish. The idea that sound might be strongly affected in this way was considered speculative at the time, but has been vindicated by synchronous biological and acoustical measurements.

Michael Ainslie presented the details of scenario A1, involving a killer whale hunting its prey. The orca sonar pulse has a very large bandwidth, extending in frequency from 20kHz to 80kHz, and one of the purposes of this test was to improve understanding of the effect of this large bandwidth on sonar performance. Jan Ehrlich described his results for problem A1 using the MSM sonar performance model, including the effect on array gain of an anisotropic noise field. It was noted that anisotropy of the ambient noise field results in a correction of between 5 and 26 dB to the array gain, depending on the distance to the fish (through the changing steer direction).

The meeting closed with an awards ceremony. Mario Zampolli received the A B Wood medal from IOA president John Hinton OBE for his contributions to the understanding of scattering from elastic objects in acoustic waveguides and of long range sound propagation in the sea, and this was followed by the IOA Best Diploma Student Award to Dr Neil McBride, also presented by John Hinton. Finally, a one-off Weston 'Wood for trees' award (sponsored by Springer-Praxis) was awarded to Jan Erhlich for his comprehensive discussion of sonar issues, clear presentation of interesting and thought-provoking results and his novel simulations of a biological sonar. The prize, a copy of *Principles of Sonar Performance Modeling* (Springer-Praxis, 2010), was presented by Philippe Blondel, series editor for Springer-Praxis.

Acknowledgements

The author was motivated above all by a desire to see David Weston's achievements commemorated in a fitting manner. He thanks the Institute of Acoustics for making this possible and regrets that David's widow Joyce was unable to attend owing to a recent knee operation. He also thanks TNO for support, his co-organisers Linda Canty, Barry Uscinski and Peter Dobbins, and the scientific committee made up of Chris Harrison, Charles Holland, Dale Ellis, Gary Heald, Mario Zampolli and Tim Clarke. Finally he thanks Lt Cdr Bjørn Kerstens of the Royal Netherlands Navy for posing the question 'Which sonar performance model should I use for evaluating LFAS performance?' which led to the idea of holding a validation workshop.

David E Weston (16 November 1929 - 19 January 2001)

David's obituary was published in Acoustics Bulletin in September/October 2001 (volume 26 no.5). The workshop was held in his memory, so the appreciation from 2001 is reproduced here.

David E Weston, former President of the Institute of Acoustics, 1970 recipient of the *Rayleigh Silver Medal* and 1998 recipient of the Acoustical Society of America's *Helmholtz-Rayleigh Interdisciplinary Silver Medal in Acoustical Oceanography and Underwater Acoustics*, died of heart failure at his home on 19 January 2001. He was a Fellow of the Institute of Physics, Fellow of the Institute of Acoustics, and Fellow of the Acoustical Society of America.

David obtained his BSc in physics at Imperial College in 1950. This was followed by an MSc in 1952, also at Imperial College and supervised by R W B Stephens, on the propagation of sound waves in tubes. He joined the Admiralty Research Laboratory (Teddington) in 1951 and dedicated the next 50 years to the study of ocean acoustics and sonar. In this time he made ground-breaking contributions to many different aspects of underwater sound, from generation mechanisms to the detection process, through propagation, scattering, absorption and ambient noise. As a young scientist

continued on page 16

Meeting report - *continued from page 15*

he worked with A B Wood on the attenuation of sound propagating through mud, both at sea nd in a model scale tank.

He also developed his own brand of propagation theory based on conservation of flux and invariance of basic ray properties, that enabled him to predict fundamental characteristics of the field without needing to trace individual rays. That flux theory, and the associated 'Weston invariants' now form the scientific basis fro the computer models ASTRAL and INSTANT.

In the 1960s, influenced by his postgraduate work on tubes, David developed an interest in the scattering and absorption of sound by fish bladders. He conducted a series of shallow water experiments with D Revie and others at Perranporth in the Bristol Channel, designed to quantify these effects. The data collected at the time were unique and today are still regarded as among the best available.

In addition to this pioneering experimental work he personally laid the foundations for the currently accepted theory of scattering and absorption of sound by fish.

David spent two sabbatical periods in the USA, the first of which in 1964-65 was spent at the Hudson Laboratories (Columbia University). His second visit, to the Applied Research Laboratory (University of Texas) in 1979, resulted in a successful collaboration with C T Tindle, investigating the theoretical relationships between ray properties such as cycle distance and reflection loss, and modal eigenvalues and decay rates.

Apart from the two American visits, David worked at Admiralty laboratories continuously from 1951 until his retirement in 1989 as Individual Merit Deputy Chief Scientific Officer, from what by then had become the Admiralty Research Establishment in Portland (Dorset). After his retirement, David worked as a consultant to BAeSEMA Ltd (later BAE Systems) in New Malden, Surrey, and his advice continued to be sought by scientists throughout the world resulting in many invited lectures and visits to research laboratories.

In fact David never fully retired. He continued to publish at a prolific rate, contributing further to a final total of 67 publications in learned journals, two encyclopaedia entries and countless conference papers and unpublished reports. Even on the day he died, there were some carefully annotated papers on his desk concerning a long-standing interest of his: anomalous propagation measurements, attributed to the presence of high fish population densities in the Yellow Sea.

David's early work was rewarded in 1970 by the British Acoustical Society (a forerunner of the IOA) in the form of the *Rayleigh Silver Medal*, and in the same year he received the prestigious DSc degree from the University of London. His scientific excellence across multiple disciplines was recognised by the Acoustical Society of America by awarding him its *Helmholtz-Rayleigh Medal* in 1998.

David's scientific work was complemented by a long and selfless involvement with the affairs of the Institute of Acoustics: he was a council member from 1974 to 1986 and chaired both the Underwater Acoustics group (1977-79) and the Publications committee (1980-82) prior to his term as President (1982-84).

It is fitting that his last publication was a history of underwater acoustics in the IOA [D E Weston (1999) *Underwater acoustics during the life of the Institute*, Acoustics Bulletin vol 24 no3, pp17-20]. David also served on the Acoustics group committee of the Institute of Physics.

David had strong convictions that he would articulate passionately, but always with an open mind and the greatest respect for a differing opinion. This rare combination of integrity and humility was rounded by a cheeky sense of humour, characterised by his reaction to a frustrated comment by his colleague Dr Chris Harrison.

Having for the umpteenth time derived what he had thought to be a new result, only to discover that it had been published many years ago by a certain D E Weston, with tongue in cheek Chris suggested a new universal theorem: 'No matter how novel your theorem is, D Weston has already thought of it'. After a few moments' consideration David retorted 'Your theorem is clearly false, because you thought of it before me'.

David enjoyed life to the full, and never more so than when walking with friends in the Lake District or playing bridge. He loved all kinds of music and spent much of his spare time helping to organise the Weymouth Music Festival. Sorely missed by family, friends and colleagues, he is survived by his widow Joyce, daughter Anna and son Peter.

Active sonar performance modelling, validation and simulation

Organisers: Michael Ainslie, Dale Ellis and Charles Holland

There is a growing interest to develop and validate echo and reverberation models for sonar performance prediction and simulation. Compromises between fidelity, accuracy, robustness and speed are typical trade-offs made in various modelling approaches. This session encompasses echo and reverberation modelling as well as measurements intended to support validation of active sonar performance models. Frequencies of interest include, but are not limited to, those chosen for the recent US ONR reverberation modelling and UK IOA sonar performance assessment workshops, including both man-made and bio-sonar.

Fourth UAM Conference, Underwater Acoustic Measurements: Technologies and Results, 20-24 June 2011, Kos, Greece

Organisers: John Papadakis and Leif Bjørnø.

http://www.uam-conferences.org/index.php/topics/structured-sessions

Citation for A B Wood Medal for Dr Mario Zampolli

Mario Zampolli is currently a Senior Scientist in the Sonar Department at the Netherlands Organisation for Applied Scientific Research (TNO). His research on finite element methods has contributed significantly to our understanding of the scattering of sound from elastic objects.

Mario started his research as a mathematics student at the University of Bologna (Italy), with a thesis on optimal control applied to aerodynamics. A collaboration with the Aerospace Engineering Department of the University of Rome La Sapienza led him to Boston University, where, as a part of his PhD studies in mechanical engineering, he conducted research on the vibrations of a membrane inside the cavity of a microelectromechanical system (MEMS) chip, and on the effect of viscosity on diffraction from sharp edges. Through this work, he became involved in the translation and study of Sommerfeld's Mathematical Theory of Diffraction, leading to the first complete English translation, now published as a book, of Sommerfeld's seminal text.

Mario then moved to the NATO Undersea Research Centre (NURC) in Italy. Here he developed a finite element model for scattering from axisymmetric submerged elastic targets, with internal structural detail, for frequencies at which the wavelength is on the order of the size of the object, or smaller. In this regime, the echo is rich in structural resonances, which can be used for classification purposes. This work, including experimental validation, has resulted in five journal publications. The target scattering model developed by Mario at NURC is currently employed at national laboratories, universities and industry around the world, for applications as diverse as mine-countermeasures, anti-submarine warfare and medical ultrasound. The same finite element method has also been applied to two-way interaction of sound with the seabed in long range sound propagation problems at low frequencies, for benchmarking range-dependent elastic parabolic equation models. These results are published in two further journal papers.

At TNO, Mario quickly adapted to his new surroundings and colleagues, and is already making his mark with his innovative approach to research on low frequency active sonar, multipath filtering for the detection of buried objects, minesweeping and harbour security.

Not just a gifted acoustician, Dr. Zampolli is also a natural communicator, as illustrated by his contributions to the organisation of, and enthusiastic participation in numerous international conferences, and recognised by invited seminars at American, British and Italian universities.

The Institute of Acoustics is proud to award the 2010 A B Wood Medal to Dr Mario Zampolli for his contributions to the understanding of scattering from elastic objects in acoustic waveguides and of long range sound propagation in the sea.

Meeting report

Kevin Howell. Midlands branch

The Arup Campus in Solihull was the venue on 25 August for an entertaining presentation by Ray Goodwin on wildlife recording or *'Sounds of the Countryside'*.

The holiday season and the very wet weather meant that a smaller than usual audience gathered for this event, but this was more than compensated for by the enthusiasm of those present.

Ray, now retired, had left school at fifteen and spent his whole working life in agriculture. Early on in his career he developed an ear for identifying the wildlife sounds he encountered in the countryside. This acuity became particularly well honed when out at night during a brief career in poaching!

He embarked on a hobby to record as many of these sounds as he could. He started off with a Uher tape recorder, a microphone and a dustbin lid as a 'parabolic' reflector. He has progressed through different equipment over the years and currently uses a Sennheiser K300 gun microphone and a Fostex solid state recorder. The system works well even with up to 600m of microphone cable. Ray confesses to 'struggling a bit' with computers but, with the help of his grandson, is trying to get to grips with 'Audacity' software. He would like to digitise his 200-plus miles of analogue tape recordings.

Ray presented to us more than twenty recordings which ranged from the sound of the vibrating tail feathers of a snipe, white storks clattering bills together as a greeting, dung beetles in flight and a (much amplified) Roman snail feeding on a lettuce. The attentive silence of the audience during the playing of each recording contrasted with the eager questions which invariably followed, either relating to the wildlife subject matter or his recording equipment and technique. Ray has a particular interest in, and many recordings of, foxes. He debunked the notion that you can identify the sex of a fox simply by listening to its howling or barking – apparently, you simply cannot!

His hobby has taken him around the world including trips to Peru and, during the Cold War, behind the iron curtain. He had recently returned from Canada. He has featured on radio and television and some of his recordings have been used as soundtracks, leading to a BAFTA nomination.

The Midlands branch offers many thanks to Ray for his engrossing presentation. Thanks also, once again, to Stuart Colam and to Arup for hosting the meeting.

ANC consultancy spotlight

Adrian James.

Normally the summer holidays tend to be a quiet period for acoustical consultancy, and this year more than most as public spending has all but ground to a halt pending the Government's Spending Review. The Board and committee members of the Association of Noise Consultants have, however, been unseasonably busy. Some of the more important activities of the past few months, and plans for the next few, are described below.

Reform of Building Regulations

Over the summer, the Department for Communities and Local Government (DCLG) issued a consultation document on proposed changes to the Building Regulations. There was some concern that in the process of lightening the regulatory burden, the Department might bow to the views of one large but influential firm of house-builders whose directors, unlike the majority of their fellows, do not see why people living in their houses should not be able to converse with their neighbours through separating walls and floors.

The ANC Consultations Executive, having received an unusual number of responses from the membership on this vital subject, provided a comprehensive and beautifully worded response brilliantly summarising the benefits to householders and the building industry as a whole arising from the 2003 revisions to Approved Document E, including pre-completion testing and the introduction of mandatory acoustical standards for schools. ANC members, of course, can read this magnificent document on the members' area of the web site. Reference to the ANC's unique statistical database of test results allowed us to demonstrate the improvements in sound insulation achieved on site before and after the regulations became effective. Ed Clarke and Robin Hall represented these views for the ANC at a workshop on the 2013 Building Regulations revisions at DCLG in September, and the feedback received from the government department gives us confidence that Approved Document E – reputedly one of the few undisputed successes among approved documents – will not be weakened in the planned revisions.

Conference

As you will read elsewhere in this edition of Acoustics Bulletin, at the time of writing arrangements have been finalised for the joint IOA / ANC Conference on 2 and 3 November at Austin Court, Birmingham. The format of the conference is slightly unusual; although the first day will be in the usual Institute conference format of short formal papers, followed, if time allows, by questions, the second day will be a more informal series of workshops led by experts from the ANC. Following feedback from the membership on areas that they would like to be covered, there will be sessions on measurement of environmental noise (including discussion of the forthcoming ANC 'Green Book'), the reduction in noise during the volcanic ash shutdown of airports, BB93 and testing in schools, design of acoustically flexible environments, soundscapes, wind turbine noise, and construction noise.

Acoustical testing in schools

Testing for compliance with BB93 or to obtain HEA13 credits under BREEAM is a growing area of work for many consultants, but the requirements are less well understood than those for dwellings. The Schools committee of the ANC has drafted a Good Practice Guide based on the similar Registration Scheme Guide. The purpose of the guide is to provide consistency in interpretation of the test methods briefly described in BB 93. Following much hard work from the Schools committee it is hoped that by the time you read this the first version will be available to all members on the ANC web site.

PCT registration scheme

The revised version of the ADE Registration Scheme Handbook was emailed to all testers in September. Copies can be downloaded from the members' area of the web site. The handbook has been extensively revised and updated with some information transferred to the Good Practice Guide on sound insulation tests in dwellings. It is essential reading for all members working in pre-completion testing. Don't wait for the film – read the book!

Stolen equipment

In these commercially difficult times, it is always pleasant to hear of examples of individual enterprise but on the whole we wish that this did not involve enterprising individuals stealing our members' noise measuring equipment . Stolen from Lister Road, Liverpool on the night of 30 September 2010 were a Brüel and Kjær type 2260 sound level meter (serial number 02554022), Brüel & Kjær microphone type 4189 (serial number 02573460) and Manfrotto 055CL tripod. Anyone offered these in a pub, or seeing them on eBay, please phone Peter Hepworth on 01925 579100, who will probably buy a drink for anyone who helps to recover the equipment, or the police, who probably won't.

Web site

The next major upgrade of the ANC web site will be to introduce the 'competence area', to allow prospective clients to find members with expertise on specific areas of acoustics. This requires members to list which of the many categories of acoustics they claim competence in, and to provide information (normally in the form of a link to specific documents either on their own or the ANC web site) demonstrating competence in that field, normally in the form of past project descriptions. The competence search is currently only available in the members' area while members provide and add this information. In the New Year, the search will be activated in the public part of the site, so members should ensure that their details are up to date if they want prospective clients to locate them by the services that they provide.

Tranquillity rating prediction tool (TRAPT)

Robert J Pheasant, Kirill V Horoshenkov and Greg R Watts.

In both urban and rural environments 'tranquil space' is predominantly constructed via the sensory information received by the auditory and visual modalities, both of which provide rapid cues about a location's suitability for purpose. It is useful to establish a relationship between the subjective cues and objective measures that contribute to the tranquillity construct. This brief article updates the results of research reported by the authors in *JASA 123(3), 1446-1457 (2008)* that proposed a method by which an environment's 'tranquillity rating' can be established. By extending the original sample size from 10 to 34 environments to include locations that ranged from urban to wholly natural, it has been possible to validate and refine the model underpinning the 'Tranquillity Rating Prediction Tool'. The results of this work show that when responding to combined audio-visual stimuli, the A-weighted sound pressure level L_{Aeq}, and the percentage of natural and contextual features contained within the visual scene relate well to the tranquillity rating. The final version of the model proposed here can be used to determine an environment's existing tranquillity rating and to calculate a tranquillity rating value in response to specific visual and acoustical parameters.

Introduction

In response to the mass levels of rural-urban migration brought about by the industrial revolution, city planners of the late 18th, 19th and early 20th centuries formalised much of the UK's common land, by turning it into public parks and gardens. This was not only done to provide the inhabitants of some of the country's most deprived regions with access to clean air, but also to provide them with quiet environments that offered both visual and mental stimulation. Places such as parks and gardens that utilise a blend of natural features and relatively quiet soundscapes to facilitate cognitive respite are now broadly referred to as 'restorative' or 'tranquil' environments1 and are as important today as they were in the Victorian era. However, despite their recognised health and well-being benefits, 'restorative environments' are invariably in conflict with the continual drive for urbanisation. As a result, increasing amounts of urban green space, such as the 1000 hectares lost in London during the 1990s, are regularly given up in the name of 'development'2. Preserving existing, and developing new, restorative urban environments that have the ability to facilitate tranquillity should therefore be an essential component of all inner-city regeneration plans.

In order to identify the auditory and visual factors that make 'restorative' or 'tranquil' environments so valued, the University of Bradford examined how the potential tranquillity of external spaces may be measured. This resulted in the development of an interim **T**ranquillity **R**ating **P**rediction **T**ool (TRAPT)[3] that used equations 1 and 2.

$$TR = 13.93 - 0.165\ L_{Amax} + 0.024\ NF \quad [1]$$

$$TR = 8.57 - 0.11\ L_{Aeq} + 0.036\ NF \quad [2]$$

Here TR is the subjective tranquillity rating on a scale ranging from 0 (low) to 10 (high), L_{Amax} the maximum sound pressure level, L_{Aeq} the equivalent continuous sound pressure level, and NF the percentage of natural features (excluding sky) present within the scene. The decision to omit the percentage of sky from the calculation was taken because it was recognised that very small deviations in the camera angle could bias the overall percentage of natural features present, by introducing larger tracts of sky than would not normally be within view. The percentage value of each natural and manmade component of the visual scene was determined by overlaying a 10 by 10 grid onto still frames taken from the start, middle and end of each 32-second video clip, and counting the amount of space occupied. Natural features were deemed to include flora, fauna, geological features (including dry stone walls which, for many, are an intrinsic part of the English countryside) and water. Conversely anthropocentric features included people, the space that they occupied, and all manmade objects (excluding dry stone walls). Where more than one landscape component occupied the same 1% of space a smaller 4 by 4 grid was used, thus enabling the values to be determined to within <0.1% of overall space.

Analysis of the data from which the interim TRAPT was derived showed that few of the environments utilised in the study fell into the set 10% < NF < 60%. The decision was therefore taken to extend the sample size to ensure that a representative range of locations, including those characterised by 10% < NF < 60% and 36 < L_{Aeq} < 71dB (A), were included in a larger dataset, from which a revised tranquillity rating prediction tool could be determined. In addition, the interim TRAPT was independently validated using data from an alternative set of stimuli, the detailed results of which are contained in reference [4].

This report provides a summary of the key findings of the validation study along with an analysis of the combined data collected from the 34 contrasting environments that were utilised during the course of this five year study[3,4,5]. It concludes by proposing a revised model of the TRAPT that should be of use to both practitioners and those involved in landscape management and planning.

Methodology

A series of subjective experiments was carried out in which three groups of subjects (102 in total), were presented with unimodal and bimodal audio-visual data recorded using a binaural head and a Canon XM2 camcorder (Figure 1). Although the raw video data were edited into 32-second clips using Adobe Premiere 6.5 software, the visual and acoustical content remained unchanged, thereby presenting the subjects with stimuli identical to those recorded in the field. The subjective experiments were conducted in a psycho-acoustics suite at the University of Bradford as shown in Figure 2.

