Vol 38 No 3 May/June 2013

ACOUSTICS BULLETIN

in this issue… **New Government aviation policy aims to reduce aircraft noise nuisance**

plus… **Membership figures hold firm despite financial climate**

Work under way on blueprint for IOA's future

Electret microphones in the field; care and the effects of the environment and damage

Institute of Acoustics

ACOUSTICS BULLETIN

Vol 38 No 3 May/June 2013

Front cover photograph:
The Government's new aviation framework aims to reduce aircraft noise.

Contacts

Editor:
Charles Ellis

Contributions, letters and information on new products to:
Charles Ellis, Editor,
Institute of Acoustics,
3rd Floor St Peter's House,
45-49 Victoria Street, St Albans,
Hertfordshire, AL1 3WZ
tel: 01727 848195
e-mail: charles.ellis@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,
3rd Floor St Peter's House,
45-49 Victoria Street, St Albans.

Design and artwork by:
oneagency.co London
81 Rivington Street
London, EC2A 3AY
e-mail: london@oneagency.co
web site: www.oneagency.co

Printed by:
Newnorth Print
College Street
Kempston
Bedford MK42 8NA

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

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

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

Noise Sentinel has won the UK Noise Abatement Society's John Connell Technology Award 2012

Noise Sentinel Web-based subscription service

Simplify your outdoor noise management

Safeguard your business

If you exceed noise limits your operating licence may be under threat; we ensure that results are valid and that your monitoring programme has a high uptime

Simplified operations – 24/7

We establish and operate the web-based Noise Sentinel monitoring programme on your behalf, allowing you to focus on your core business

Simplified finances

Using Noise Sentinel you will get a reduced capital expenditure with 10% to 20% lower total cost of operation and a 40% lower startup investment

DISCOVER HOW EASY NOISE MANAGEMENT HAS BECOME

Go to www.bksv.com/NoiseSentinel for more information or contact your local Brüel & Kjær representative

We take care of instrumentation, installation and operation.

You download noise reports which demonstrate your compliance with environmental legislation.

Noise Sentinel

Noise Compliance Management

www.bksv.com/NoiseSentinel

BN 1247–11

United Kingdom: Bruel & Kjaer UK Ltd. · Jarman Way · Royston · Herts · SG8 5BQ
Telephone: +44 (0) 1223 389800 · Fax: +44 (0) 1223 389919 · www.bksv.co.uk · ukinfo@bksv.com

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 77 41 20 00 · Fax: +45 45 80 14 05 · www.bksv.com · info@bksv.com

Local representatives and service organisations worldwide

Brüel & Kjær

creating sustainable value

Conference programme 2013

13 May 2013
IOA spring conference
Acoustics 2013
Nottingham

21 May 2013
Organised by the
Wind Turbine Noise Working Party
Launch of the Good Practice Guide
Bristol

5 June 2013
Organised by the Measurement and Instrumentation Group
Trials and tribulations of overcoming acoustic challenges
London

2 July 2013
Organised by the
Musical Acoustics Group
Acoustic challenges in quires and places where they sing
London

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

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

Dear Members

Spring seems to have arrived at last, and with it comes an interesting range of one day meetings to take us through to the summer. As always, Linda Canty has been working hard with the various groups to put together stimulating programmes covering a wide variety of topics. The most ambitious meeting is the Spring conference in Nottingham on 13 May which this year is going to incorporate all our groups in one day of parallel sessions. Then the following week, on 21 May, we have the launch, in Bristol, of the IOA Good Practice Guide for the assessment of noise from wind turbines. This document has been produced, in record time, by a working group chaired by Richard Perkins. Many thanks are due to Richard and his team for their hard work over the past few months in putting the document together. Given the controversial nature of wind farms and wind farm noise, it is not surprising that the team have had to take on board disparate views expressed by many members and non-members. You will see that this Bulletin has an article on wind farms to coincide with the publication of the Good Practice Guide.