Wearing calibrated Technics RP-295 or Roland RH-300 headphones and sitting in pairs 2m from a Pioneer PDP-506XDE plasma screen, the subjects were asked to assess how tranquil they found the various environments to be. Each location was presented three times per experimental condition (audio only, visual only and combined audio-visual) and scored using a scale of 0 to 10, where 0 meant 'not at all tranquil' and 10 meant 'most tranquil'. The first exposure in each condition was used as an introduction to the environment and the two repeat runs used to determine the locations' mean (or weighted mean)[4] tranquillity rating. Prior to the experiment the subjects were informed that a tranquil environment was one that they considered a quiet, peaceful place to be, *ie* a place in which to get away from everyday life[6]. They were also informed that for the purpose of the exercise the environments that they saw should be considered 'steady state', ie they never change. For each environment, objective measures in the form of the percentage of natural features present within the scene (excluding sky) and the noise indices L_{Amax}, L_{Amin}, L_{Aeq}, L_{A10}, L_{A90} and L_{A50} were used as independent variables in multiple linear regression analysis.

Results and discussion

The results presented here were taken from the combined audio-visual experimental condition.

Key findings of the validation study

When the subjectively derived dependent variable (weighted mean tranquillity rating) and the objectively determined independent variables listed above were tested using multiple linear regression analysis, no strong relationship was found in the model that utilised L_{Amax} and *NF*. When L_{Aeq} was tested, a coefficient of determination (R^2) of 0.67 was returned. However, in the case of the *NF* independent

Figure 1

Binaural head and camcorder

Figure 2

Psycho-acoustic suite

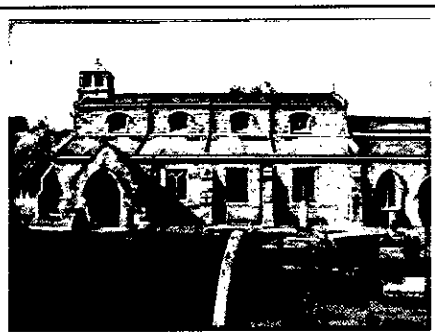


Figure 3

Linton Church

Figure 4

Castletown Harbour

variable this reasonable value was not supported by the confidence intervals for the 95% confidence level (CI -0.03 – 0.03), or by the associated significance score ($p = >0.05$). This poor result was directly attributable to the fact that the mean percentage of natural features calculated for environments such as Linton Church (see Figure 3) were relatively low (53%), considering that this particular structure was entirely in context with its rural setting in the heart of the UK's Yorkshire Dales National Park.

This led to a revised measure being developed of the visual descriptor that sought to take into account the effect that cultural and contextual features have on the perception of tranquillity. This new descriptor entitled 'Natural and Contextual Features' (*NCF*), employed the same methodology for calculating the visual components of the landscape as previously described[3], but in addition included a range of man-made features that were perceived to contribute visually to, or were in context with, the overall quality of the natural environment. Examples of such features are: listed buildings, as these have already undergone a value assessment; religious and historic buildings; landmarks; monuments; and man-made elements of the landscape that are geographically and aesthetically in keeping with the surrounding environment. An example can be seen in Figure 4, where the boats and traditional buildings surrounding a harbour could well be included alongside water and vegetation as 'natural and contextual features'.

When the mean tranquillity ratings from the combined audio-visual experimental condition were tested against the independent variables L_{Aeq} and *NCF*, a much stronger relationship was identified ($R^2 = 0.86$, $p < 0.05$). Despite attaining a reasonably high R^2 value (0.70), L_{Amax} once again failed to correlate significantly at the 95% confidence level.

continued on page 20

Tranquillity rating prediction tool (TRAPT) - *continued from page 19*

Revision of the TRAPT

Table 1 lists the mean Tranquillity Rating, L_{Aeq} and percentage of Natural and Contextual Features (*NCF*) for the 34 environments included in the study. For ease, the environments have been described as sites 1 – 34 and the data arranged from the lowest to highest L_{Aeq} values. It should be noted that one outlier was removed from the original data set reported in ref [3]. This was Chatsworth House, where a poor choice of recording location resulted in an otherwise pleasant environment being characterised by excessive water flow noise (L_{Aeq} = 78.3dB).

Figure 5 shows the percentage of natural and contextual features of each location plotted against the mean tranquillity rating. Here it can be seen that the tranquillity rating increases as the percentage of NCF contained within a scene increases, whereas Figure 6 shows how the mean tranquillity rating decreases as the L_{Aeq} increases.

Figures 5 and 6 illustrate how both the visual and auditory modalities contribute to the perception of tranquillity in almost equal measure. However, it should be understood that this is a complex relationship and that the construction of tranquil space is as a minimum a bimodal process[5].

The role of auditory-visual interaction in the perception of tranquillity is further shown in Table 2, where both NCF and L_{Aeq} are highly related with the mean TR, R^2 = 0.86 ($p < 0.001$). This bi-modal relationship is in turn supported by work recently carried out by SCANLab at the University of Sheffield, using fMRI neuro-imaging techniques[7]. This study demonstrated for the first time the significant differences in effective connectivity between areas of the brain, namely the auditory cortex and the medial pre-frontal cortex, under tranquil and non-tranquil conditions. Specifically the medial pre-frontal cortex receives significantly enhanced contributions from the auditory cortex when presented with a tranquil visual scene compared with non-tranquil visual stimuli.

continued on page 22

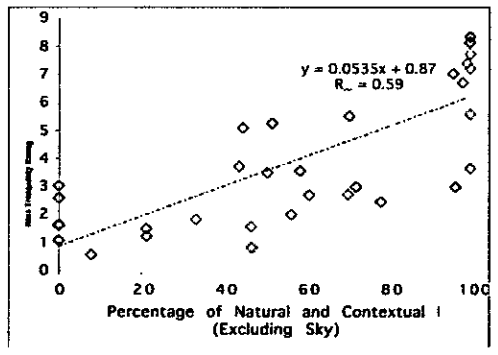


Figure 5

%NCF plotted against the mean tranquillity rating

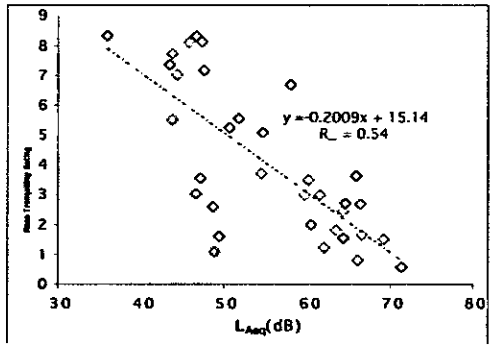


Figure 6

L_{Aeq} plotted against the mean tranquillity rating

Site	mean TR	LAeq dB	NCF	Site	mean TR	LAeq dB	NCF	Site	mean TR	LAeq dB	NCF
1	8.35	35.0	100	13	1.08	48.9	0	25	1.80	63.5	33.3
2	7.37	43.5	99.2	14	1.60	49.5	0	26	2.45	64.3	78.0
3	7.72	43.8	100	15	5.25	50.7	51.7	27	1.54	64.3	46.8
4	5.51	43.8	70.4	16	5.56	51.8	100	28	2.71	64.6	70
5	7.02	44.4	95.8	17	3.72	54.5	43.8	29	3.64	65.8	100
6	8.12	45.8	99.7	18	5.09	54.7	44.7	30	0.80	66.1	46.8
7	8.33	46.7	100	19	6.70	58.0	98.1	31	2.69	66.4	60.7
8	3.03	46.7	0	20	2.98	59.7	72.0	32	1.64	66.6	0
9	3.55	47.2	58.5	21	3.49	60.2	50.6	33	1.49	69.1	21.3
10	8.14	47.4	100	22	1.99	60.5	56.4	34	0.57	71.3	7.8
11	7.18	47.6	100	23	2.98	61.5	96.3				
12	2.59	48.7	0	24	1.22	62.1	21.3				

Table 1

Data from all 34 locations used in the multiple linear regression analysis

The World's Biggest Noise Map.

SoundPLAN 7 was chosen for the world's biggest noise map, the railway noise map of all Germany.

Although SoundPLAN is already the most flexible and one of the fastest programs of its kind, version 7 represents another big step forward for noise control software. This version introduces the new calculation core employing SoundPLAN's Dynamic Search scanning method. It is now possible to calculate huge noise maps with complex geometry using modern simulation standards.

SoundPLAN Version 7.0

Incredibly Fast

The new dynamic search method makes it the fastest noise control software on the market to our knowledge.

Incredibly Accurate

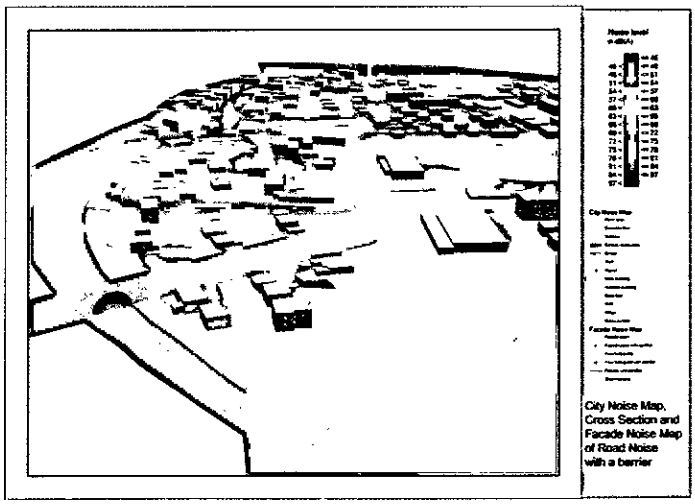
Mesh maps, hot spots, dynamic search and extensive testing for utmost accuracy according to 50+ standards.

Incredibly Useful

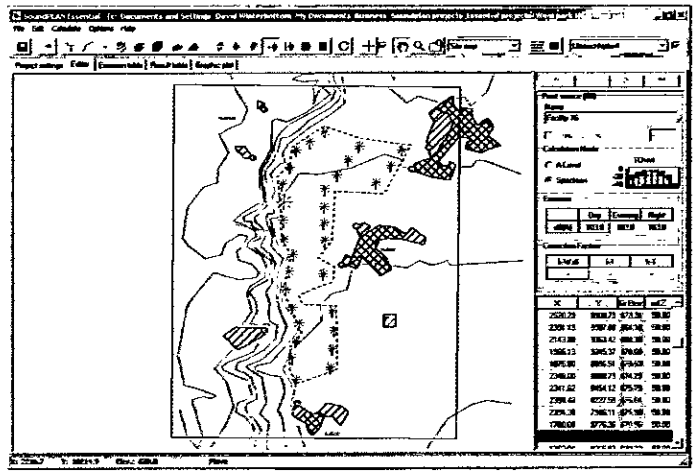
Stunning Graphics are easy to use. Spreadsheet for multiple results and automation of analysis such as DMRB. Documentation with advanced formatting. User definable templates and much, much more.

Incredibly Popular

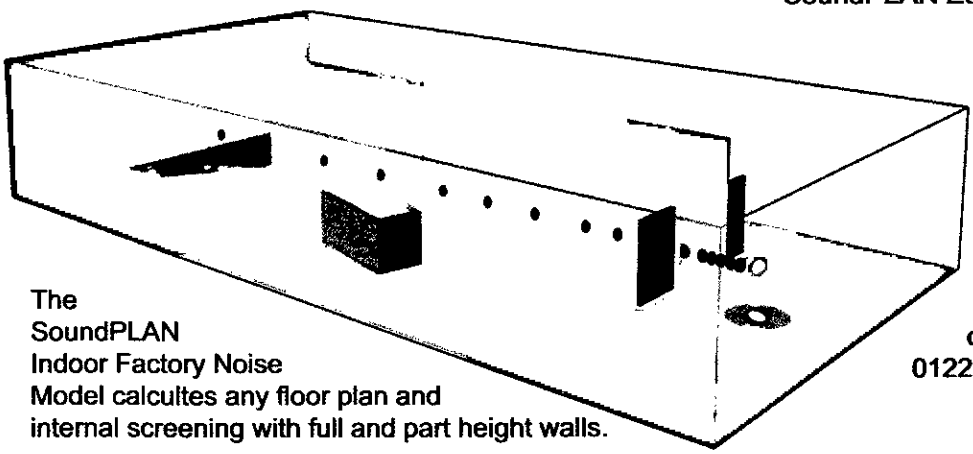
Nearly 5000 users in 50+ countries. Used by governments, consultants and researchers. Available in European, Asian and soon Arabic languages.



City Noise Map, Cross Section and Facade Noise Map of Road Noise with a barrier



SoundPLAN *Essential* is a compact version for occasional users and less complex projects with a very competitive price.



The SoundPLAN Indoor Factory Noise Model calcultes any floor plan and internal screening with full and part height walls.

Contact us for a demo CD

UK & Ireland Distributor
David Winterbottom
SoundPLAN UK&I

david@soundplanuk.co.uk
01223 911950 / 07050 116 950
Skype david.winterbottom
www.soundplan-uk.com

SoundPLAN

ANOVA	df	SS	MS	F	significance F
regression	2	182.89	91.45	93.62	7.2881E-14
residual	31	30.28	0.98		
total	33	213.17			

	coefficient	standard error	t-Stat	P-value	lower 95%	upper 95%
intercept	9.68	1.21	7.98	5.2E-09	7.21	12.16
L_{Aeq}	-0.15	0.02	-7.54	1.7E-08	-1.09	-0.11
% NCF	0.04	0	8.25	2.5E-09	0.03	0.05

Table 2

Results of multiple linear regression analysis $r = 0.93, r^2 = 0.86$, *adjusted* $r^2 = 0.85$ *S E 0.99, n = 34*

Tranquillity rating prediction tool (TRAPT) - *continued from page 20*

By extending the sample size and incorporating L_{Aeq} and *NCF* into the multiple linear regression analysis, the previously proposed TRAPT can be refined. Equation [3], which gives the refined model for the subjectively perceived tranquillity rating (TR), is based on the objectively measured equivalent continuous sound pressure level (L_{Aeq}) and the percentage of natural and contextual features (excluding sky), contained within the visual scene (*NCF*).

$$TR = 9.68 - 0.146\ L_{Aeq} + 0.041\ NCF \quad [3]$$

To demonstrate graphically the strength of the relationship between TR and the independent variables, the predicted TR from [3] was plotted against the subjectively derived mean tranquillity ratings for each of the 34 locations. This is shown in Figure 7 together with the regression statistics.

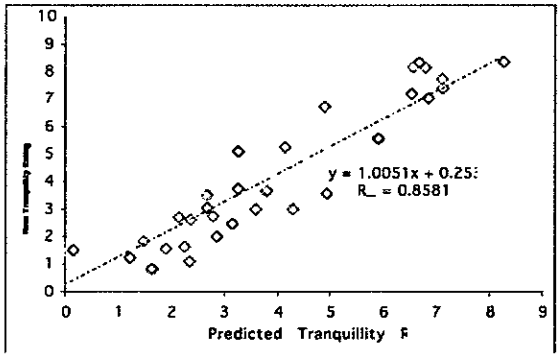


Figure 7

Predicted TR plotted against actual TR

Validation of the experimental methodology

The method of using laboratory based tranquillity ratings to develop the TRAPT was validated by asking a group of naive subjects to rate seven environments both in-situ and in the psycho-acoustics suite, by replaying recordings taken at the time of the outdoor assessments[8]. This study, which showed that there was excellent agreement between the two sets of ratings (see Figure 8), helps to underpin the methodology used for developing the tranquillity rating prediction tool.

Application

In order to use equation [3] in practice, it is necessary to consider appropriate sampling techniques that will identify the range of likely tranquillity ratings in the chosen areas, and to consider introducing minor adjustments or moderating factors (MF). This can lead to a modified form of equation [3], eg

$$TR = 9.68 + 0.041\ NCF - 0.146\ L_{Aeq} + MF \quad [4]$$

These moderating factors are not expected to be large and because they are relatively difficult to quantify they are the subject of ongoing research. One potentially effective solution to improving tranquillity is to mask traffic noise or distract attention with an attractive water sound. A previous experiment has demonstrated that water-generated sounds have the potential to improve the perceived tranquillity of gardens blighted by noise[8]. A further study has demonstrated that litter has the potential to degrade an environment to the extent that the tranquillity rating drops on average by one scale point[10].

Appropriate sampling techniques might include using the L_{day} measure for the average sound level from transportation noise sources from 07:00h to 19:00h. Noise maps and the use of noise prediction tools are useful starting points, but it is likely that these predictions will need to be supplemented by actual measurements. For quantifying the NCF parameter the value should be averaged over 360° at a number of points in the open space. A successful approach has been demonstrated in the tranquillity audit of six open spaces in Bradford city[10] (Watts et al 2010) though the approach could easily be adopted for open country.

A further step is to address any inadequacies by 'what if' analysis using the prediction equation and adjusting the parameters. This might indicate the need to reduce noise or increase the NCF. It may also be necessary to consider modifying factors and some guidance has been reported, though it is recognised that more research is required.

Conclusions

By using a representative range of landscape types, it has been possible to develop a tranquillity rating prediction tool (TRAPT) that utilises the auditory and visual qualities of a scene as the key components. The tool is based on the objectively measured equivalent continuous sound pressure level (L_{Aeq}), which can either be objectively measured or obtained from an appropriate noise prediction model, and the

continued on page 24

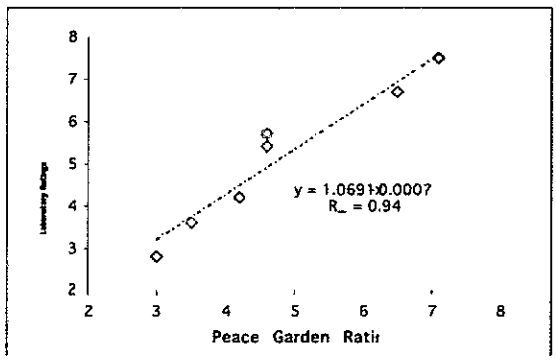


Figure 8

Results of the methodology validation study

Figure 9

Rinsey Head in Cornwall provides as much quality soft fascination as you can handle. The building is surprisingly in context with the overall scene and the suggestion from the picture is that the soundscape would be complimentary, which at the time it was.

Figure 10

Lathkill Dale doesn't do so badly either. Who would know that the small weirs are in fact medieval fish traps, so was it an industrial landscape?

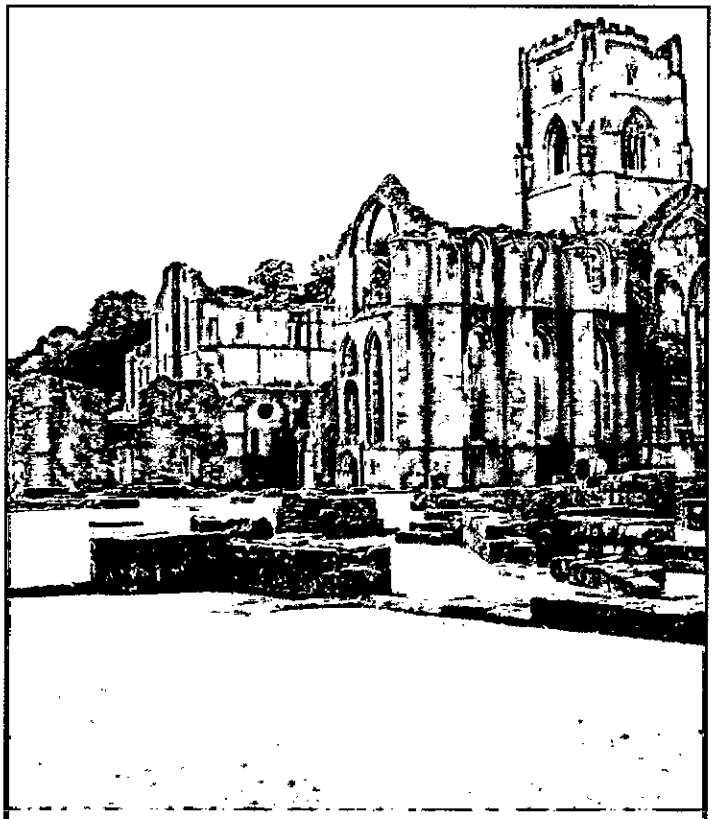


Figure 11

The ruins of Fountains Abbey provide a visual context to the landscape that is conducive with psychological restoration. The soundscape varies significantly from day to day depending on the number of visitors.

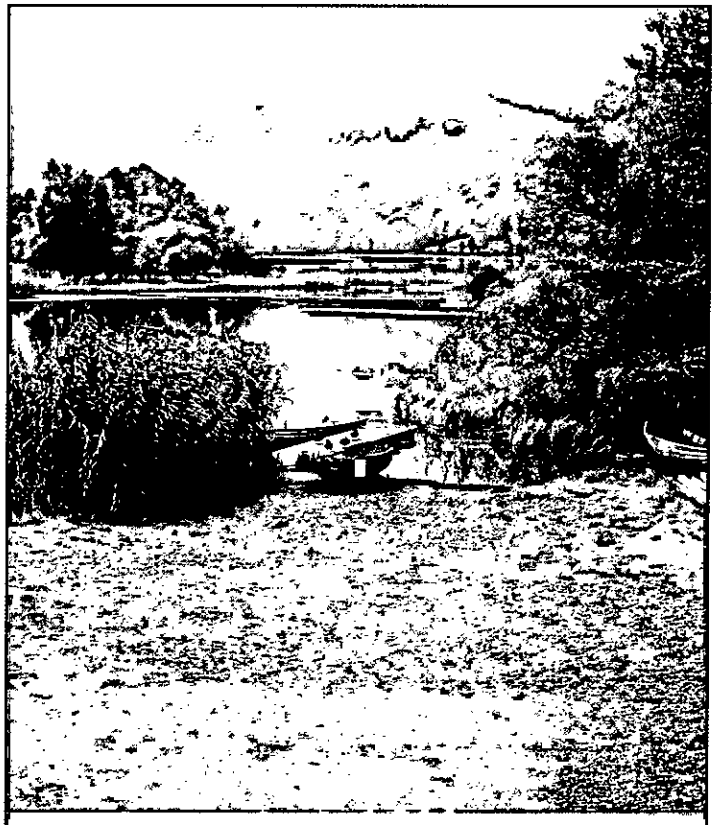


Figure 12

Grasmere is another exceptional setting that generally combines a quality visual scene with a highly acceptable soundscape. As with all these images though, the soundscape is dynamic and can significantly influence the tranquillity rating.

Tranquillity rating prediction tool (TRAPT) - *continued from page 22*

percentage of natural and contextual features (*NCF*) present within the visual scene. Whilst both of these objective measures are of equal importance for the quality assessment of restorative spaces, it is acknowledged that there may be problems in defining the percentage of natural and contextual features, as these can depend upon cultural, social and environmental preferences. However, this parameter should not be omitted from the model, as the visual information has a strong impact on the perceived quality of the soundscape and correlates well with the tranquillity rating attained. As a starting point, the whole of the visual composition of a scene that positively contributes to its perceived quality should be accounted for. This should include all green space, listed, historic and religious buildings, landmarks, monuments and man-made elements of the landscape that are geographically and aesthetically in keeping with the natural environment. The model has been successfully applied to predicting the levels of perceived tranquillity in a range of outdoor open spaces in a metropolitan area.

TRAPT will have many applications in the design and enhancement of open spaces and parks in town and country, by providing an estimate of the levels of tranquillity that can be and have been achieved. This is important because it is likely that the level of tranquillity can be related to the 'restorative' value of these spaces and therefore linked to health and wellbeing benefits. As an example, recent work in applying the tool has been used to produce an audit of the level of tranquillity of parks and open spaces in the city of Bradford.

Acknowledgements

The authors would like to acknowledge the UK's Engineering and Physical Sciences Research Council (EPSRC), for the two grants (EPSRC GR/P/02738/01 & EPSRC EP/F055986/1) that made this research possible.

The authors are with the School of Engineering, Design and Technology, University of Bradford, BD1 7DP

References

1. S Kaplan, 'The restorative benefits of nature: Towards an integrated framework,' J Environmental Psychology **15**, 169-182 (1995)
2. Green Spaces Investigative Committee, Scrutiny of Green Spaces in London, November 2001 Greater London Authority November 2001
3. R J Pheasant, K V Horoshenkov, G R Watts, B T Barrett: 'The acoustic and visual factors influencing the construction of tranquil space in urban and rural environments: Tranquil spaces – quiet places?' J Acoust Soc Am **123**, 1446 – 1457 (2008)
4. R J Pheasant, K V Horoshenkov and G R Watts 'Validation of a Tranquillity rating prediction tool,' Acta Acustica united with Acustica, **95(6)** 1032 – 10394 (2009)
5. R J Pheasant, M N Fisher, G R Watts, D J Whitaker and K V Horoshenkov 'The importance of audio-visual interaction in the construction of tranquil' J Environmental Psychology, doi:101016/j.jenvp.2010.03.006
6. T R Herzog and P J Bosely: 'Tranquillity and preference as affective qualities of natural environments,' J Environmental Psychology **12**, 115 – 127 (1992)
7. G R Watts, M D Hunter, M Douglas, R J Pheasant, T F D Farrow, I D Wilkinson, J Kang, K V Horoshenkov, and P W Woodruff 'The use of fMRI techniques to investigate the perception of Tranquillity' on the CD-ROM: *Ottawa, August 23-26, proceedings of INTER-NOISE 2009*
8. G R Watts, R J Pheasant and K V Horoshenkov, 'Validation of tranquillity rating method', Proceedings of the Institute of Acoustics & Belgium Acoustical Society, Noise in the Built Environment, Ghent, 29-30 April 2010)
9. G R Watts, , R J Pheasant, K V Horoshenkov and L Ragonesi, 'Measurement and subjective assessment of water generated sounds', *Acta Acustica united with Acustica*, 95, 1032-1039 (2009)
10. G R Watts, R J Pheasant and K V Horoshenkov, 'Tranquil spaces in a metropolitan area ' on the CD-ROM: *Sydney, August 23-27, proceedings of International Congress on Acoustics, 2010*

Figure 13

Award winning Lister Park. One of the tranquillity survey sites set within Bradford City

Figure 14

The most tranquil spot in Lister Park.

Figure 15

Another view of Lister Park, Bradford on a rather chilly morning

influenced by the flow through the valve. The valve can then be maintained in oscillation by the influence of upstream and downstream pressure variations and their effects both through simple pressure exposure to the upstream portion of the valve and also by Bernoulli flow through the valve aperture. The general features of such behaviour are well understood [10] and apply to human vocalisation and to lip motion in the playing of trumpets as well as to birds. A detailed model [5] for the song of birds with rich-harmonic vocalisations, as sketched in Figure 1(b), predicts results, as shown in Figure 2, that are in good agreement with observation. For the parameter values selected, the syringeal valve is found to close completely on each cycle at a frequency of about 200Hz and there are emphasised formant bands near 1kHz and 2kHz, which correspond to resonances of the vocal tract [7]. These formants are important to sound quality but are not essential for the production of sound. The radiated sound will retain these formant features, but its waveform will be much more 'continuous' in structure than are the pressure and flow in the figure. Each of the two syringeal valves in the song-bird anatomy of Figure 1(a) will function in a very similar manner.

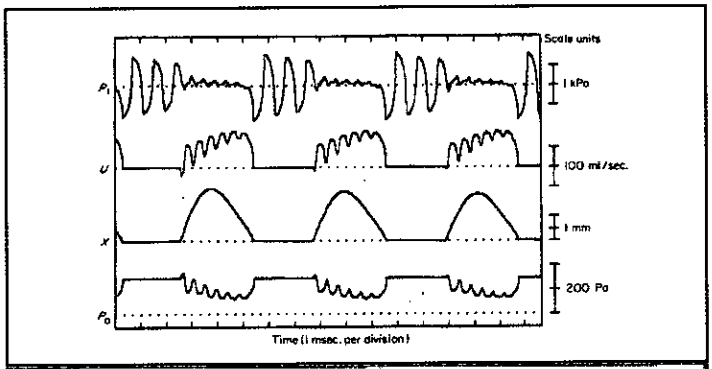


Figure 2

Calculated acoustic behaviour of a syringeal valve as in Figure 1(b). Variable p1 is the acoustic pressure in the trachea above the valve, U is the acoustic flow through the valve, x is the valve opening, and p0 is the pressure in the reservoir below the valve (from reference [5]).

Pure-tone song

One puzzling feature of the model proposed for the production of normal bird song is the fact that it fails to provide an explanation for the almost pure-tone songs produced by some birds. The only way in which this can be achieved with the model is to use a very low blowing pressure so that the valve fails to close on each cycle, but this results in an extremely low sound level, which is not what is observed in practice.

Two alternative mechanisms for pure-tone song production have been identified. In the first case [11], which applies to birds such as the northern cardinal *Cardinalis cardinalis* which are able to produce sweeping whistle-like sounds over a 1 – 8 kHz frequency range in a single 'syllable' of song, the mechanism relies upon a tuneable resonant cavity near the junction of the trachea and the mouth as shown in Figure 3(a). The cavity itself is actually in the oesophagus, which leads to the stomach, and is referred to as an 'oropharyngeal esophageal cavity' or OEC. This cavity can be stretched over a wide volume range by attached muscles. The bird then essentially tunes this vocal tract resonance to match the frequency of the note being sung, in much the same way as do human coloratura sopranos and with the same result, though with different anatomical features. A model for this vocalisation using the electric network analogue shown in Figure 3(b) is able to produce good agreement with observations [12].

The second mechanism, which applies to the 'coo' sound of doves, is quite different, since doves, particularly ring doves, sing with their beaks closed. The 'coo' itself is a rather short syllable, lasting not much more

continued on page 28

Acoustical background to the many... - *continued from page 27*

than one second, and typically has a frequency around 600Hz that remains almost steady. Observations show that the dove expands a sac in its neck when producing the call, and this sac expands somewhat during the call since the bird is exhaling into it. Once again it is possible to devise a theoretical model [13] to accommodate this anatomy and behaviour, though this model is rather different from that for the cardinal since the beak is closed and air is simply transferred from the lungs to the vocal sac, which is once more located in the oesophagus near its junction with the mouth. The resonance of prime importance in this case is almost that of a Helmholtz resonator comprising the sac and the tubular connection through the glottis between it and the trachea, though this has to be modified to allow for vibration of the thin walls of the sac. The great difference between the dove and the Cardinal is that the dove's beak is closed, so that sound radiation is not through the beak but directly from the vibrating thin walls of the inflated oesophageal sac.

Surprisingly, perhaps, the resonant frequency changes very little as the sac expands, because the decrease in the mass per unit area of the walls nearly compensates for the increase in sac volume. The song therefore maintains a nearly constant pitch.

Chaotic vocalisation

The third type of song of interest can be termed chaotic song, because the waveform is genuinely chaotic rather than being just random noise [4] and typically has a Lyapunov exponent of 0.28 ± 0.06 and a correlation dimension in the range 3.2 to 3.8, values that are comparable with those for standard computed chaotic signals. Australian birds with this type of song are mostly cockatoos, the most prominent being the sulphur-crested cockatoo *Cacatua galerita*, which is also known for its beautiful appearance and its destructive behaviour when a group flies into a tree and pulls off any flowers and new shoots, or even when they attack the rubber gaskets in street lights. The cry of these cockatoos is also very loud – about 80dB at a distance of 10 metres, which corresponds to a radiated power of about 100mW. The spectral distribution of the sound is broad, with a maximum near 2.5kHz and a 10dB bandwidth from 1 to about 3.5 kHz, so that it sounds very loud and 'harsh' to human ears. An example of the waveform and spectrum is shown in Figure 4.

Modelling of the production of such a sound is difficult because of lack of information about the detailed anatomy of the vocal valve in these birds. The standard model described above, however, in which the restoring force on the valve membranes under pressure is proportional to its deflection but there is a large increase in both restoring force and damping when the two membranes come into contact, does show some chaotic behaviour when the lung pressure is made very high so that the nonlinearity is emphasised [4]. This suggests that an extended model in which a nonlinear term is added to the membrane restoring force might adequately reproduce the observed chaotic behaviour at lower lung pressures. It is easy to suggest the origin of such a nonlinear term because biological structures are rarely linear in behaviour once the stretching or bending becomes nontrivial. This is because the structures are complex assemblies of cells with quite different elastic properties. To date no anatomical data on this question have been available.

Song structure and mimicry

Setting aside the detailed acoustics of sound production in birds, there is a wealth of information encoded in the songs that has provoked great interest among behavioural biologists. While the information content of vocalisations can be formally defined and measured [14], there is much more interest in the structure of the 'conversation' of birds, conveying information to each other, and in the way in which some species are adept at imitating the calls of birds or animals of other species, or even the sounds of non-biological sources such as chainsaws.

Various species of parrots and cockatoos have been known for a very long time to be able to imitate human speech by tuning the formants and articulation patterns to match human phrases such as 'pretty polly'. This is perhaps not surprising from an acoustical point of view, since

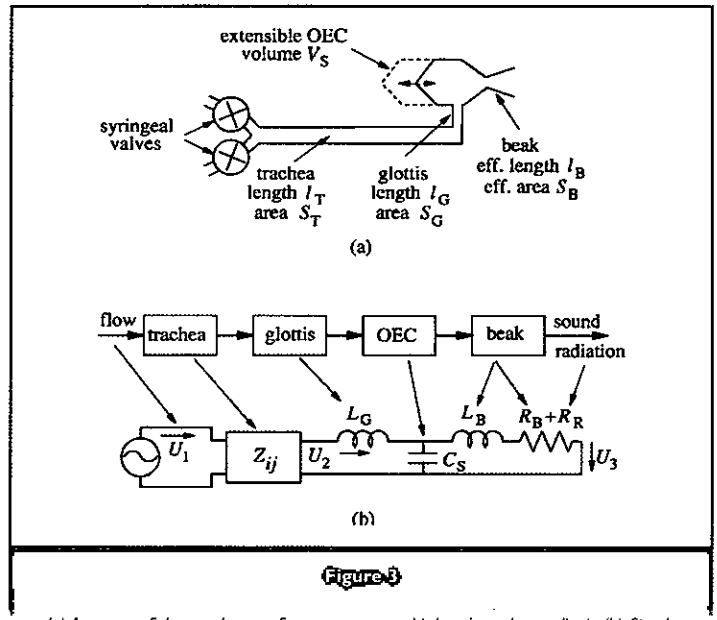


Figure 3

(a) Anatomy of the vocal tract of a pure-tone songbird such as the cardinal. (b) Simple electrical network model used to analyse the vocal tract behaviour. The bird adjusts the resonance of the OEC and beak aperture to match the frequency of the air flow produced by the syringeal valves (from reference [12]).

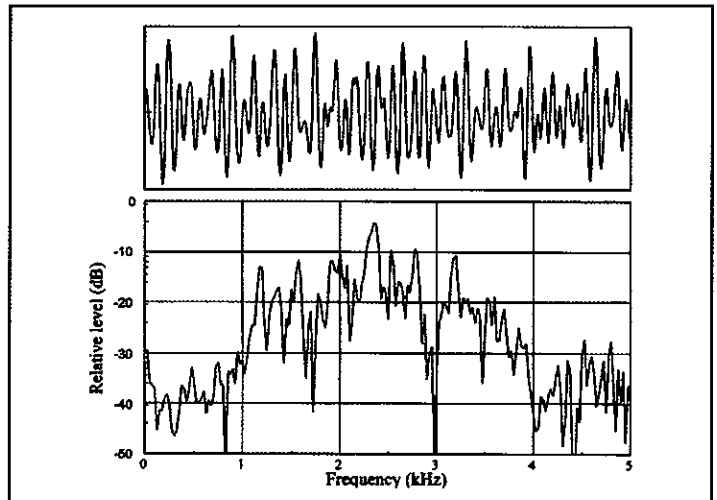


Figure 4

Waveform and spectrum of a short sample of the call of a sulphur-crested cockatoo Cacatua galerita. Plots for the gang-gang cockatoo are very similar (from reference [4]).

the vocal formants, except perhaps the first, can be appropriately tuned by varying tongue position and beak opening [7], and there are generally clear rewards provided by their human hosts for those birds that excel at this imitation.

Of particular interest is the vocal behaviour of several species of Australian birds, particularly the lyrebird *Menura novaehollandiae*, which is adept at imitating a huge variety of birdsongs from other species as well as mechanical and other sounds [15]. The pied butcherbird [16] and the magpie [17] have similar abilities. A true understanding of the reasons for this mimicry behaviour involves physiology and psychology as well as acoustics [18] and is outside the scope of this article.

Conclusions

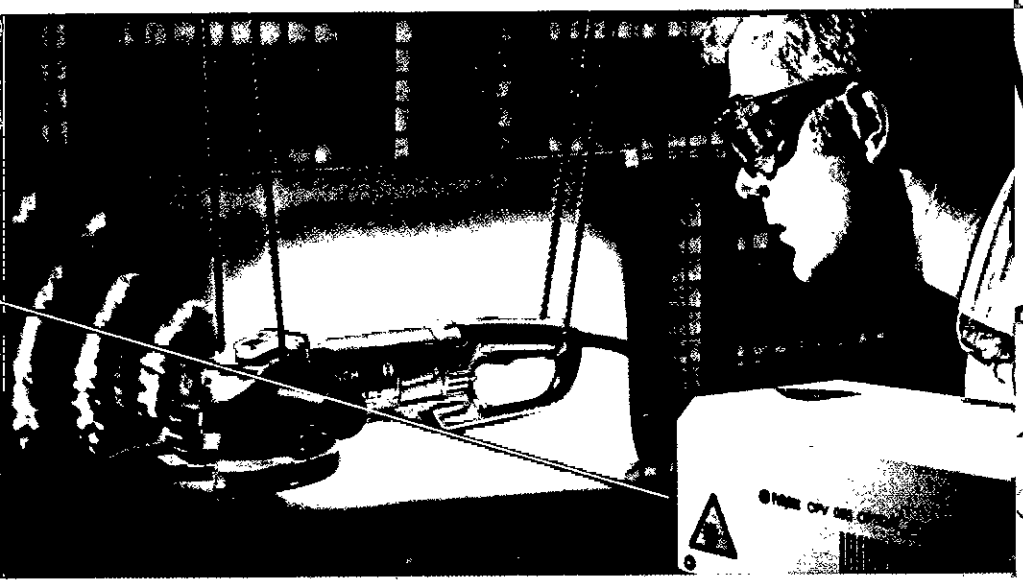
Birdsong is one of the most interesting and varied forms of vocalisation produced by any animals and almost rivals human speech and song in complexity. Even the acoustics of sound production by birds is complex

continued on page 30

Polytec

Non Contact Vibration Measurement

Making vibrations visible



For over 40 years Polytec has provided high technology, laser-based measurement solutions to researchers and engineers.

Polytec offers you a way to improve vibration measurements, correlate FEA models and reduce development time.

See results as intuitive 3D colour maps from – small, fragile, hot, rotating and large surface area parts.

Discover more from **Polytec** by visiting **www.polytec-ltd.co.uk.** Call **01582 711670** or email **info@polytec-ltd.co.uk** to arrange a demonstration.

Why measure with a laser?

- **Fast**
  Fix your sample points by mouse or geometry import, not by sticking on and hooking up
- **Precise**
  Track even picometer vibrations on micrometer-scale structures
- **Flexible**
  You're not limited by the availability of sensors or data acquisition channels
- **Weightless**
  Get true values with no influence of the sensor mass
- **Universal**
  Measure vibrations up to 24 MHz, on virtually any surface at any temperature

Acoustical background to the many... - *continued from page 28*

and varied, as has been summarised here. Collaborative studies between many biological and physical scientists have now achieved a basic understanding of the subject, but there is an immense field of research available on the information content and 'cultural' background involved as well as on the vocal anatomy and physiology of individual bird species.

Neville Fletcher is with the Research School of Physics and Engineering, Australian National University, Canberra ACT 0200
Email: **neville fletcher@anu.edu.au**

This article first appeared in *Acoustics Australia* volume 38 no.1, August 2010, and the permission of the Australian Acoustical Society to reproduce it here is gratefully acknowledged.

References

These references are largely restricted to studies with which the author has had a personal involvement. The biological literature on birdsong is very large and cannot adequately be referenced here. References 1–3 have extensive citation lists.