Two other one day meetings coming up this summer sound both entertaining and informative – and both are related to overcoming acoustic challenges! One, on 5 June, is about the practical trials and tribulations of life as an acoustic consultant while the other, on 2 July, concerns the challenges presented to musicians by the acoustics of different performance venues. The latter meeting marks the very welcome resuscitation of the Musical Acoustics Group and we look forward to more activities by the group in future.

You will also find in this Bulletin a report of the strategy meeting that was held in March to gauge the opinion of a cross section of members, with a view to formulating the Institute's strategy for the next few years. Council are now working with the Chief Executive to put together a new strategic plan, taking account of views expressed at the meeting and in last year's membership survey. Members will see some changes come into effect quite quickly. Priorities include upgrading our IT systems and website to allow us to manage and deliver services more effectively, and devolving some budgeting responsibilities to groups and branches.

A particular initiative which has been introduced following the strategy meeting, and which is reported elsewhere in the Bulletin, is the setting up of a working group to consider diversity issues in the Institute, in particular issues affecting women members and others with childcare or similar commitments.

Also reflecting members' views, I hope you will have noticed that we are finally close to achieving our objective of sending out all meeting and other notices electronically, thereby greatly reducing the costs of postage, the use of paper, and time spent by our hard working office staff in stuffing envelopes.

Bridget

Bridget Shield, President

Membership figures hold firm at just under 3,000 despite financial climate

Annual report of the Council for 2012

The Institute has continued to serve the interests of its members through its established programmes in the areas of education, professional development, meetings and publications, and by providing representation in areas such as the Engineering Council, Standardisation and International affairs.

The Trustees confirm that in the exercise of their powers as charity trustees, they have had due regard to the published guidance from the Charities Commission on the operation of the public benefit requirements and the aims of the charity are carried out for the public benefit.

During the year:

- The Chief Executive, Kevin Macan-Lind, resigned in August 2012. He was replaced by the previous Chief Executive, Roy Bratby, who came out of retirement until a new Chief Executive could be appointed. A new Chief Executive was appointed in December and was due to take up post in January 2013. Chantel Sankey joined the staff at St Albans in January as the full-time Membership Officer.
- An ambitious programme of well attended conferences and technical meetings was undertaken at international, national and regional level. These included the 11th European Conference on Underwater Acoustics (ECUA 2012), which was held in Edinburgh and attracted 411 delegates, and a jointly organised spring conference with the French Acoustical Society (SFA) in Nantes, attended by 960 delegates.
- Seven candidates presented themselves for CEng Professional Review Interview, of whom two were "Standard Route" candidates, holding accredited degrees, and five were "Individual Route" candidates with diverse backgrounds, including physics degrees. Their areas of employment were equally diverse – aerospace engineering, architectural and building acoustics, and naval noise and vibration engineering. One candidate, holding the University of Salford Acoustics degree, was elected IEng. All eight candidates were successful.
- The Diploma in Acoustics and Noise Control is now in its fifth year since extensive revision in 2008. During the year 97 students were awarded the Diploma with 108 new students registering for the course, of whom 63 have enrolled for distance learning, including six from overseas.
- An online survey of members was carried out; 37% of members responded.
- The Institute's *Acoustics Bulletin* continues to provide a high standard of technical content and remains popular with members, as confirmed by the membership survey.
- Despite the financial climate, membership has been retained at just under 3,000.
- The Institute is represented internationally through the following members: Colin English (Vice President, EAA), Barry Gibbs (Director, IIAV), Professor Yui Wei Lam (ICA Board), and Rupert Thornely-Taylor (Director, IIAV).
- The Institute once again sponsored the Noise Abatement Society's John Connell Technology Award.
- The Institute has purchased demonstration equipment to support the "You're Banned" acoustic workshop for presentation to schools. A number of volunteers have been trained and 12 workshops were delivered in schools during the year.
- The Institute continues to engage with a number of government departments (DfE, DCLG, Defra and DECC) to influence future policies affecting acoustics.

An image from a presentation at the autumn conference

Standing Committees

The operation of the Institute is guided by Council through standing committees concerned with Education, Meetings, Membership, Publications, and Research Co-ordination. There is also a committee of the Engineering Division. The reports of the various committees follow.