[1] C H Greenewalt, *Birdsong: Acoustics and Physiology* (Smithsonian Institution, Washington DC 1968)

[2] D E Kroodsma and E H Miller, Eds, *Acoustic Communication in Birds* (Academic Press, New York 1982)

[3] P Marler and H Slabbekoorn, *Nature's Music: The Science of Birdsong* (Elsevier, London 2004)

[4] N H Fletcher, 'A class of chaotic bird calls?' *J Acoust Soc Am* **108**, 821–826 (2000)

[5] N H Fletcher, 'Bird song – a quantitative acoustic model' *J Theor Biol* **135**, 455–481 (1988)

[6] N H Fletcher, 'A simple frequency-scaling rule for animal communication' *J Acoust Soc Am* **115**, 2334–2338 (2004)

[7] N H Fletcher and A Tarnopolsky, 'Acoustics of the avian vocal tract' *J Acoust Soc Am* **105**, 35–49 (1999)

[8] J Sundberg, *The Science of the Singing Voice* (Northern Illinois University Press, Dekalb 1987)

[9] E Joliveau, J Smith and J Wolfe, 'Vocal tract resonances in singing: the soprano voice' *J Acoust Soc Am* **116**, 2434–2439 (2004)

[10] N H Fletcher, 'Autonomous vibration of simple pressure-controlled valves in gas flows' *J Acoust Soc Am* **93**, 2172–2180 (1993)

[11] T Riede, R A Suthers, N H Fletcher and W E Blevins, 'Songbirds tune their vocal tract to the fundamental frequency of their song' *Proc Nat Acad Sci* **103**, 5543–5548 (2006)

[12] N H Fletcher, T Riede and R A Suthers, 'Model for vocalization by a bird with distensible vocal cavity and open beak' *J Acoust Soc Am* **119**, 1005-1011 (2006)

[13] N H Fletcher, T Riede, G J L Beckers and R A Suthers, 'Vocal tract filtering and the 'coo' of doves' *J Acoust Soc Am* **116**, 3750–3756 (2004)

[14] N H Fletcher 'The variety of information transfer in animal sonic communication: review from a physics perspective' *Entropy* **11**, 888–906 (2009)

[15] F N Robinson and H S Curtis, 'The vocal displays of the lyrebirds (Menuridae)' *Emu* **96**, 258–275 (1996)

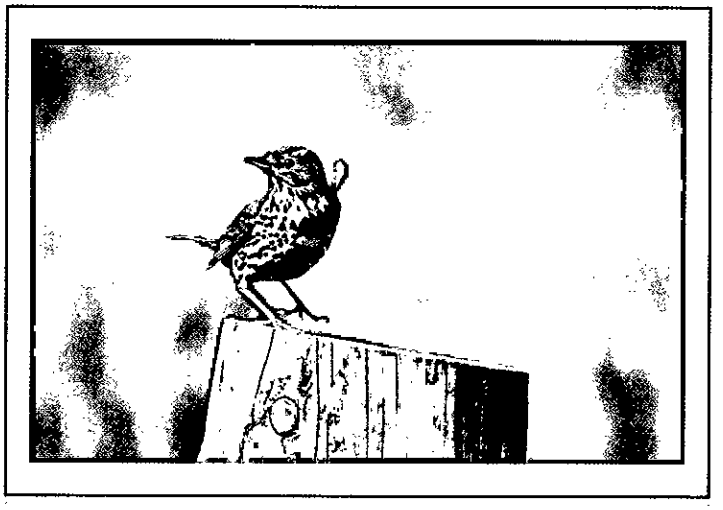
[16] H Taylor, 'Decoding the song of the pied butcherbird' *Transcultural Music Review* (2008) http://sibetrans.com/trans/trans12/art13.htm

[17] G Kaplan, *Australian Magpie: Biology and Behaviour of an Unusual Songbird*, Natural History Series, (University of New South Wales Press, Sydney and CSIRO, Melbourne, 2004)

[18] G Kaplan, 'Animals and music: between cultural definitions and sensory evidence' *Sign System Studies* **37**, 75–101 (2009)

The front cover of Acoustics Australia, vol.38 no.2, bore a specially commissioned illustration by Heidi Hereth of three Australian songbirds

The European blackbird Turdus merula has a song very familiar to UK residents...



... as does the song thrush Turdus philomelos

The application of scale models to predict the acoustical performance of screens attached directly to vented facades

Ze Nunes, Alex Daymond-King and Jeremie Dufaud.
Reducing environmental noise break-in to naturally ventilated buildings

Introduction

In modern architecture, natural ventilation is a key design feature. Because of the nature of these buildings, vented facades with low levels of air resistance and in turn, low levels of acoustical resistance are typically required. Acoustical barriers have been used for many years to control noise from roads and other environmental noise sources. These barriers are not particularly effective at protecting buildings when placed at some distance from the building. This article, the first in an occasional series, presents a method of assessing the acoustical performance of vented facades which incorporate acoustic barriers as part of the facade. It is demonstrated that scale models can be used to assess the acoustical performance of these facades.

It should be noted that the terms 'screens', 'baffles', and 'barriers' are used interchangeably in the following.

The importance of increasing the acoustical attenuation provided by vented facades is becoming of great importance, owing to the desire to develop green buildings on noisier sites. The acoustical performance of a vented facade can principally be increased by two means; by including some form of acoustical attenuator into the air inlet vent of a vented facade or alternatively and more unconventionally, to incorporate acoustic barriers in front of the air vents within vented facades. This paper focuses on this latter form of acoustic attenuation and how to assess the acoustical performance of acoustic screens/barriers incorporated within a vented facade.

A paper written by Gavin Irvine[1] shows the effects of adding acoustic barriers directly to the side of a building. This paper describes how the 'Lansdown' window shown in Figure 1 still achieves 22dB R_w of sound insulation when open. This is estimated to be some 7 to 12 dB better than that of a conventional window.

The Lansdown window was developed using a mock-up office placed near the noise source in question (in this case a railway line). The prototypes used for the development work were made from plywood. Once the final design had been optimised, it was built from aluminium and tested in a laboratory which gave similar results to the models tested. The final conclusion of the report was:

'A window design has been developed which can provide up to 25dB Rw from an open window. The baffle works best at high frequencies and is therefore most suitable for train noise and fast-flowing traffic.'

Reference[2] provides the results of a range of tests undertaken on opening windows. The investigation included seven popular domestic window models, and tested for the effects of degree of opening and the angle of incident noise. The range of measured insulation ratings for windows with a free open area of 0.05m² was (in terms of D_w) 14 to 20 dB.

The results indicated that no one particular opening style provided significantly better insulating characteristics over others. Nevertheless, the report stated that in general the set of windows with an outward-opening light performed well. Rotation of source incidence away from the normal within a non-diffuse acoustical environment is found consistently to improve the resulting open window façade insulation.

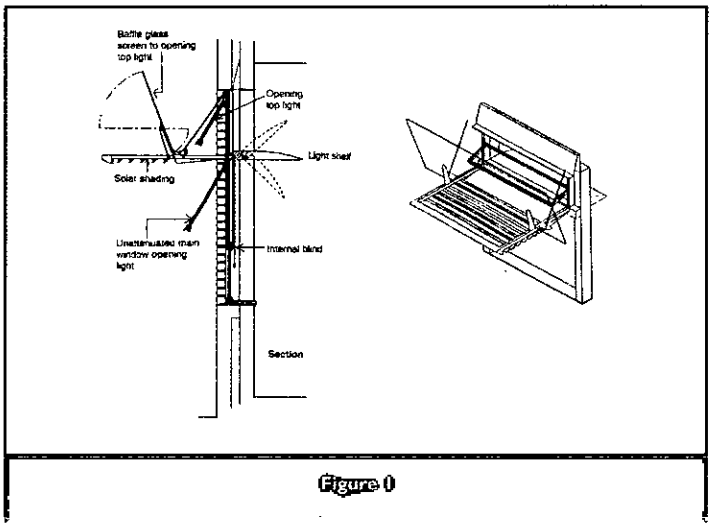


Figure 1

The Lansdown window system

There is a direct relationship between a windows area of opening and its characteristic level of acoustical insulation: larger openings reduce the degree of acoustical protection. This relationship does not however correlate with a logarithmic ratio of relative opening sizes. Measured weighted insulation differences in opening areas are limited to 1dB for open area increases from 0.05m² to 0.1m² and 2dB for increases from 0.1m² to 0.2m².

This article highlights the complexities in predicting the acoustical performance of an open window. Reference[1] shows that baffled windows can be used to increase significantly the attenuation of a vented facade. The drawback here is that a combination of a number of acoustical factors makes calculating the performance of baffled windows difficult to predict accurately. This is mainly due to the complexity of the sound field within a localised and confined space, along with the complexities of predicting the effects of diffraction around screens. In addition, it is exceptionally difficult to assess and predict the effects of the sounds' angles of incidence, an important factor on open windows or a baffled opening.

A second major difficulty in assessing the acoustical performance of vented facades and bespoke screened facades is that of cost and practicality. Owing to the nature of these facades, it is not seen as possible to use the methods given within ISO140-10:1992[3], since acoustic barriers and screens only work in free-field conditions. It is therefore necessary to build a room and a facade to assess the acoustical performance of these types of systems, which is extremely costly and highly impractical.

continued on page 32

The application of scale models - *continued from page 31*

This article goes on to discuss how scale models are already used in acoustics and what advantages they offer in the prediction of the acoustical performance of vented facades. In order to demonstrate the accuracy of such models, the results of tests undertaken by MACH Acoustics are presented. These first provide a comparison between three facades at full size, half and quarter scales. From there, a detailed analysis of performance levels is provided.

Theory of scale models

Scale models have been used for some decades in order to predict the behaviour of concert halls. One of the main reasons why scale models are used today is to assess diffraction, resonance and other complex acoustical properties which cannot as yet be computer simulated. The basic reason for using scale models is one of practicality: it is simply not possible to test and 'tweak' a full-scale auditorium before construction. The scale model of an auditorium therefore provides a practical and accurate method of assessing the acoustical performance of these spaces. On the same principles, it is seen that scale models could be used to assess the acoustical performance of open or baffled windows.

Scale models can also be used to model the airborne sound insulation of glazing. Reference[4] concluded that:

'The results of this study have demonstrated that it is possible to model the sound transmission characteristics of windows by means of using scale models'

We shall now consider how by building a scale model of a façade, an identical sound reduction index is measured.

The principles behind scale models are relatively simple: a test object is reduced in size to a given scale and is then tested conventionally. The resulting frequency response is shifted in frequency by the same factor as that of the scaling ratio, and the result is an accurate prediction of the system's performance taken from a manageable model. This principle is shown in Figure 2: in this case the model scale is one-quarter. In the case of vented facades, the hole within the facade is also reduced by a scaling factor, so the acoustic attenuation of this facade is increased. To correct for this, the magnitude of the frequency response has o be adjusted by 10 times the logarithm of the scale, so as to represent the full-scale model.

The frequencies are multiplied by the scaling factor [1]

10 times the logarithm of the scaling factor is added to the original amplitude [2]

Window diameter	Scaling factor	Frequency	Amplitude
200mm	1	times 1	plus 10 log(1)
100mm	½	times 0.5	plus 10 log(2)
50mm	¼	times 0.25	plus 10 log(4)

Table 1

Scaling effects

Feasibility of using scale models to assess the acoustical performance of vented facades

The aim of the first set of feasibility tests was to establish whether it was possible to predict the same acoustical performance from three facades at three different scales, at full size, half scale and one quarter scale. To do this, three different models were built as shown in Figure 4. The dimensions and screen size used, as shown in Figure 3, were chosen so as to maximise resonant behaviour, standing waves and any other acoustical effects which may occur. The reason for doing this was to determine whether all three scale models would predict the same performances.

In all cases, the screen was formed using 18mm medium density fibreboard (MDF). The solid section of the facade was formed from an 18mm MDF panel, lined on the back with 32mm of dense plasterboard. The expected resistance to the passage of sound through the solid part was at least 10dB greater than that through the opening.

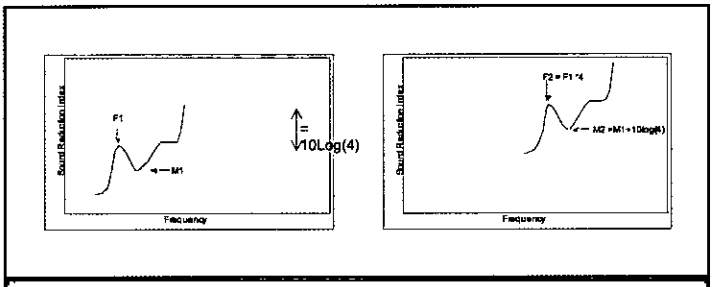


Figure 2

Scale model effect

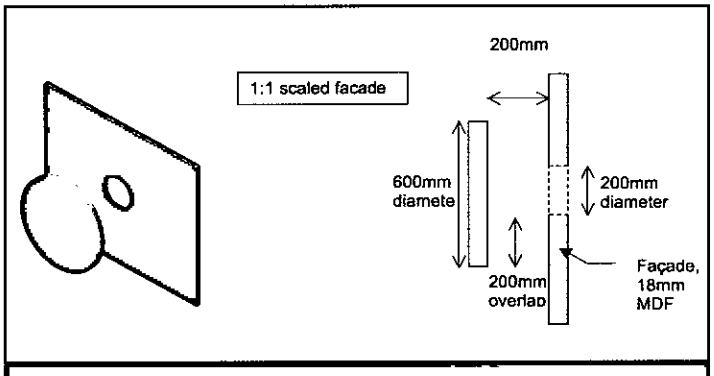


Figure 3

The window studied

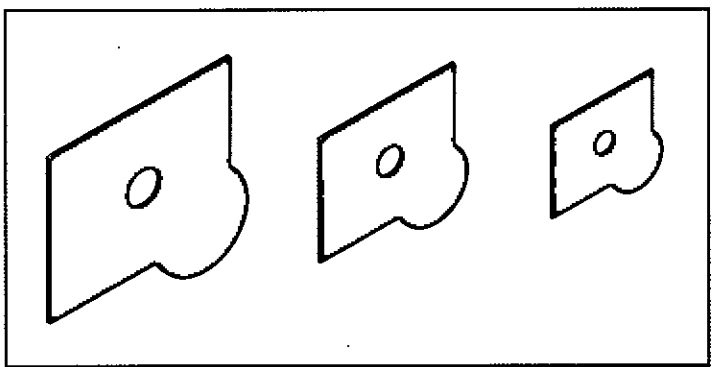


Figure 4

Full-size model, half scale model and quarter scale model

Measurement set up

The measurement setup is shown in Figure 6. The noise source was situated in free field conditions outside the test room. The receiving microphone was positioned inside the room, which was made acoustically as 'dead' as possible with soft finishes.

Tests were conducted to conform as closely as possible to BS EN ISO 140-5:1998[5]. This standard advises placing the loudspeaker with an angle of sound incidence of 45° to the facade (±5°), however in order to drive as many resonances as possible within the screened

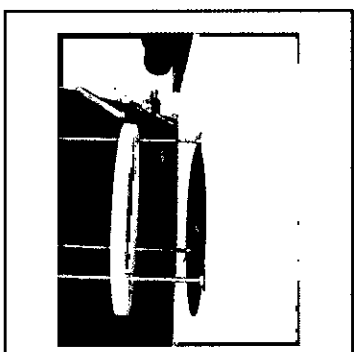


Figure 5

Window with a baffle

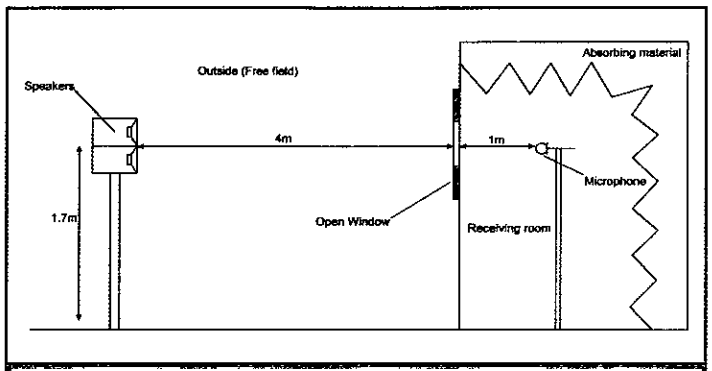


Figure 6

Measurement setup

window, normal incidence sound waves are desirable. The loudspeakers were therefore placed on-axis with the test specimen.

Results relating to the feasibility of using scale models

Figures 7, 8 and 9 present the sound pressure levels for the three facades at full size, half and quarter scales. Figure 7 presents the FFT results without scaling of any sort. As can be seen, there is no obvious correlation between the results for the three facades.

Figures 8 and 9 present the same data as Figure 7, but with frequency and magnitude of the half-scale and quarter-scale results shifted in accordance with Equations [1] and [2]. Figures 8 and 9 now show strong agreements between the frequency responses and magnitude of all three cases. It can be seen that the peaks and troughs in the frequency response of the system are similar in frequency and in amplitude.

The information in Figures 8 and 9 reveals one of the limitations of this type of analysis: the data for the quarter-scale model with an aperture diameter of 50mm is limited to 5kHz. The fact that the measured data points need to be shifted in frequency means that the scaling of facades to less than quarter scale may not be feasible using conventional measurement equipment, assuming that it is desirable to know the frequency response of the facade above 4kHz.

Insertion losses

ISO 7235:2003[6] defines insertion loss as follows:

$D_i = LW_i - Lw_{ii}$ [3]

where

LW_i is the level of the sound power in the frequency band considered, propagating along the test duct or radiating into the connected reverberation room when the test object is installed, and

continued on page 34

The application of scale models - *continued from page 33*

LW_{ii} is the level of the sound power in the frequency band considered, propagating along the test duct or radiating into the connected reverberation room when the substitution duct replaces the test object.

MACH Acoustics has used the above equation to interpret the acoustical performance of a baffle as an insertion loss. The data presented in Figure 10 is therefore the effect of adding a screen to a simple open vent within a facade. In effect, these data present the insertion loss added by a baffle in front of the open vent. Figure 10 shows all three models scaled in frequency and magnitude as in Figure 9.

This again confirms that scale models can be used to assess the acoustical performance of vented and screened facades.

Detailed assessment

Figure 10 shows that the effects of adding a screen to an open vent can improve the acoustical performance of the vent, but can also have a detrimental effect at given frequencies. This past of the article therefore looks at a detailed assessment which investigated the factors affecting the frequency response of a baffle placed over an open window.

Figure 12(a) shows the two main vented facades modelled, one with a 100mm diameter vent and the other with rectangular vent of the same open area. Figure 12(b) shows that the measured sound pressure levels at the receiver position were almost identical for the two models.

Figure 13 presents the insertion loss for a screen with a diameter of 300mm, placed 20 metres from the facade. This screen was then moved towards the façade in increments of 40mm. It can be seen that as the screen becomes closer to the facade, the detrimental effect of the screen between 500Hz and 1.25kHz becomes amplified, starting at a 5dB detriment and increasing to 10dB. These data also show that as the distance between the screen and the facade is reduced, the dip in frequency response increased in frequency. At higher frequencies above 1.5kHz, the effects of varying the distance are not noticeable until the screen is extremely close at 20mm, but for the most part there is no additional attenuation of high frequencies achieved by moving the screen closer to the facade.

Figures 14(a) and 14(b) show the effects of adding acoustical absorption to either side of the screen. It can be seen that when the absorption is on the rear of the screen, *ie* between the screen and facade, the resonance is reduced at 3kHz. This resonance was most likely due to reflections between the screen and the facade, the absorption suppresses this behaviour.

Circular holes and screens were originally used to increase the resonant effects in the frequency response of the test specimen. This was done so as to assess the feasibility of using scale models to predict the performance of vented facades. In reality, vents and screens are more likely to be rectangular in shape than circular. A comparison of the circular and rectangular holes was therefore made, as shown in Figures 15(a) and 15(b). For comparative purposes, the areas of the screen and vents and the amount of overhang were all kept constant.

The most noticeable difference between the circular and rectangular arrangements is above a frequency of 6.5kHz. Here the rectangular screen showed improved performance levels over those of the circular screen: the rectangular screen provided significantly higher levels of attenuation. The other notable feature is that the resonances of the rectangular shaped facade are less severe and spread across more frequency bands. This is assumed to be due to the fact that there is a fixed distance between the edge of the vent and the edge of the screen when using a circular screen. This fixed distance is likely to drive a resonance or standing wave effect. Since the distance between the edge of the vent and the edge of the screen in the rectangular model is more varied, the magnitude of the response is reduced and is spread across a broader frequency range.

With a view to reducing reflections between the facade and screen, the effect of angling the screen was studied (with the large screen being used in these models). Tests were carried out at 10° intervals between 0 and 30°. The results in Figure 16(a) and 16(b) are for those where the base of the screen was fixed. The main effect of changing the angle of the screen occurs between 500Hz and 1.25kHz, where there is an improved level of sound reduction. The resonance within this frequency band is suppressed by angling the screen, with the best performance being obtained at 30°. However with a 30° angle the improvement at these frequencies is offset by the loss in performance at the

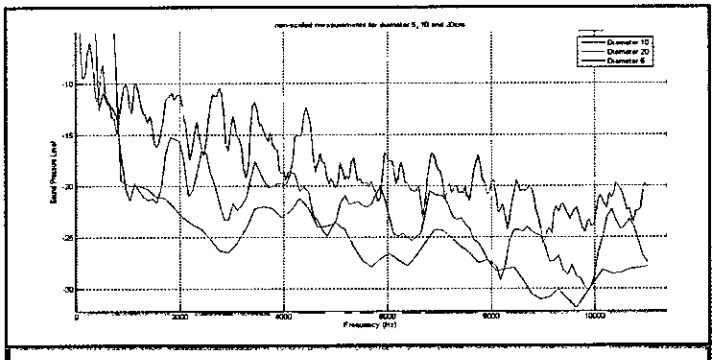


Figure 7

Non-scaled frequency responses of receiving noise levels

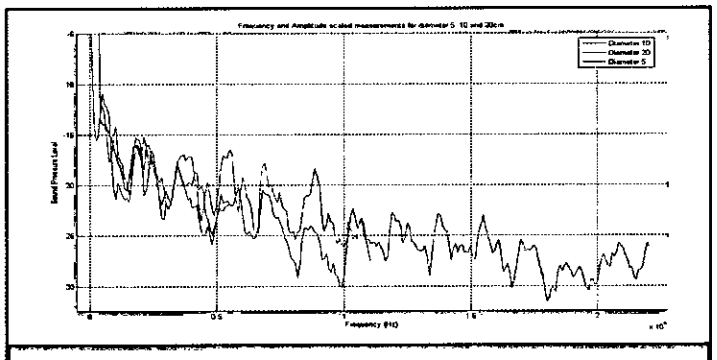


Figure 8

Frequency response within the receiver room, amplitude and frequency shifted

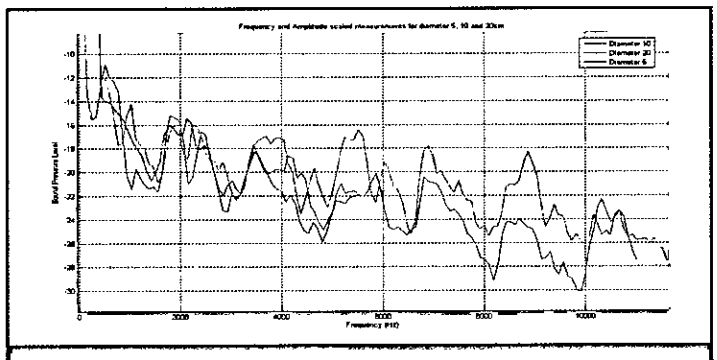


Figure 9

Zoom on Figure 8 to show audible frequency range

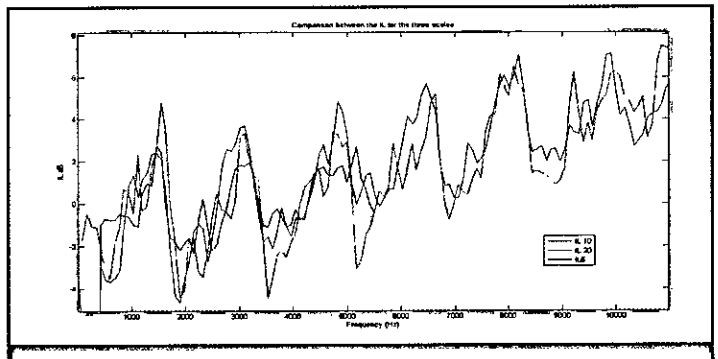


Figure 10

Comparison of the insertion losses for the models at three different scales

frequencies just above, from 1.25kHz to 3.15kHz. The best compromise therefore seems to be 20°.

Again, absorption was added to the rear of the screen and then the angles tests were repeated. As might be expected, similar results were found as when testing the variation of distance: the resonance between 500Hz and 1kHz was limited to 5dB, and the performance above 2kHz was increased by an average of 5dB. In these tests, there was a strong correlation between the increase in angle and the decrease in the resonant behaviour at the mid-range frequencies. With absorption present, the difference between the barrier angles is less pronounced, and the best angle to use would be 30°. Although it offers less performance between 1.2 kHz and 2kHz, this angle has the least resonance and so is a good compromise. Figures 17(a) and 17(b) provide the results of this assessment.

Scaling results

The final point to be considered is that the models described above use air vents and screens which are fairly small compared with those used within buildings. It is therefore likely that the results will be shifted by a factor of between 2 and 10, depending upon the size of the final vents. In order to provide clear results, the data were shifted by a factor of 2 in terms of frequency only in Figure 11. This provides an indication of the possible results of using screens incorporated directly into the facade of a building.

Conclusion

In conclusion, is can be seen that scale models of facades provide a practical and cost effective method of assessing the acoustical performance of screens incorporated directly into the facade of a development. The results of early modelling show that screened facades not only have a benefit in terms of acoustic attenuation, but can also have a negative effect on the acoustical performance of a vented facade.

Through a series of detailed testing, MACH Acoustics has studied the factors controlling resonance and other aspects influencing the acoustical performance of barriers to vented facades. The authors are therefore confident that this form of acoustical study could be used to improve the acoustical performance of vented facades.

Ze Nunes, Alex Daymond-King and **Jeremie Dufaud**
are with MACH Acoustics
e-mail: **ze@machacoustics.com**

References

[1] Irvine, G. Sound insulation of open windows: Novel measures to achieve ventilation and sound insulation. *Proceedings of IOA*, 1993, 15(Part8): pp 249–64.

[2] Napier University, School of the Built Environment – NANR116.; 'Open/closed window research' Sound insulation through vented domestic windows, 2007.

[3] BS EN 20140-10: 1991; Acoustics - Measurement of sound insulation in buildings and of building elements - Part 10: Laboratory measurement of airborne sound insulation of small building elements.

[4] Simons, M W. The measurement of airborne sound insulation using acoustic scale models. *Architectural Science Review*, 1982

[5] BS EN ISO 140-5:1998; Acoustics – Measurement of sound insulation in buildings and of building elements, Part 5: Field measurements of airborne sound insulation of façade elements and facades.

[6] BS EN ISO 7235:2003; Acoustics - Laboratory measurement procedures for ducted silencers and air-terminal units - Insertion loss, flow noise and total pressure loss.

continued on page 36

The application of scale models - *continued from page 35*

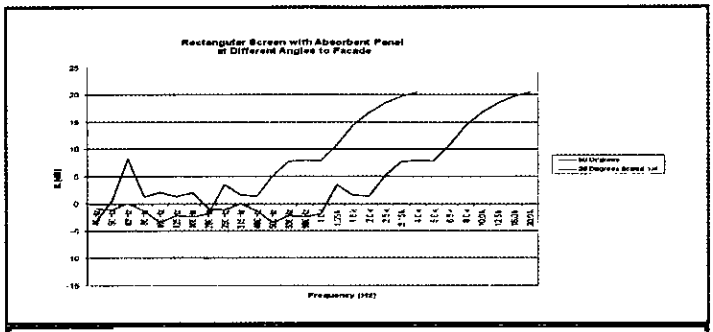


Figure 11

Results of scale modelling, the data above represents the shifted results for a square hole and baffle. The inside face of the baffle is lined with acoustical absorption, and the baffle is also placed at a 30° angle.

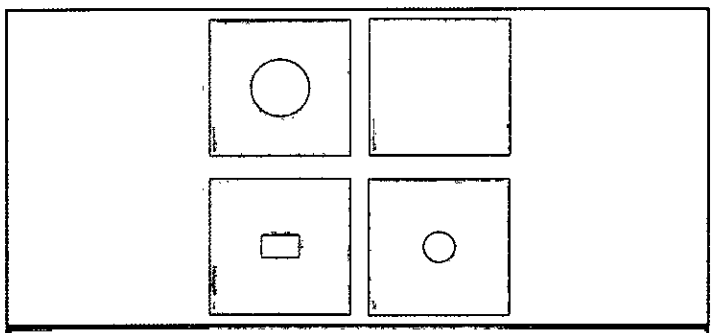


Figure 12(a)

Different facade styles

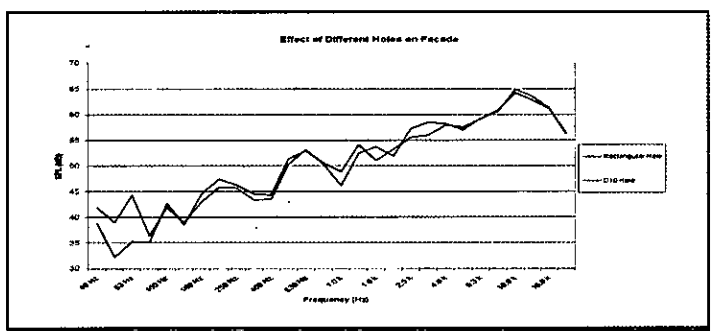


Figure 12(b)

Sound pressure levels within receiver room for the two facade types modelled

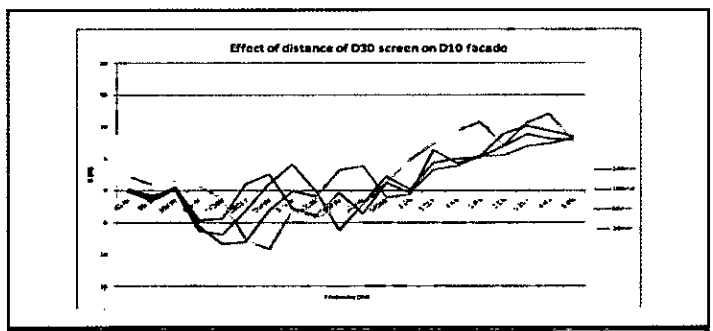


Figure 13

Variation of distance between screen and facade as an insertion loss

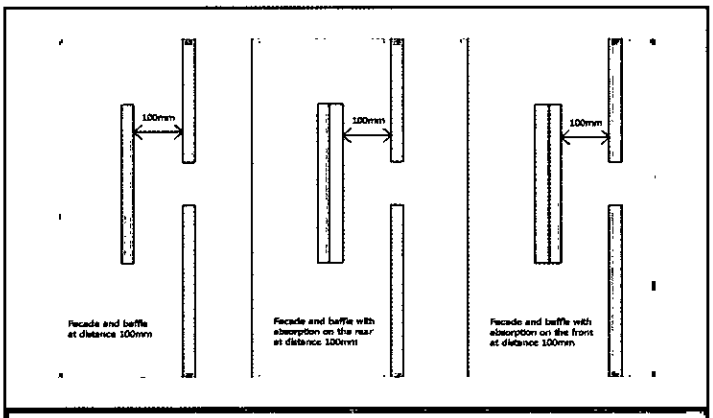


Figure 14(a)

Acoustical absorption incorporated into the baffles

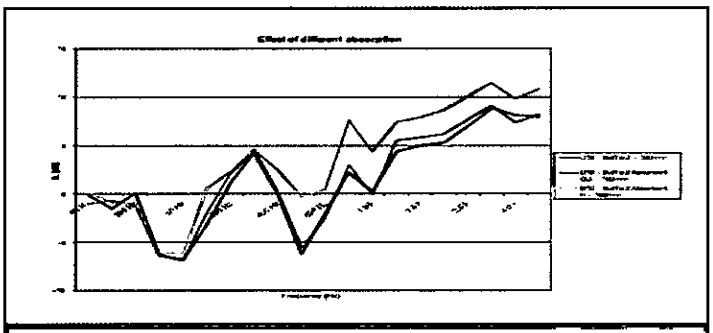


Figure 14(b)

Effects of acoustical absorption incorporated into the baffles

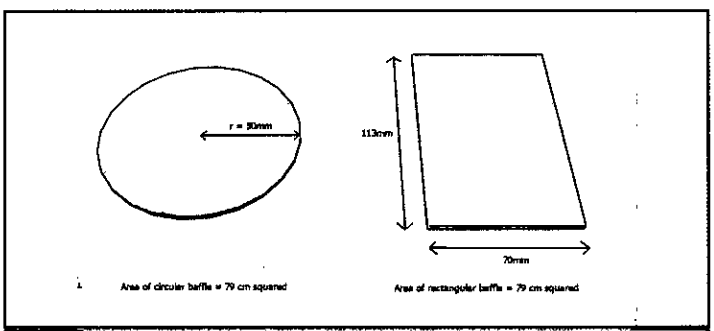


Figure 15(a)

Comparison between circular and rectangular baffles

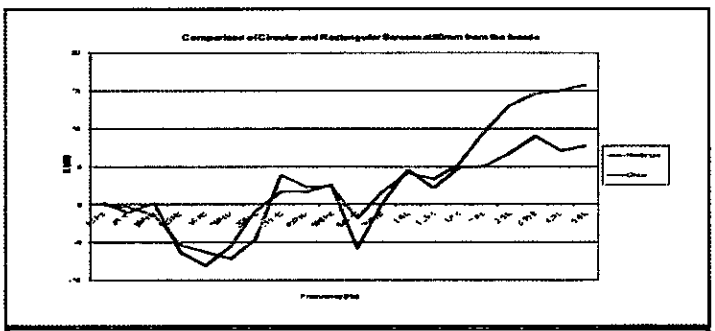


Figure 15(b)

Results showing the difference in performance between circular and rectangular baffles

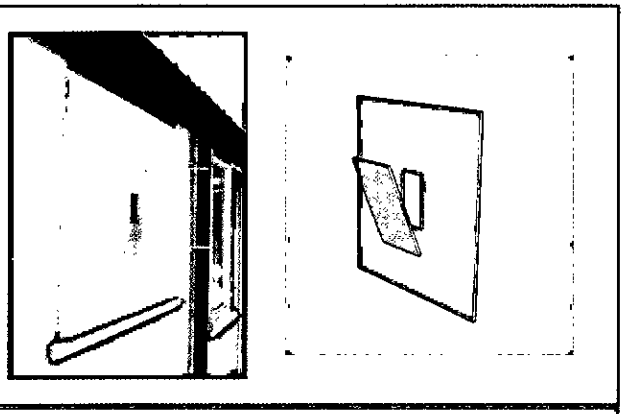


Figure 16(a)

The effect of angling the baffle

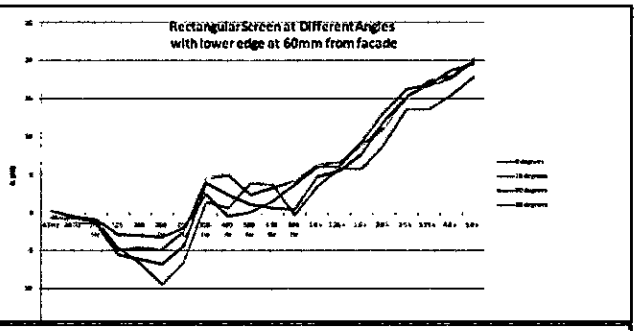


Figure 16(b)

The results of angling the baffle

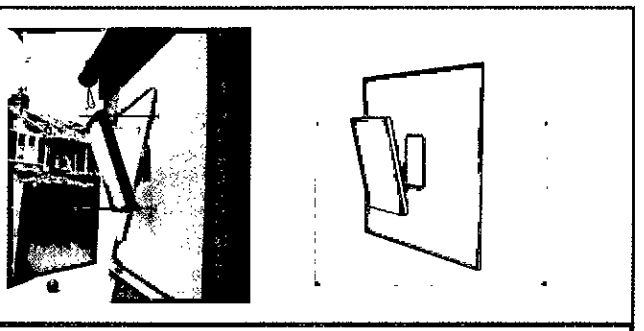


Figure 17(a)

The effect of adding acoustical absorption to the inside face of an angled baffle

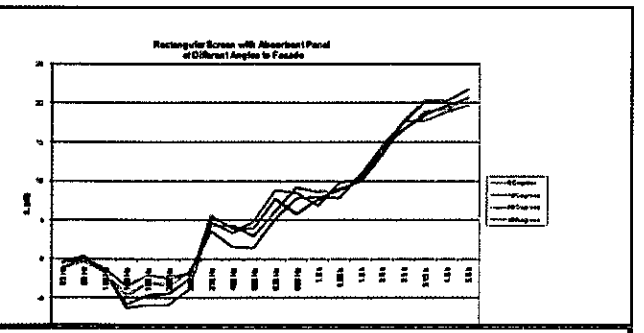


Figure 17(b)

Result of placing acoustical absorption on the inside face of an angled baffle

Tinnitus Awareness Week 2011

Plans announced by BTA

The British Tinnitus Association (BTA), the only charity solely dedicated to supporting those with tinnitus, is gearing up for the forthcoming national Tinnitus Awareness Week. Tinnitus is a term that describes the sensation of hearing a noise in the absence of an external sound and it is experienced by approximately 10% of the population in the UK. The week-long Tinnitus Awareness campaign – taking place from Friday 4 until Thursday 10 February 2011 - will aim to encourage better tinnitus awareness among the general public.

Currently there is a widely held misconception that tinnitus is confined to the elderly, but various studies show that it can occur at any age, including childhood. The cause of tinnitus is most commonly linked to frequent and/or prolonged exposure to loud noise, which can damage the auditory system and increase the risk of getting tinnitus or potentially make an existing condition worse.

Therefore during Tinnitus Awareness Week 2011 the BTA will build on the success of its 2010 campaign which addressed the impact of exposure to loud music and how this exposure can cause tinnitus and permanent hearing damage. The reach of its activities will be extended to encompass people of all ages, while focusing specifically on those who are exposed to loud music, whether via a personal music player or at home, or at public music concerts or nightclubs.

The BTA is pleased to confirm it will be working with the independent singing performance company 'Inspired Harmony' to raise awareness of tinnitus among the classical music community. Directors of Inspired Harmony are passionate about the cause and inform their students of the debilitating effects of tinnitus and of the need to protect both their voices and their hearing. Inspired Harmony, launching on 1 January 2011, has also pledged to provide free copies of its new CD and to donate 1% of its annual operating profits to the BTA.

While there is currently no cure for tinnitus, those who experience it can be assisted by the BTA in the form of free support and advice. The BTA helps thousands of people each year via its helpline and through the provision of information which includes updates on the latest clinical research into the causes and treatment of the condition.

About tinnitus

Not an illness or disease, tinnitus is a term that describes the sensation of hearing a noise in the absence of an external sound. The noise can have virtually any quality. Ringing, whistling, and buzzing are common, but more complex sounds may also be reported. Troublesome tinnitus can be very distressing for the affected individual, and issues may arise with sleep, concentration and mood. However, in many cases, subtle

Raising awareness of tinnitus among the classical music community

changes in people's environment can address these issues, and improve quality of life.

About the BTA

The BTA is an independent charity which supports thousands of people who experience tinnitus and advises medical professionals from across the world.

The British Tinnitus Association strives to be the primary source of support and information for people with tinnitus in the UK, thereby facilitating an improved quality of life. It aims to encourage prevention through its educational programme and to seek a cure for permanent head noise through a medical research programme.

The experienced team at the BTA understands the impact that tinnitus can have on the lives of those who experience tinnitus and those who live with them, so seeks to provides the most appropriate and expert advice and information free of charge - via a confidential freephone helpline on **0800 018 0527** and online at **www.tinnitus.org.uk**. The BTA can also post printed and audio information and advice.

The BTA has a Facebook page at **www.facebook.com/BritishTinnitusAssociation** and can be followed on Twitter at **www.twitter.com/BritishTinnitus**.

School in Selby cancels breaks outside

Noise nuisance alleged

Children at a school near Selby have had a playtime break cancelled, and games with hard balls have been suspended, after complaints from some neighbours about excessive noise were received by the local council. Barlby Community Primary School has erected a sound-resistant fence in an attempt to forestall a noise abatement order.

The school said the decisions were regrettable, but they were needed so that the North Yorkshire County Council would not go down the formal enforcement route.

Some parents are unhappy about the school's action, and it has also been strongly criticised by the Play England children's charity. This news comes just weeks after research was released showing that the average child has little over half an hour of time to play throughout the school day.

The measures were put in place after some neighbours contacted environmental health officers. The school's outdoor afternoon break has now been cancelled, and other breaks have been staggered so that there are fewer children are in the playground at any one time. Parents were also told in a letter that hard ball games were being cancelled.

The move has alarmed some parents. One said that the action was ridiculous, and questioned why there was a problem when the school had been there, in close proximity to houses, for some decades. The school had put up a fence which cost a great deal of money, which could have been spent elsewhere on the children's education.