Education Committee

The Diploma and (now five) Certificate courses have continued to recruit and to provide education and training for both members and non-members of the IOA. The education programmes and courses introduce many working in acoustics and associated professions to the Institute and help in the recruitment of new members.

The Diploma in Acoustics and Noise Control is now in its fifth year since extensive revision in 2008. As a result of grades obtained in 2011/12, the Diploma was awarded to 97 students. Despite the fact that NESCOT decided not to operate as a Diploma Centre for 2012/13, recruitment for the 2012/13 year has been buoyant at 108 including 63 by distance learning. The latter include six overseas students and an effort is being made to cater for them and attract more such students by videoconferencing the tutorials offered through the St Albans centre, by making arrangements for examinations to be taken at suitable overseas venues and by arranging consolidated laboratory sessions in Liverpool.

The Education Committee is monitoring the effects of the changes in higher education funding on students and centres.


Richard Collman examines a schools test rig

For the 2012/13 presentation of the Diploma the distance learning notes for the Noise and Vibration Control Engineering Module have been revised and edited. They will be distributed in January 2013.

In 2011/12, the Certificate of Competence Courses recruited as follows: Management of Hand-Arm Vibration 21 students (21 passes), Environmental Noise Measurement 230 students (200 passes), and Workplace Noise and Risk Assessment 41 students (40 passes). The Certificate of Proficiency programme in Anti-Social Behaviour (Noise) continues to be run in Scotland by Bel Education and Strathclyde University and recruited 27 students (23 passes) despite not being run in spring 2012 at Strathclyde as a result of a fire.

The Certificate of Competence in Building Acoustics Measurements had its second cohort of candidates at Southampton Solent University in 2012. A total of 15 students have taken the course (15 passes).

Since 2011, Diploma members have been able, for CPD or other reasons, to register for additional specialist modules. So far four people have taken advantage of this opportunity. Additional "formal" CPD courses (with a syllabus and assessment) are being considered in conjunction with groups and branches. Options for alternative delivery of courses (including e-learning) have been considered.

Since 2011 the Education Committee has agreed a policy whereby, if there have not been any material changes in facilities, tutors or delivery, then Certificate and Diploma Centres may achieve their (quinquennial) re-accreditation simply by submitting the necessary proforma without also being subjected to a visit.

In 2012 Council approved that sets of demonstration equipment to support the "You're Banned" acoustic workshop for presentation to schools could be purchased. A workshop on education in schools was held at the new IOA headquarters in May 2012 and was attended by 20 delegates including many Acoustic Ambassadors. A presentation was also made at the London branch. Twelve "You're Banned" presentations were given during 2012.

The Education Committee continues to be indebted to the support of its members, course tutors and examiners, the work of the Education Manager and for the assistance provided by the Education Administrator and other members of office staff.

Engineering Division Committee

The Committee met once during the year, confirmation of approval of registration for some candidates being given by email correspondence. One internal audit was carried out, with no non-compliances identified. The number of enquiries for registration from Institute members remained strong, but many potential candidates still deferred or failed to complete their applications, despite the personal support provided.

The number of formal applications for Chartered Engineer and Incorporated Engineer registration was higher in 2012 than in recent years. Seven candidates presented themselves for CEng Professional Review Interview, of whom two were "Standard Route" candidates, holding accredited degrees, and five were "Individual Route" candidates with diverse backgrounds, including physics degrees. Their areas of employment were equally diverse – aerospace engineering, architectural and building acoustics, and naval noise and vibration engineering. One candidate, holding the University of Salford Acoustics degree, was elected IEng.

All eight candidates were successful.

Medals and Awards Committee

Professor Yui Wei Lam of the University of Salford was awarded the 2012 Rayleigh Medal for his outstanding contributions to teaching and research in room acoustics. The medal was presented to Professor Lam at Acoustics 2012, the conference organised jointly by the IOA and SFA and held in Nantes. Also at the same conference, Carl Hopkins of Liverpool University was presented with the Tyndall Medal which is awarded in alternate years to younger acousticians for their achievements.

The (overseas) recipient of the 2013 Rayleigh Medal was also decided and awarded to Professor Jacques Guigné of PanGeo Subsea based in Newfoundland, Canada. The medal will be presented at the international conference on underwater acoustics (ECUA/UAM) to be held in Corfu in June 2013.

The A B Wood Medal for underwater acoustics (for 2011) was presented to Dr Kyle Becker at the ECUA conference in Edinburgh.

In October, at the NPPF meeting in Birmingham, Stephen Turner was presented with an Honorary Fellowship in recognition of his many years of service to the Institute and continuing contribution to acoustics in the UK.

Several awards were made at the autumn conference in Birmingham. John Hinton, President from 2008 to 2010, received an Honorary Fellowship and Ian Bennett received a Distinguished Services award in recognition of his many years as editor of the *Acoustics Bulletin*. Two ANC prizes were also presented by Sue Bird, President of the ANC: the award for best IOA Diploma project (2011) to Richard Shears and for best paper presented by a young person at an IOA conference (2011) to Ned Crowe.

The Peter Barnett Memorial award was given to Pat Brown of SynAudCom in the USA. Unfortunately, Pat was unwell and was unable to travel to Reproduced Sound to receive the award in person, so the citation and presentation were videoed and the award was subsequently presented in person by Peter Mapp on a visit to the US. Two other awards were presented at Reproduced Sound. Brian Tunbridge received a Distinguished Services award for his work in acoustics and for the Institute, in particular as chairman of the Membership Committee. Luke Rendell was also presented with his (2011) prize for the best IOA Diploma student.

The final presentation of the year took place at the London branch dinner in November. The Engineering Medal was presented to Derek Sugden in recognition of his long and distinguished career in engineering acoustics.

Other awards made during the year were as follows. A Distinguished Services award was given to Dennis Baylis who has acted as the IOA Advertising Manager for many years (presented to Dennis at his home in France). The Professor D W Robinson prize for best ISVR MSc Audiology project was given to Sarah Meehan. P8

President Bridget Shield presents an Honorary Fellowship to John Hinton

Brian Tunbridge receives a Distinguished Service award from Bridget Shield

P7

Meetings Committee

The committee met four times in 2012. The membership of the committee remains the same as last year. The committee constitutes a chairman (Jeremy Newton), secretary (Hilary Notley), young member (Christopher Turner) and two other members – Ken Dibble and Paul Lepper.

The committee presided over the organisation of 14 meetings covering a wide variety of topics including the joint spring meeting with the French Acoustical Society and the very successful underwater acoustics international conference, ECUA 2012, held in Edinburgh. The feedback from the meetings' questionnaires continues to be very favourable. Given the global recession, the financial performance of meetings in 2012 has been very positive. The committee continues to scrutinise the financial performance of conferences for future events and ensures that lessons learnt from previous conferences are applied going forward.

Membership Committee

The committee met four times in 2012. Brian Tunbridge retired as Chairman after six years in the post and was thanked for his support and commitment. Paul Freeborn was appointed as his replacement. It is intended to recruit a local authority member to the committee to improve the balance of the committee.

During the year 282 applications for membership were considered and 271 accepted. The majority of these were for new associate members and for associate members transferring to corporate member grade when they had accumulated sufficient experience.

The committee is now requiring all members to practise CPD and revised CPD forms have been posted on the Institute's website.

The committee considered seven Code of Conduct cases, four of which have been closed; one following a rejected appeal; two following advisory letters; and one following the resignation of the member. One case has been withdrawn and two are on-going.

The membership bylaws were revised to remove age limit requirements and also the Rules of Conduct have been clarified. Both the revised bylaws and the revised Rules of Conduct have been posted on the Institute's website.

A fast track process has been introduced to improve the efficiency of assessing non-corporate members.