Elaine Spooner, who lives near the school, said the noise did not bother her. All that could be heard was children playing at break time. They were children, they were at school, and they were playing.

Laky Sahota, of Play England, which promotes free play opportunities for children, said he was concerned that the decision was not focused on the best interest of the child. The school was not considering the importance of play, lack of which had an impact on their ability to plan and concentrate.

Stories like this indicate a growing intolerance towards children in the UK, according to Play England. Further research released by the organisation demonstrates an inclination for adults to judge children in negative terms. Whilst 70% of adults would describe children as 'friendly', a large proportion also describe them as 'disrespectful' (54%), 'intimidating' (40%) and 'out of control' (38%), Forty-eight per cent of adults also believe that children today do not have respect for their community.

Adrian Voce, Director of Play England voiced their concern that children were losing the freedom to simply be children. Not only was school break time the main chance children get to play with their friends, but research showed that making time for children to play during the school day improved concentration and behaviour. Play also contributed to children's informal learning and development. Break times for teachers are protected by legislation, but there was no requirement for children to have time to play at school.

Suzanne Douglas, who is one of the school's governors, said that it was a regrettable decision, and one they did not want to make. However, the board of governors had given the problem a great deal of consideration, and there was a possibility of an abatement notice being served on the school. To avoid this happening they were doing all they could to maintain the school as an operational primary school.

A spokeswoman for North Yorkshire County Council said it was aware of complaints made by some of the school's neighbours to the environmental health department at Selby District regarding "excessive noise". However, they were not satisfied that a statutory noise nuisance existed from what amounted to normal use of the school and playground areas. Nevertheless, they were taking the complaints seriously and wished to maintain good relationships with local residents. She added that an assessment of noise levels would be taking place over the next month.

A sound-resistant fence has been constructed at the school

Background noise affects the taste of foods

Research by Unilever and Manchester University psychologists

The level of background noise affects both the intensity of flavour and the perceived crunchiness of foods, researchers have found. Blindfolded diners assessed the sweetness, saltiness, and crunchiness, as well as the overall flavour, of foods as they were played white noise. Louder noise reduced the reported sweetness or saltiness, and increased the impression of crunchiness. The research is reported in the industry journal *Food Quality and Preference*.

It may go some way to explaining why airline food is notoriously bland, a phenomenon that drives airline catering companies to season their foods heavily. Andy Woods, a researcher from the Unilever laboratories and the University of Manchester, says that there is a general opinion that airline foods are less than fantastic. Airlines do their best, but the researchers wondered if there were other reasons why the food would not be so good. One thought was that perhaps the background noise had some impact. NASA gave their space explorers very strong-tasting foods, because for some reason they could not food very strongly. Again, perhaps the background noise was affecting their perception. There was no previous research on this, so the team started to investigate whether the hunch was correct.

In a comparatively small study, 48 participants were fed sweet foods such as biscuits, or salty ones such as crisps, while listening to silence or noise through headphones. They then rated the intensity of the flavours, and rated their liking of the foods presented. In noisier settings, foods were rated less salty or sweet than they were in the absence of background noise, but were rated to be more crunchy. The evidence points to the effect being down to where the person's attention was focused. If the background noise was loud it might draw your attention, and thus away from the food.

Also in the group's findings there is the suggestion that the overall satisfaction with the food was correlated with the degree to which diners liked what they were hearing, and this is a finding the researchers are pursuing in further experiments.

In the words of the experimenters (from the School of Psychological Sciences, University of Manchester, UK, and Unilever Research and Development, Vlaardingen, Netherlands), they investigated the effects of auditory background noise on the perception of gustatory food properties (sugar level, salt level), food crunchiness and food liking. Participants blindly consumed different foods whilst passively listening to either no sound, or quiet or loud background white noise. The foods were then rated in terms of sweetness, saltiness and liking (experiment 1) or in terms of overall flavour, crunchiness and liking (experiment 2). Reported sweetness and saltiness was significantly lower in the loud compared with the quiet sound conditions, but crunchiness was reported to be more intense. This suggests that food properties unrelated to sound (sweetness, saltiness) and those conveyed via auditory channels (crunchiness) are differentially affected by background noise. A relationship between ratings of the liking of background noise and ratings of the liking of the food was also found in experiment 2. It was concluded that background sound unrelated to food diminishes gustatory food properties (saltiness, sweetness) which is suggestive of a cross-modal contrasting or attentional effect, whilst enhancing food crunchiness.

Airline foods may be less than fantastic - perhaps it's the background noise?

CMS Acoustics

creates a quiet environment at Everthorpe Prison

CMS Acoustics, the UK's largest provider of acoustical solutions, has delivered its free reverberation calculation service for Everthorpe Prison, Hull. Everthorpe Prison consulted CMS Acoustics to help remedy high noise levels in its newly refurbished visitors' room, with SuperPhon acoustic panels retrospectively installed to significantly reduce reverberation times.

Accommodating up to 689 category C male prisoners, Everthorpe Prison had replaced all the soft furnishings in its visitors' room with hard reflective surfaces such as a vinyl floor covering and plastic tables and chairs. Whilst this created a more hygienic environment it also removed all natural means of sound absorption in the room, resulting in high levels of reverberation.

Using plans of the building, CMS Acoustics calculated the average mid-frequency reverberation time within the room as 1.8 seconds. Its technical sales team recommended the retrospective installation of 95m² of 50mm SuperPhon acoustic panels to the walls, ceilings and pillars. Delivering class A absorption, the increased absorption reduced the reverberation time considerably, to 0.74 seconds.

SuperPhon acoustic panels reduce noise by impeding sound transmission through an element of the structure, and by absorbing sound at the surface. The panels complement most design concepts with their high quality decorated finish. Covered with an aesthetic fabric, the panels are easy to clean and in this instance were also removable.

Anna Parish, operations principal officer at Everthorpe Prison, commented that the visitors' room was in use practically every day of the week and could become extremely noisy, especially when there were families with young children. She was extremely impressed with the level of technical advice and service received from CMS Acoustics. They recommended a product that not only exceeded the prison's requirements and expectations but was cost effective while achieving high performance.

The panels are manufactured from sound absorbing, non-combustible mineral board, covered with high quality open weave fabric. Providing an effective means of controlling reverberation time and reflected sound in rooms, they are ideal for application in studios, conference centres, cinemas and other areas where acoustical absorption combined with an aesthetically pleasing appearance is required.

Paul Absolon, technical director, CMS Acoustics, commented that the panels were a fully bespoke product that could be manufactured to order on a site-by-site basis, and were easy to install as a cost effective method of sound control. Furthermore, the company's free reverberation calculation service was ideal for end user customers such as Everthorpe Prison, as it allows the exact acoustical solution for the situation to be specified.

The CMS SuperPhon range also includes a total wall coverage system and suspended absorbers. For further details on the SuperPhon range and other products offered by CMS Acoustics, email **enquiries@cmsacoustics.co.uk**, phone **01925 577 711** or visit **www.cmsacoustics.co.uk**

CMS Acoustics aims to deliver a fast, reliable

and cost-competitive service to architects, acoustical consultants and building contractors. Sister company CMS Vibration Solutions operates purely in the anti-vibration and structural isolation marketplace, and provides access to high performing construction and industrial systems. Through an exclusive partnership with Regupol manufacturer, BSW, CMS offers the complete Regupol range as well as CMS-manufactured acoustical materials. The acoustical needs of all types of developments, from refurbishments, through new-build developments to bespoke architectural projects can be met by the product range.

CMS is headquartered in Warrington with a second office in Wickford. It has played a leading role in high profile acoustic projects such as the Grand Theatre, Leeds; News International, Broxbourne; the Nanoscience Laboratory; Cambridge University and the Young Vic Theatre, London.

Visitors' room at Everthorpe Prison

Wakefield Acoustics

Making a noise - celebrating 30 years in business

West Yorkshire noise control specialists Wakefield Acoustics Ltd used the occasion of its '30 years in business' anniversary celebration to recognise the huge contribution its staff has made to the success of the company by presenting a number of long service awards and announcing a series of new appointments.

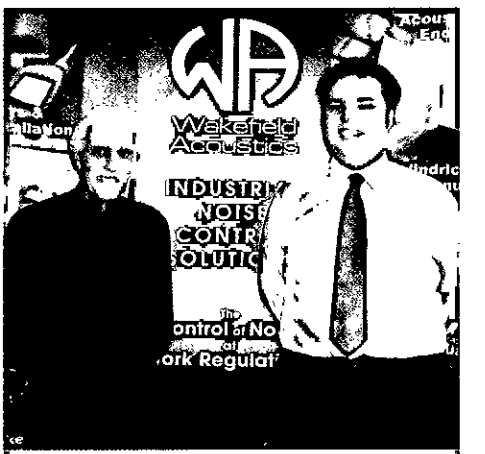
Wakefield Acoustics Ltd was established in 1980 and took its name from its original location, but has been based in Cleckheaton, near Bradford, since 2000. The company is a leader in the design, manufacture and supply of industrial and environmental noise control products to customers throughout the world. It designs, manufactures and supplies a wide range of noise control products, solutions and services for industrial and environmental applications. It is one of only a small number of UK companies which provides a complete noise control solution, from initial noise audit, assessment and diagnosis through to design, manufacture and installation, recommending the most appropriate products and implementation strategies.

The company's products and services include noise assessments and audits, silencers, acoustic enclosures, acoustic doors, louvres, cabins and sound havens, all of which are helping companies to comply with increasingly stringent health and safety requirements on exposure to noise in the workplace following the introduction of recent European noise legislation, as well as eliminating noise pollution from manufacturing sites.

The company, which was founded in 1980 by John Pickard, was acquired in 2005 by current managing director, Jane Dawson. Since Mrs Dawson took control, the company has invested heavily throughout the business including new manufacturing equipment, a new IT infrastructure and the latest 3D AutoCAD computer system. It has also continued to grow, recruiting and appointing new personnel to key roles, despite the current recession.

Staff, management and the company's original founder John Pickard joined together at Ripon Races to recognise the contribution staff has made throughout the company's history.

New appointments included Steve Watson, who has been with the Wakefield Acoustics for over 14 years and in the industrial noise control industry over 32 years. Mr Watson takes up the role of technical director, with responsibility for spearheading the company's technical innovation. Matthew Shard, a Huddersfield University graduate who worked with the company during his sandwich year, has now joined them as trainee project engineer, to assist with the company's sales growth.



Steve Watson (left) with Matthew Shard

Wakefield Acoustics prides itself on the experience of its staff and was delighted to present four employees, who between them have over 74 years combined experience, with long service awards in recognition of their loyalty to the company. The recipients were Ian Fisher (senior contracts engineer, 25 years); Ian Hargreaves (sheet metal worker, 20 years); Robert Furniss (contracts engineering manager, 20 years); and Steve Watson (technical director, 14 years).

For further information about Wakefield Acoustics please visit **www.wakefieldacoustics.co.uk** or telephone **01274 872277**

Big Sky at Cambridge

Noise monitoring over a four-day music event

Entertainment noise control specialists Big Sky Acoustics managed the noise monitoring for Cambridge Folk Festival 2010. Richard Vivian worked in collaboration with Steve Gosling of 24 Acoustics. Together they co-ordinated the noise monitoring team over the four-day event ensuring that the off-site noise levels complied with the strict limits stipulated in the licence.

One of the UK's longest established dates on the festival calendar, Cambridge Folk Festival brings 12,000 people to Cherry Hinton in the suburbs of the city. As an established event most local residents appreciate there will be some disruption, but the management of noise is always a priority for the festival organisers.

Working closely with the technical crew from PA specialists Canegreen, the Big Sky team correlated off-site noise levels directly with the sound system levels from each stage subtly regulating overall levels and individual frequencies.

The idea of just relying on automatic limiting equipment really would be a last resort both in terms of a realistic control method and the detrimental impact such a system would have on sound quality, according to Vivian. Instead, an initial A-weighted level was agreed at each front of house position and then spectral 'tweaks' occurred through the day. When something needed to be adjusted, a slip of paper was filled in with the third octave levels and overall levels clearly marked on it. If 3dB less is needed at 80Hz, the team just writes in '-3dB' in the 80Hz box on the ticket, and drops it off with the front of house sound man. In this way there is very specific control but it is the sound man that implements the final control.

Those operating the sound systems like the ticket system although the slips of paper do get nicknamed 'speeding tickets'. It was developed by Big Sky to improve communication without distracting the operator during a live set. Unlike radioing levels through it means everything is documented and less likely to be misunderstood or forgotten.

There were no logged complaints from the public about music noise at this year's festival, probably the first time this has been the case. Vivian commented that this did not mean that local residents could not hear the event during the day: it was, after all, a festival in a park in a residential part of the city. What they did notice was that peaks in sound level, often caused by changing climatic conditions, were rapidly corrected and across the four days the noise levels did not drift upwards.

Steve Gosling (L) and Richard Vivian at Cambridge Folk Festival 2010

Big Sky Acoustics is developing a bespoke wireless-based noise monitoring system to improve data correlation at large sites, but insists that skilled people remain vital in assessing and controlling noise at outdoor events.

For more information contact Richard Vivian at Big Sky Acoustics, Diss, Norfolk on **08453 918221** or **020 7617 7069**, email **richard@bigskyacoustics.co.uk**, web site **www.bigskyacoustics.co.uk**

Sonata Acoustics

Bishop Wilton Hall

The new Sonata range of acoustic absorbers is starting to cause quite a stir in the field of room acoustics. Its patented fixing design ensures ease of installation every time, and the unique acoustic foam ensures the very highest performance. Non shedding materials, design driven aesthetics and a wide range of finishes have helped secure Sonata installations in schools, offices and various types of church and community halls, to name but a few, the latest of which being Bishop Wilton Hall.

Bishop Wilton Hall is the recent newcomer to the North Yorkshire village bearing its name. Situated in a rural Wolds setting 15 miles east of York, it provides a modern community facility with adjoining sports pavilion and grounds.

Sonata Acoustics was asked to provide advice on the problem of excessive reverberation within the main hall as the reverberation was seriously marring use of the hall. Not only was this creating an unpleasant environment, but day-to-day income, essential to maintaining the facility, was affected.

Sonata Acoustics sent a technical representative to site to discuss the issues and provide a proposal for treatment which offered the committee a range of choices to

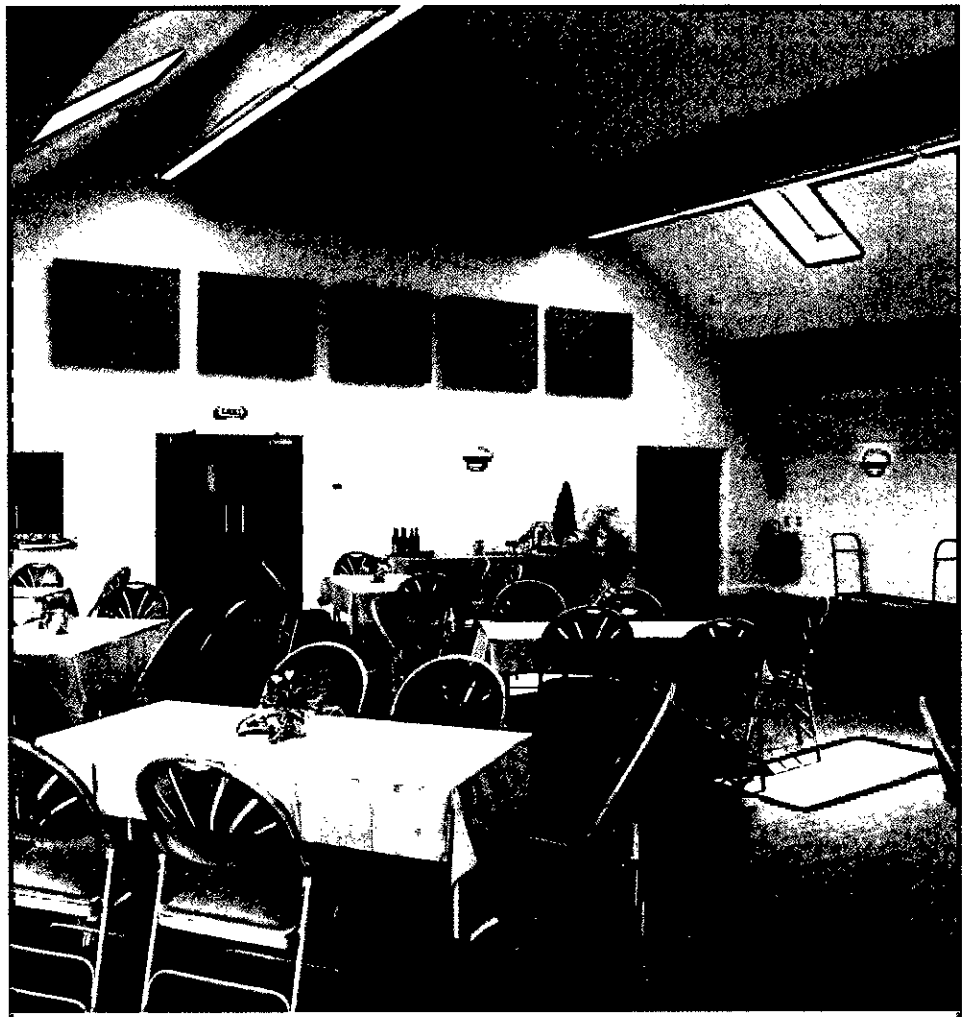
Bishop Wilton Hall, a new eco-friendly multi-purpose facility

meet the necessary reverberation reductions, achieve a visually sympathetic solution along with a number of budgetary options. Using its own experienced installation team, Sonata Vario panel absorbers, on Vario mounting brackets, were equally placed to the two walls either end of the hall, and Sonata Aurio absorbers were fitted directly to the two sloping ceilings. Sympathetic to the hall decoration, the Vario panels were chosen in a colour to match the doors; the Aurio absorbers were in white, to blend perfectly with the background. The hall was suitably transformed and the results were plain to see and hear.

Steve Swire, Chairman of the Hall committee said that the fitting team was *very accommodating, the job looked stylish and most importantly the echo and reverberation had to all intents and purposes been killed. He thanked the team for a job well done.*

For further information on Sonata Acoustics' patented range of acoustic absorbers, please feel free to call the technical team on **01977 799252**, email **info@sonataacoustics.co.uk** or visit the website **www.sonataacoustics.co.uk** .

For further information on Bishop Wilton Hall, including hire rates, visit **http://www.bishopwiltonhall.co.uk/**



An internal view of the hall showing acoustical absorption to wall and sloping ceiling surfaces

Arup Acoustics

Bursary announced

Are you passionate about sound? Would you like the opportunity to research and present a paper relate to the theme of room acoustics at an international acoustics conference of your choice in 2011?

In recognition of the importance of further study on the area of acoustics, Arup is pleased to announce the launch of the Arup Acoustics Bursary.

To be eligible for the Arup Acoustics Bursary, applicants are invited to submit a proposal for a research paper on a topic related to room acoustics. This proposal should be a short extract of the longer research piece you intend to write if you win the award.

The winner of the 2010-2011 Arup Acoustics Bursary will receive funding to attend an international acoustics conference of their choice, and present their research paper.

The Arup Acoustics Bursary is an international competition open to:

- students
- graduates
- postgraduates
- professionals requiring research assistance
- individuals not yet in full-time employment.

The Bursary will fund the costs associated with attending the conference including entry, travel, food and accommodation, up to AU$5000.

Applications close at midnight on Sunday 21 November 2010 (AEST). For more information and to apply, visit **www.arup.com.au/acoustics**. The winner will be announced via the web site on Sunday 9 January 2011.

A new standard in 3D ears

A new standard in 3D ear

Scientists at the UK's National Physical Laboratory (NPL) have developed a means of representing a 3D model ear, to help redefine the standard for a pinna simulator (the pinna is the outer part of the ear) – used to measure sound in the way we perceive it.

The nature of human hearing is heavily dependent on the shape of the head and torso, and their interaction with sound reaching the ears allows for the perception of location within a 3D sound field. Head and torso simulators (HATS) are designed to model this behaviour, enabling measurements and recordings to be made taking account of the head related transfer function (HRTF), the difference between a sound in free air and the sound as it arrives at the eardrum.

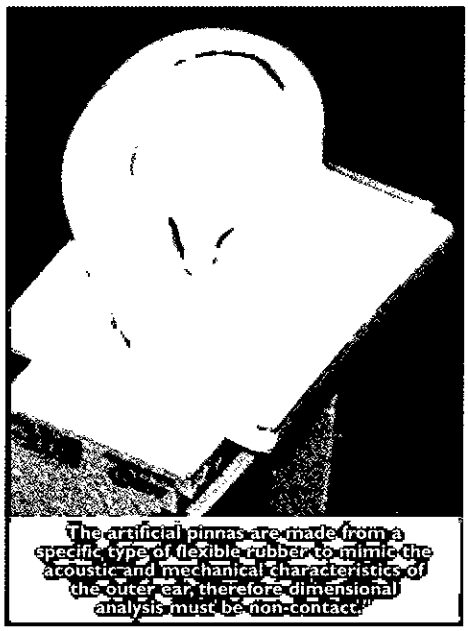
HATS are mannequins with built-in calibrated ear simulators (and sometimes mouth simulators), that provide realistic reproduction of the acoustic properties of an average adult human head and torso. They are ideal for performing in-situ electro-acoustic tests on, telephone handsets (including mobile and cordless), headsets, audio conference devices, microphones, headphones, hearing aids and hearing protectors.

Critically the shape of the pinna has a large effect on the behaviour, and as a result it is defined for HATS by its own standard (IEC TR 60959:1990) to provide consistency across measurements. However, this standard defines the shape of the pinna through a series of 2D cross-sectional profiles. This form of specification and definition has on occasion proved to be an inadequate guide for manufacturing processes.

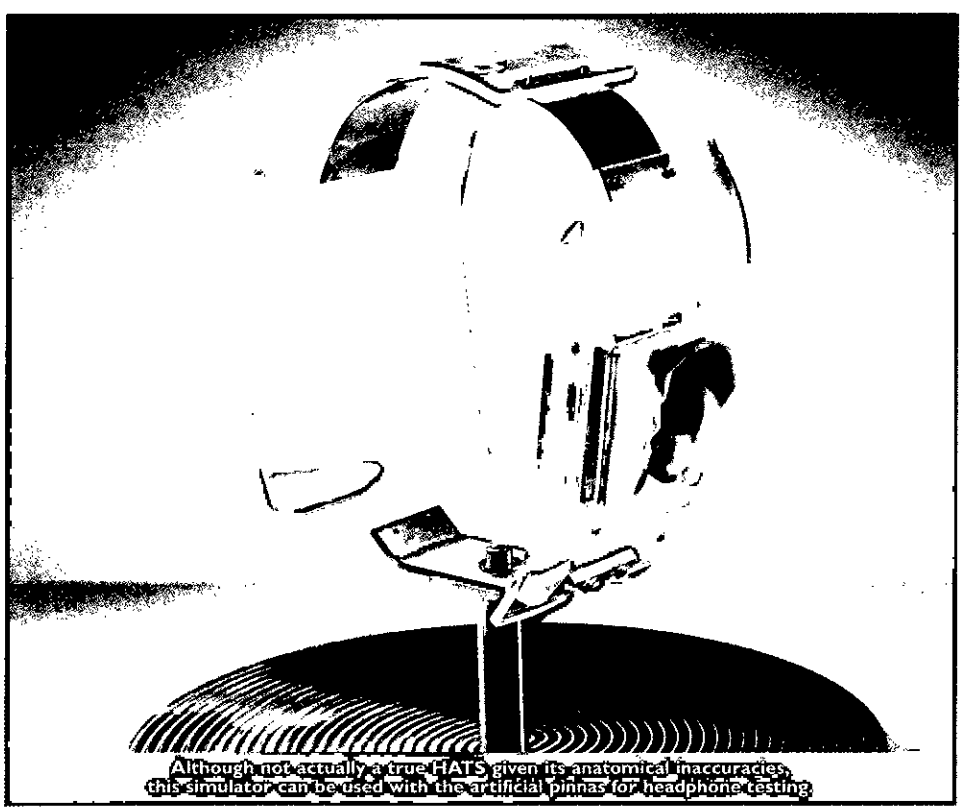
As part of a revision of this standard, the acoustics team at NPL teamed up with the National Freeform Centre in a novel move to redefine the standard through an on-line 3D CAD specification. A model ear was measured using a coordinate-measuring machine with laser scanner to produce a 3D scan of the ear, which can then be used to provide manufacturers with a more practical specification for reproduction and a standard that is easily comparable with similar non-contact freeform measurement techniques.

Ian Butterworth from NPL, said that having a 2D pinna in an artificial ear had some inherent frequency limitations. For example, when sound spreads through structures like narrow tubes, annular slits or over sharp corners, noticeable thermal and viscous effects take place causing further departure from the lumped parameter model. The new standard for the 3D model has been developed to give proper consideration to these effects. The National Freeform Centre is expert in measuring items that are unconventional in shape or design, and their contribution helped NPL to develop the new standard, which would now help manufacturers to develop better products.

The National Physical Laboratory (NPL) in Teddington is one of the UK's leading science facilities and research centres. It is a world-leading centre of excellence in developing and applying the most accurate standards, science and technology available. It occupies a unique position as the UK's National Measurement Institute and sits at the intersection between scientific discovery and real world application. Its expertise and original research have underpinned quality of life, innovation and competitiveness for UK citizens and business for more than a century. NPL provides companies with access to world leading support and technical expertise, inspiring the absolute confidence required to realise competitive advantage from new materials, techniques and technologies. NPL expertise and services are crucial in a wide range of social applications, helping to save lives, protect the environment and enable citizens to feel safe and secure. Support in areas such as the development of advanced medical treatments and environmental monitoring helps secure a better quality of life for all. NPL develops and maintains the nation's primary measurement standards, supporting an infrastructure of traceable measurement throughout the UK and the world, to ensure accuracy and consistency.



The artificial pinnas are made from a specific type of flexible rubber to mimic the acoustic and mechanical characteristics of the outer ear, therefore dimensional analysis must be non-contact.



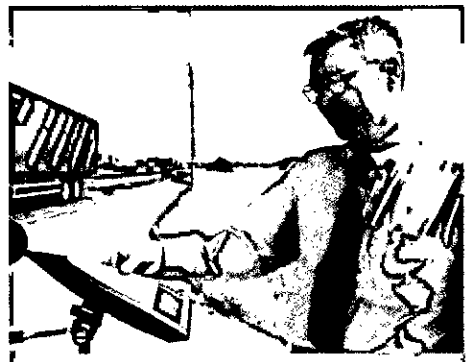
Although not actually a true HATS given its anatomical inaccuracies, this simulator can be used with the artificial pinnas for headphone testing.

The National Freeform Centre at NPL supports UK end-users, manufacturers and academics in freeform measurement by providing evaluation and traceability for CMMs with tactile and non-contact probes, laser scanners, articulated arms, fringe projection systems, and point cloud processing software. Examples of the gains potentially achievable with suitable advances in freeform manufacture include efficiency of aero engines, drag reduction for automotive bodies and increased life span of prosthetics.

The efficiency of aero engines, drag reduction for automotive bodies and increased life span of prosthetics are just some examples of the gains potentially achievable with suitable advances in freeform manufacture. However, such advances are partly limited by poor metrology infrastructure, lack of measurement traceability and absence of specialised facilities and knowledge base.

Obituary

John Nicol



John Nicol MSc MIOA, 1954 – 2010

John Nicol began his route to the world of acoustics in 1973, working as an Apprentice Sanitary Inspector with Motherwell and Wishaw Burgh Council. In 1977, having completed his professional examinations at Glasgow College of Food Technology, he was employed as an Environmental Health Officer with Motherwell District Council. After a spell with West Lothian District Council in the early 1980s, John moved to Hamilton District Council and it was here that he really became interested in acoustics. With Hamilton Council's approval, 'Nick', as many of us knew him, had already began work as an acoustical consultant in his spare time.

In 1987 John graduated from Heriot-Watt University with an MSc in acoustics, vibration and noise control. It is no surprise that his thesis was entitled '*The use of a musical instrument in the measurement of room acoustical properties*'. He left Hamilton Council in 1989 and joined SRL, where he set up their Scottish office in East Kilbride. John later worked with Edinburgh based RPS Environmental Consultants, primarily dealing with environmental noise in Scotland and Ireland. Working from home in Wishaw, he realised that he was almost completely self supporting and in 1995 decided to take the plunge and started his own company, Nicol Acoustic Consultants, NAC.

Over the years, John expanded his expertise into most aspects of acoustics, establishing NAC as one of the leading consultancies in Scotland. Whether conducting environmental assessments, acting as an expert witness, or just carrying out overnight noise measurements from the warmth of his big 4 by 4, he was always active. He worked throughout the UK and Ireland and thoroughly enjoyed the challenges. Despite all this activity, John still made time to serve on the Scottish branch committee of the IOA.

As implied earlier, outside running NAC, John's great passion was music. He was a classically trained flautist and played with the Scottish Youth Orchestra in his schooldays. Scottish branch members will remember his recital of the Intermezzo from Mascagni's Cavalleria Rusticana at our AGM in Glasgow a few years ago. Whilst this was primarily to demonstrate the acoustics of Kelvinside Hillhead Parish Church, it was also a stunning performance. On the music scene, John was a well known contributor to Scottish and Irish folk music and he was a gifted player of many instruments. At meetings and conferences John's guitar was never far away and he would often entertain us in the evenings. At his funeral, most of the music was multi-track recordings of John singing and accompanying himself on an array of instruments. It was a very moving celebration of happier times.

I sought help from many people for this tribute. Whilst some had useful historic information the main response was, what a genuine, good friend John was. He was always willing to help others and even in his professional life, he was often a campaigner for the ordinary person.

Tragically and unexpectedly, John left us on 28 June 2010. He will be greatly missed.

This appreciation was compiled by Bill McTaggart, with huge thanks to the many contributors - Nick would have been very proud.

Product news

from Brüel & Kjær

Hand-held sound intensity system

Machinery manufacturers required by law to provide precise specifications of products noise levels can reduce the time and effort involved, by using Brüel & Kjær's new hand held sound intensity system type 2270-G.

A combination of strict legislation and customers demanding noise-friendly surroundings has increased pressure for manufacturers producing products - such as washing machines, refrigerators, lawn mowers and electric motor devices - to label the noise output in accordance to national and international standards.

Many machines also contain parts from sub-suppliers, which means in order for manufactures to predict noise output, they must label individual parts to ensure the final product is in accordance with national and international standards.

To simplify this process, Brüel & Kjær has created its 2270-G, a complete sound intensity system consisting of the hand-held sound level analyser (2270), sound intensity software (BZ-7233) and sound intensity probe kit. This portable battery operated system allows one person to make sound intensity measurements complying with the IEC 61043 sound intensity standard.

Users simply swap the 2270 meter's microphone for the sound intensity probe to start measuring. The BZ-7233 software transforms the analyser into a powerful measurement tool, using the intensity technique to determine sound power levels and locate noise sources using contour maps. A unique phase calibration technique allows users to make all measurements with a 12mm spacer covering a frequency range from 50Hz to 10kHz. The sound intensity system is part of Brüel & Kjær's 2270 range, which offers many sound and vibration analysis applications.

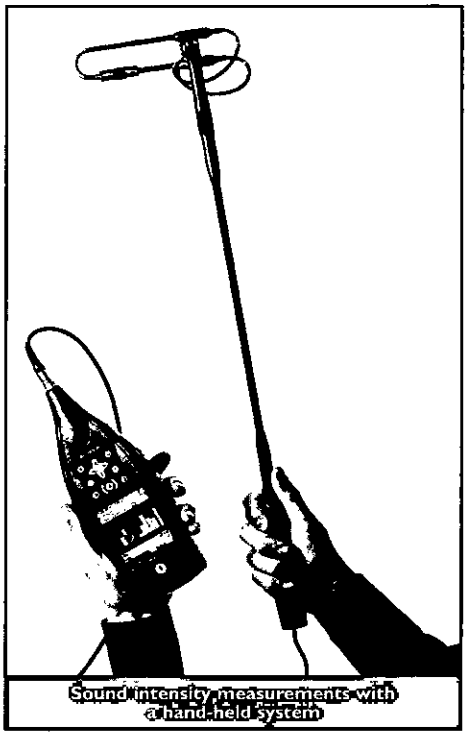
Increased shaker system capacity

Brüel & Kjær has launched a quality range of LDS head expanders to increase the capability for customers' existing shaker systems. Head expanders allow users to increase the effective mounting surface, which in turn provides more room for assessing bigger loads. It also offers them the opportunity to test several items at once, thereby reducing the time and cost spent.

The robust head expanders are cast in magnesium alloy - an extremely high strength material with excellent damping properties - used mainly within aerospace, automotive, military and electronics industries. The optimised finite element analysis (FEA) design ensures the head expanders are usable over a very large frequency range. Coupled with the shaker system, the expanders boost the versatility for vibration testing for many different applications, such as helicopter gearboxes, aircraft engines and performance car components. Each head expander is supplied with specific lifting capabilities to ensure the user's safety, whilst allowing them to fit expanders quickly.

LDS ha been part of Brüel & Kjær since 2008, and is a world-leading design and manufacturer of vibration testing system, vibration controllers, and data acquisition systems.

For more information about LDS head expanders, please visit www.bksv.com/lds



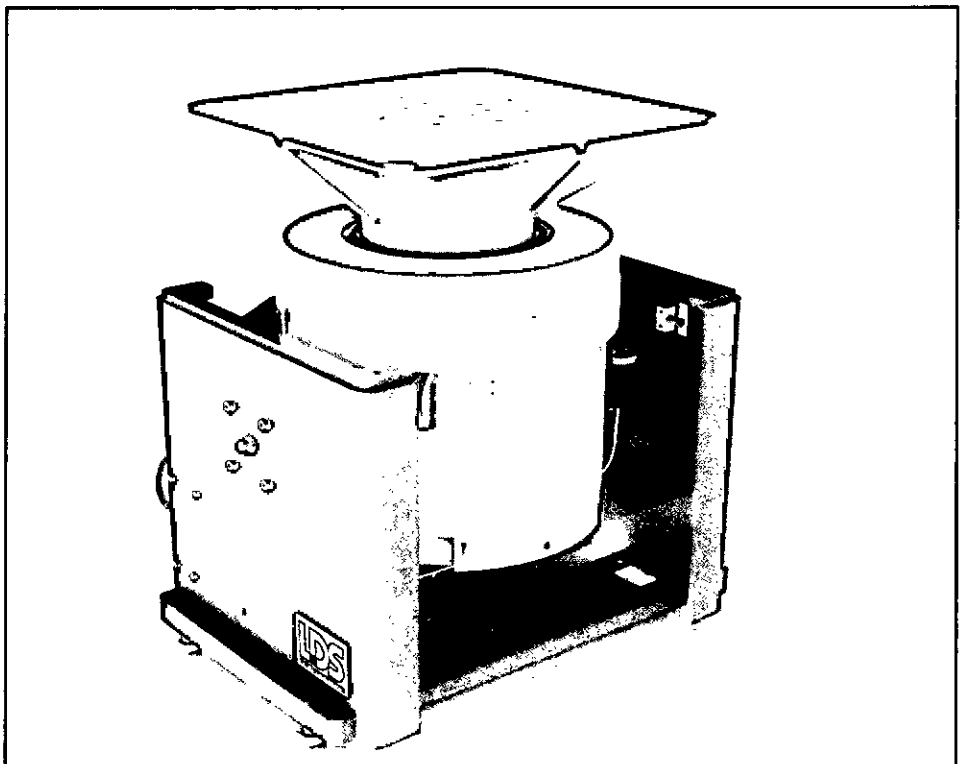
Sound intensity measurements with a hand-held system

The University of Windsor dedicates test laboratory to Brüel & Kjær

The University of Windsor's Center for Engineering Innovation is Canada's largest facility of its kind, covering all aspects of automotive engineering including equipment for noise, vibration, harshness (NVH), sound quality (SQ) and structural analysis.

Dr Colin Novak, Assistant Professor at the University says that Brüel & Kjær is their preferred supplier of sound and vibration applications. The relationship went back many years and was a good example of how the University worked closely with industrial partners. The relationship is continuously evolving and deepening and as a public acknowledgement of mutual success, the Faculty of Engineering within the Department of Mechanical, Automotive and Materials Engineering has decided to dedicate one of its test laboratories to Brüel & Kjær.

Since Brüel & Kjær was founded, it has always been the company's policy to work closely with universities around the world. The relationship with the University of Windsor is



Shaker system with head expander

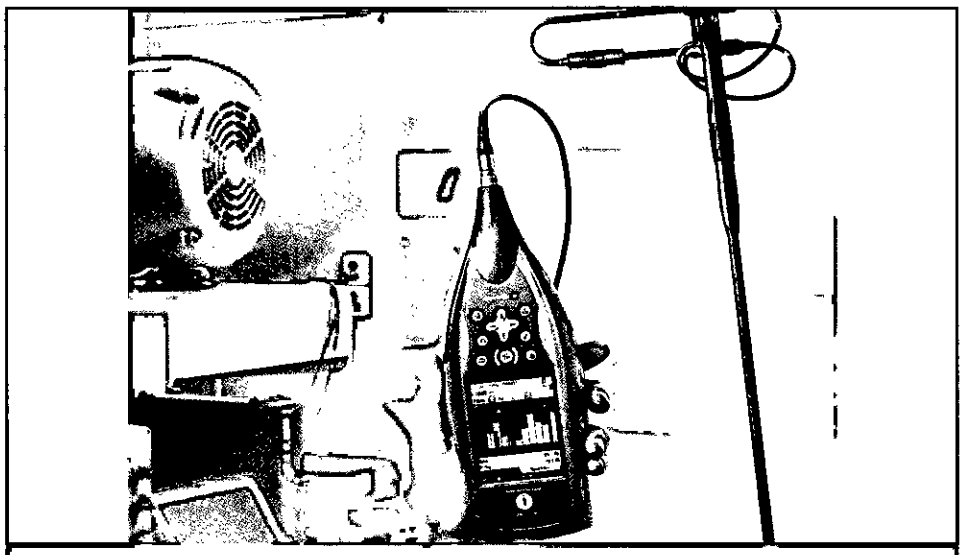
a great example of how both the university and Brüel & Kjær can benefit.

For more information about the University of Windsor, please visit: http://www.uwindsor.ca/about-the-university

Brüel & Kjær is a world-leading manufacturer and supplier of sound and vibration measurement systems. Brüel & Kjær helps its customers measure and manage the quality of sound and vibration in their products and in the environment. Focus areas are aerospace, space, defence, automotive, ground transportation, airport environment, urban environment, telecom, and audio.

Brüel & Kjær has an unparalleled portfolio of sound and vibration equipment, and is a renowned deliverer of innovative instrumentation, including sound level meters, microphones, accelerometers, conditioning amplifiers, calibrators, noise and vibration analysers and software. To see the full range of products and systems, visit www.bksv.com.

Brüel & Kjær also runs a variety of training courses, from basic introductions to noise and its effects to more specialised classes teaching customers how to get the most out of their equipment. Free, online training courses conducted by experts run throughout the year too. For all course registration details visit http://www.bksv.com/courses.



Measurement of sound intensity on an industrial site

For additional information please contact: Heather Wilkins, Marketing Coordinator, on **01763 255 780**, web: **www.bksv.com**, email: **heather.wilkins@bksv.com**

Meggitt Sensing Systems

Endevco low mass piezoresistive accelerometers

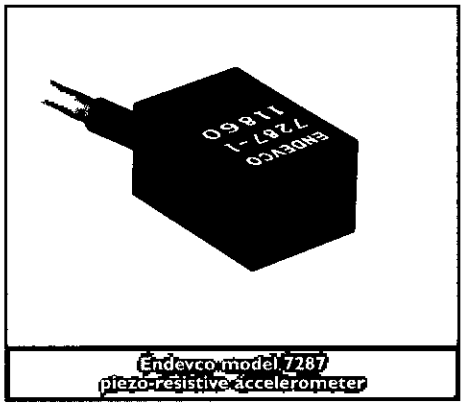
Meggitt Sensing Systems, a Meggitt group division, has announced the global market introduction of the Endevco model 7287, a small footprint, very low mass piezo-resistive accelerometer weighing less than one gram, designed for the cost-effective measurement of long duration transient shocks, such as those found in product and packaging drop testing, shipping container shock testing, jack hammer testing and high-g destructive testing applications.

With a measurement range of 2000G, 200mV full scale output and a high resonance frequency of more than 20kHz, the Endevco model 7287 uses a MEMS sensing element incorporating integral mechanical stops and features a small, lightweight, easy-to-mount package for minimal mass loading of the test structure. This monolithic sensor design offers ruggedness, stability and reliability with broad frequency response from DC to 4kHz at ±5%, with non-linearity of <1% and ruggedness to 10,000G shock. The model 7287 has also minimum damping, thereby producing no phase shift over the useful frequency range.

The design of the accelerometer has drawn upon decades of proven experience in manufacturing these types of sensors for the automotive crash test market, with successful technology that has now been carried over into the general test and measurement realm. As a result, the high reliability of the transducer ensures that critical data are recorded on demand at very low cost. Units are available with adhesive mounting or an integral bracket for screw mounting and are supplied with a strong PVC jacketed cable in standard lengths. Recommended accessories include the model 136 three-channel DC signal conditioner, model 4430A bridge transducer signal conditioner or 4990A (Oasis) multi-channel signal conditioner. For more information about the Endevco® model 7287 or other products available from Meggitt Sensing Systems, visit www.meggittsensingsystems.com.

The company has also announced the new market introduction of the Wilcoxon Research model F4/F7, a dual piezoelectric and electromagnetic vibration system, or 'shaker', designed to provide wide frequency range structural excitation, simulate external forces, determine structural resonance frequencies, and provide structural characterisations under excitation within aerospace, automotive and general research and testing applications.

The unique design of the Wilcoxon Research model F4/F7 combines a high-frequency piezoelectric vibration exciter (model F7) encircled by a low-frequency



Endevco model 7287 piezo-resistive accelerometer

electromagnetic vibration exciter (model F4). Units incorporate a transducer base, containing a force gauge for test structure force monitoring, and an accelerometer, for measuring resultant motion. Transducer signals can be fed into either read-out equipment or signal conditioners. The model F4 electromagnetic vibration generator provides low frequency excitation from 10Hz to 7.5kHz, whereas the model F7 piezoelectric vibration generator produces vibrational forces over a high frequency range of 500Hz to more than 20kHz, resulting in the net capability to provide high force-to-weight output and a

continued on page 48

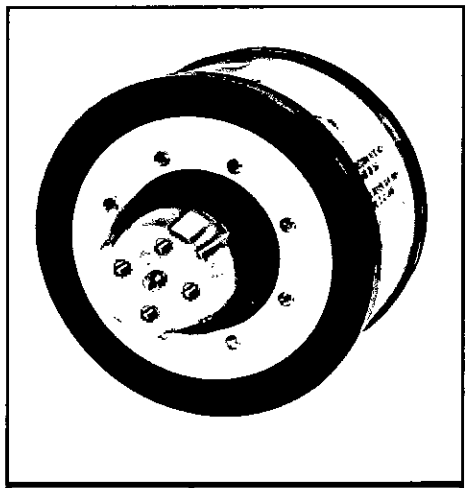
Meggitt Sensing Systems - *continued from page 47*

continuous sweep from low to high frequencies of 10Hz to over 20kHz, with excitation capabilities across the entire audio range.

The unit contains a stack of piezoelectric plates which requires a voltage step-up (impedance matching via matching network) for high force output levels. An air-cooling feature is included to allow it to be run at higher output levels for extended periods without overheating. Its lightweight coil and bobbin are rigidly attached to the generator, and incorporate use of heavy cylindrical magnets, which are suspended by two rubber diaphragms. The added dynamic weight is relatively low, since the rubber suspended weight does not affect axial or rotational inertia of the vibration generator core above its 30Hz system resonance frequency. In addition, the compact, lightweight shaker can easily be attached directly to a test structure in any position without external supports. Two power amplifiers are required to provide a continuous sweep. Input and output cables are provided.

Meggitt Sensing Systems, a Meggitt division (www.meggitt.com), is a leading supplier of high-performance sensing and monitoring systems for physical parameter measurements in extreme environments. It has operated since 1927 through its antecedents -ECET, Endevco, Ferroperm Piezoceramics, Lodge Ignition, Sensorex, Vibro-Meter and Wilcoxon Research - whose portfolios form the basis of product lines offered by today's Meggitt Sensing Systems. Meggitt's Endevco range of piezoelectric, piezo-resistive, Isotron and variable capacitance accelerometers, piezo-resistive pressure transducers, acoustic sensors, electronic instruments and calibration systems ensure critical accuracy and reliability within aerospace, automotive, defence, industrial, medical, power generation, space, and test and measurement applications. Endevco and Isotron are registered trademarks of the Meggitt group.

Email: **bruce.lent@meggitt.com**



Meggitt F4 electromagnetic vibration generator

Armacell

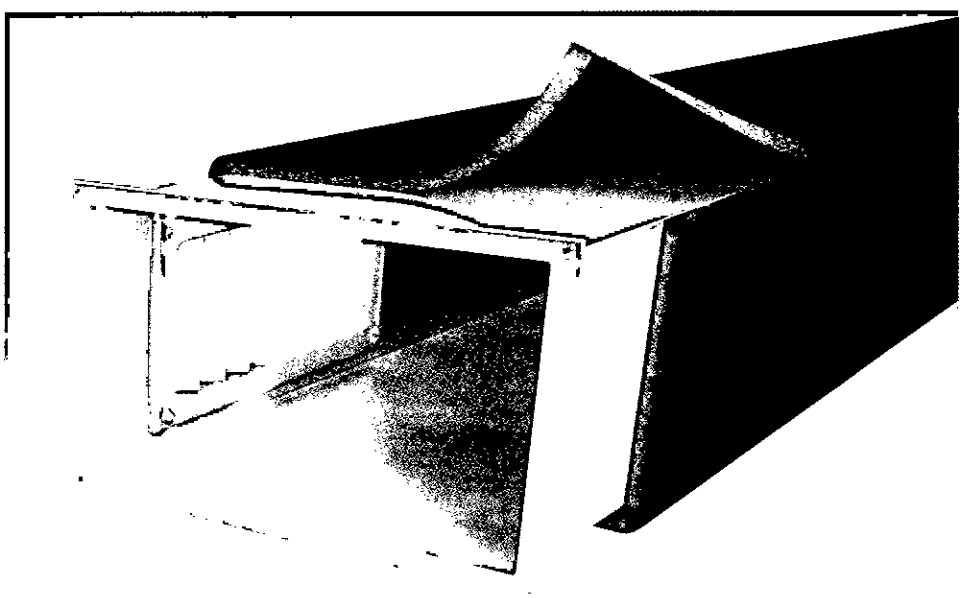
Purpose engineered ductwork insulation

Modern commercial buildings are designed to be airtight and can utilise a system of ducted warm air to maintain comfortable occupancy temperatures. However, uninsulated ductwork is subject to inevitable temperature losses which represent over 50% of the system energy requirements. To help eliminate these losses, Armaflex purpose engineered ductwork insulation can provide both thermal and acoustical properties. Information on these products is provided on a dedicated micro-site, forming part of the Armacell website (www.armacell.com/uk).

The distribution and continuous re-circulation of ducted filtered air is subject to the gradual accumulation of general pollutants which can lead to breathing difficulties and symptoms of ill health for the building occupants. Typical contaminants can include natural gasses such as carbon dioxide, in addition to harmful volatile organic chemicals (VOCs), industrial fibres, acidic particles and general dust, mould spores and bacteria – which can all contribute towards the impact of 'sick building syndrome' identified by illnesses and lost working days.

Armaflex duct system products, however, are purpose designed to provide an easy-to-clean and efficient insulation with zero ratings for ozone depletion and global warming potential. They are suited for applications in schools, hospitals, office complexes and large public buildings, providing combined thermal and acoustical properties to help maintain safe and comfortable environments within workplaces or public areas.

Armaflex products are clean and efficient, free of dust and fibres, formaldehyde and other dangerous gasses. They also feature a closed-cell structure with an in-built water vapour barrier. This eliminates the possibility of fibre migration and moisture 'wicking' with the effect that the insulation material remains dry and mould is denied the moisture it needs to grow. The incorporation of Microban anti-microbial protection enhances the inherent resistance against mould growth to ensure that the quality of the ducted air is not compromised. Highly stable thermal values are maintained, as well as excellent acoustical properties to minimise noise transmission through the ductwork. Combining these attributes reduces overall weight, and minimises both material requirements and costs for system installations.



Armaflex purpose engineered products can be fitted to circular or flat sided ductwork to provide effective thermal and acoustic insulation properties

Further information is available from Armacell UK Ltd, telephone: **0161 287 7040**, email **info.uk@armacell.com** and on the web site **www.armacell.com/uk** .

Norsonic's new noise monitoring solution

Makes on-site data downloading a chore of the past

We are pleased to introduce the new web based noise monitoring solution available from Campbell Associates. This new solution gives instant access via the internet to sound levels and saves time and money collecting data from instruments in the field.

The new NorWeb software gives real time sound level data via a customisable web page and instrument setup, data transfer and automatic calibration are all taken care of by the software.

The system is available for hire or purchase with the new compact Nor1530 enclosure. In addition, for a fixed monthly fee, Campbell Associates can host the service to make a daily check of the system, place the data on an http web site for collection, and also publish measured data on a web page.

Additional information such as third octave band spectra, audio recordings, video and weather can also be collected remotely from the monitoring stations and transferred over a secure internet connection.

For further information or a free demonstration, contact Campbell Associates on **01371 871033** or **hotline@campbell-associate.co.uk**

Enfonic launches new instrumentation hire services

Hireplus and Monitorplus

B&K equipment range

Enfonic has been selling, hiring and supporting Brüel & Kjær's (B&K) complete range of instrumentation in Ireland for over 18 years and their managing director, Gary Duffy MIOA, is a leading name in the acoustics community there.

Enfonic has recently opened an office in London to hire the range of UKAS-accredited B&K sound level meters, dosemeters, building acoustics systems and environmental monitoring solutions to the UK market. The hire service has some key features such as free data downloading and, for some equipment, a two-day minimum hire period. There is also no charge for days that the equipment is in transit, thus making a hire that much more cost effective. Their hire service is known as Hireplus.

Enfonic also operates a Monitorplus service which is an extension to Hireplus. This is a managed environmental noise monitoring system and is ideal for construction sites, concert noise or any other application where an autonomous, Class 1 monitor is required for short periods. Based on B&K's type 2250 sound level meter, a secure, battery powered enclosure using 3G mobile communication can either be delivered to the client to be installed or installed by Enfonic. The company's engineers then communicate with the system remotely, configure it for the application in hand, and periodically download the data and email it to the client.

Thanks to the advanced technology in the B&K type 2250, real-time noise levels can also be viewed from the web browser on any computer or mobile device. This allows anyone with the correct security credentials to monitor the noise levels remotely or to check the measurement status.

Outdoor music event monitoring

An example of the application of these monitors was at a recent outdoor music event where four such monitors were installed at various noise-sensitive locations in the neighbourhood around the stadium. Figure 1 shows a typical installation at one of the locations for this event.

Figure 2 shows the real-time display of noise levels from the four remote monitors at the mixer desk position inside the stadium.

Having such real-time displays from the noise monitors means better management of the prescribed noise limits because the sound engineers, who are in control of the output of the stage, have an immediate view of the resultant levels at the remote sites. It is also more cost effective as there is no manpower required at the monitoring locations.

The optional sound recording feature of the type 2250 also means that objective recordings for later analysis can be made should any exceedances occur. The system can also send automated emails when noise events take place so that appropriate action can be taken. Battery and measurement status email alerts are also sent thus ensuring the reliability of the system.

Further details on Enfonic's Hireplus and Monitorplus services can be found at **ww.enfonic.co.uk**

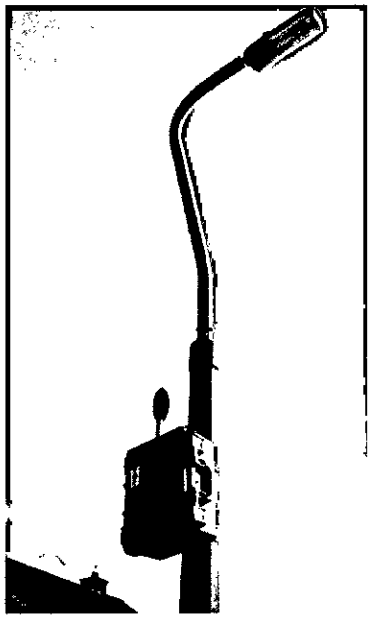


Figure 1

A remote noise monitor installed on a lamp standard

Figure 2

Real-time noise level displays

Institute Sponsor Members

Council of the Institute of Acoustics is pleased to acknowledge the valuable support of these organisations

Key Sponsors Brüel & Kjær · CASELLA CEL · Cirrus Research plc

Sponsoring Organisations: ACOUSTIC COMFORT LTD • ACSOFT LTD • AECOM (formerly Faber Maunsell) • AMS ACOUSTICS • APPLE SOUND LTD ANV MEASUREMENT SYSTEMS • ARMSTRONG WORLD INDUSTRIES LIMITED • ARUP ACOUSTICS • BUREAU VERITAS • CAMPBELL ASSOCIATES CIVIL AVIATION AUTHORITY • CMS ACOUSTIC SOLUTIONS LTD • COLE JARMAN ASSOCIATES • ECKEL NOISE CONTROL TECHNOLOGIES EMTEC PRODUCTS LTD • GRACEY & ASSOCIATES • HANN TUCKER ASSOCIATES • HILSON MORAN PARTNERSHIP LTD INDUSTRIAL ACOUSTICS CO LTD (IAC Ltd) • INDUSTRIAL COMMERCIAL & TECHNICAL CONSULTANTS LIMITED • INSTACOUSTIC LTD • ISOMASS LTD JACKSON FINE FENCING • JOHN C WILKINS ACOUSTIC Supplies Ltd • KR ASSOCIATES • LMS (UK) • MASON UK LIMITED • NOISE.CO.UK NPL (National Physical Laboratory) • ROCKFON • RPS PLANNING & DEVELOPMENT LTD • SAINT-GOBAIN ECOPHON LTD SANDY BROWN ASSOCIATES • SCOTT WILSON • SOUND REDUCTION SYSTEMS LTD • SOUND & ACOUSTICS LTD • TELENT TECHNOLOGY SERVICES LTD TELEX COMMUNICATIONS (UK) LTD • THALES UNDERWATER SYSTEMS LTD • WAKEFIELD ACOUSTICS • WARDLE STOREYS (BLACKBURN) LTD

Applications for Sponsor Membership of the Institute should be sent to the St Albans office. Details of the benefits will be provided on request. Members are reminded that only Sponsor Members are entitled to use the IOA logo in their publications, whether paper or electronic (including web pages).

Committee meetings 2011

DAY	DATE	TIME	MEETING
Thursday	6 January	10.00	Meetings
Thursday	20 January	10.30	Diploma Tutors and Examiners
Thursday	20 January	1.30	Education
Thursday	27 January	10.30	Membership
Thursday	10 February	11.00	Publications
Thursday	17 February	11.00	Medals & Awards
Thursday	17 February	1.30	Executive
Thursday	3 March	10.30	Engineering Division
Tuesday	8 March	10.30	Diploma Examiners
Thursday	**10 March**	**11.00**	**Council**
Monday	4 April	11.00	Research Co-ordination
Tuesday	5 April	10.30	CCWPNA Examiners
Tuesday	5 April	1.30	CCWPNA Committee
Thursday	14 April	10.00	Meetings
Thursday	5 May	10.30	Membership
Thursday	19 May	11.00	Publications
Tuesday	24 May	10.30	CMOHAV Examiners
Tuesday	24 May	1.30	CMOHAV Committee
Thursday	2 June	10.30	Engineering Division
Wednesday	15 June	10.30	CCENM Examiners
Wednesday	15 June	1.30	CCENM Committee
Thursday	16 June	11.00	Executive
Thursday	23 June	10.30	Distance Learning Tutors WG
Thursday	23 June	1.30	Education
Thursday	**30 June**	**11.00**	**Council**
Tuesday	5 July	10.30	ASBA Examiners
Tuesday	5 July	1.30	ASBA Committee
Thursday	7 July	10.00	Meetings
Tuesday	2 August	10.30	Diploma Moderators Meeting
Thursday	1 September	10.30	Membership
Thursday	8 September	11.00	Executive
Thursday	15 September	11.00	Publications
Thursday	**22 September**	**11.00**	**Council**
Thursday	29 September	10.30	Diploma Tutors and Examiners
Thursday	29 September	1.30	Education
Thursday	6 October	11.00	Research Co-ordination
Thursday	13 October	10.30	Engineering Division
Thursday	3 November	10.30	Membership
Tuesday	8 November	10.30	ASBA Examiners
Tuesday	8 November	1.30	ASBA Committee
Thursday	10 November	10.00	Meetings
Thursday	17 November	11.00	Executive
Wednesday	23 November	10.30	CCENM Examiners
Wednesday	23 November	1.30	CCENM Committee
Thursday	24 November	11.00	Publications
Thursday	**1 December**	**11.00**	**Council**
Tuesday	6 December	10.30	CCWPNA Examiners
Tuesday	6 December	1.30	CCWPNA Committee

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

Meetings Programme 2010-11

18-19 November 2010
Electroacoustics group
Reproduced Sound 2010
Cardiff

19 November 2010
Architectural and Acoustical Tour of the Wales Millennium Centre
This meeting is intended as an informal forum to encourage young members to present at and Institute conference.

24 November 2010
Eastern branch
Towards a Silent Aircraft
University of Cambridge

7 December 2010
Advanced Development of Automotive Audio Systems
The Arup Campus

26 January 2011
Planning and Statutory Nuisance
Millennium Stadium, Cardiff

16 February 2011
Acoustic Challenges in Green Buildings
BRE, Garston, Watford

20 May 2011
8th International Conference on Auditorium Acoustics
The Convention Centre, Dublin

24 July 2011
10th International Congress on Noise as a Public Health Problem
Imperial College, London
Conference organised by the Institute of Acoustics for the International Commission on the Biological Effects of Noise

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

List of advertisers

Please mention *Acoustics Bulletin* when responding to advertisers

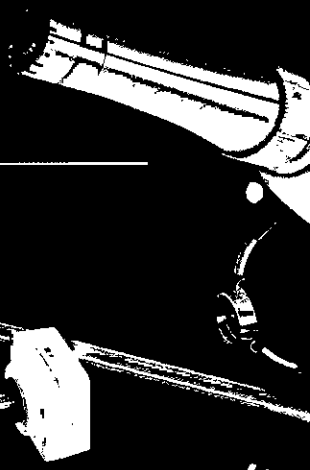
The UK Distributor of RION

sales - hire - calibration

AND Measurement Systems

Long-Term Monitors

RELIABLE • SITE-PROVEN • QUICK & EASY TO USE



RION Microphone Technology

Pre-polarised microphones are standard on RION meters
No Polarisation Voltage required
Inherently more tolerant of damp and/or cold conditions

RION WS-03 Outdoor Microphone Protection

Practical, simple and effective
Site proven - years of continuous use at some sites
No requirement for dehumidifier
No complicated additional calibration procedures
Standard Tripod Mount or any 25mm outer diameter pole

Weather Resistant Cases

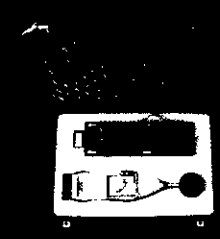
'Standard' supplied with 5 or 10m extension
'Enhanced' with integral steel pole
Gel-Cell batteries give 10 days battery life (NL Series)
Longer battery life, mains & solar options available

RION NL-31/32 (Class 1) NL-21/22 (Class 2)

Overall A-weighted sound pressure levels
Up to 99,999 measurement periods
L_{Aeq}, L_{Amax}, L_{Amin}, SEL plus 5 statistical indices
Audio recording option available

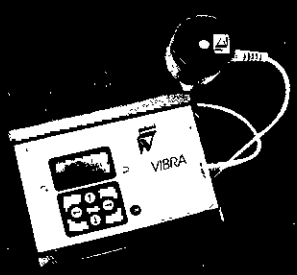
Remote Control & Download Software (RCDS)

In daily use on many sites
Download data and control the meter using the GSM Network
See the meter display in 'Real Time' across the GSM Network
Send alarm text messages to multiple mobile phones.
Automatically download up to 30 meters with Auto Scheduler (ARDS)



RION NA-28 (Class 1)

- Octaves & Third Octaves
- Audio Recording Option



Vibra/Vibra+

- Logs PPVs for up to 28 Days
- Designed for Construction & Demolition
- Sends Alarms and Data via GPRS (Vibra+)

RION VM-54

- Measures and Logs VDVs
- Perfect for Train Vibration
- FFT Option Available

RION Data Handling

- You can always get the data from a RION
- Data stored as CSV files to Compact Flash
- Specialist download leads/software not needed

☎ 01908 642846 ✉ info@noise-and-vibration.co.uk 🖳 www.noise-and-vibration.co.uk