2012	FIOA	MIOA	AMIOA	Tech	Affil	Student	Sponsor	Total
Applicants	3	105	120	17	2	29	6	282
Elected	3	99	114	17	3	29	6	271
New Members	1	27	93	16	3	29	5	174
Resigned	3	47	31	1	1	5	3	91
Deceased	1	3	0	0	1	0	0	5

Publications Committee

During 2012 the main focus of the Publications Committee was the revision to the website. Whilst the revision was initially about improving functionality, it was soon apparent that certain revisions would save vast amounts of administrative time and significantly reduce paperwork. Amongst other things the website was aiming to manage members' details, membership applications, conference organisation/registration and CPD, with the Diploma and education coming after. Naturally, the devil of such projects is in the detail, and whilst there was excellent work in the planning and design of the website, there were plenty of data headaches trying to combine different database sources and getting the system to work seamlessly. The current work on the new website was stopped at the end of 2012 and the best way to proceed will be decided in 2013.

Acoustics Bulletin and *Acoustics Update* continue to provide a high standard of technical content, reporting news and details of the Institute's meetings and affairs. During 2012 feedback from the membership survey was received on both publications and views from members have been taken on board.

The IOA group on the social networking site LinkedIn continues to attract a steady stream of interested people, now with more than 3,800 members.

There have been relatively few changes in committee membership over the year with one person leaving the committee. There were several volunteers for the committee from the membership survey and we look forward to welcoming them to the committee in 2013. Thanks go to all members of the committee for volunteering their time over the year, especially members of the website sub-committee who have given many hours throughout the year.

Research Co-ordination Committee

During 2012, the committee met in May and October at the Defra offices in London. Some discussions focused on the general organisation, attendance and outcomes, and quality of contributions of the Acoustics 2012 conference in Nantes (France) in April 2012.

The committee discussed the scope for better liaison between the IOA, EPSRC, Defra and TSB and two committee members met with Dr Tracy Hanlon of the EPSRC. The EPSRC tasked the RCC to come up with a list of grand challenges which acoustics as a discipline will face in the future. This request was discussed by the committee in May and a note was published in the October issue of the *Acoustics Bulletin* asking members to contribute to this list. These contributions have been compiled and communicated to the EPSRC.

The committee has spent a considerable amount of time discussing better integration between the IOA and IOP Physical Acoustics Group (PAG) communities (originally a joint IOA/IOP Group), joint meetings and joint membership. This issue is yet to be resolved and it is likely to be referred to Council.

The committee has noted that serious cuts in the Research Council's funding in the UK may adversely impact on the acoustics research community. The committee has discussed alternative EU research opportunities and joint UK/EU opportunities which may help to maintain the existing level of research funding in acoustics in the UK and make better use of the world-class expertise which exists within the EU. Professor Horoshenkov has spoken to the EPSRC regarding this issue and possibilities for supporting collaborative projects which can be funded jointly with research councils from other EU partners. The committee, together with the Environmental Noise Group, organised a workshop in London to discuss the Noise and Health Workplan put out for consultation by the Health Protection Agency.

Specialist Groups

The Institute reflects the broad spectrum of the science and application of acoustics and several specialist groups exist to foster contacts between members of the various specialisms; the reports of the specialist groups follow below.

Building Acoustics Group

Another busy year has just passed with the Building Acoustics Group delivering high quality educational meetings, providing thorough and coherent consultations for new documents and standards, and promoting the IOA to a wider audience.

We were involved with organising the following meetings:

- The IOA Autumn Conference in Austin Court, Birmingham, 5 - 6 November 2012 – this was a team effort and the day was received well by all
- Acoustic Challenges in Green Buildings – held at BRE in September – thanks to James Healey for organising this meeting
- Nantes 2012 – Carl Hopkins attended this joint meeting with the French Acoustical Society (SFA) with Alex Krasnic providing remote organisational assistance to his SFA Building Acoustics counterpart.

The following work was also carried out:

- BB93 – Andrew Parkin has been involved in the revision of this document and is contributing in the review panel for section 2 which is being chaired by Bridget Shield P10

Campbell Associates

Sonitus House
5b Chelmsford Road
Industrial Estate
Great Dunmow
Essex CM6 1HD

t 01371 871030
f 01371 879106
e hotline@campbell-associates.co.uk
w www.acoustic-hire.com
w www.campbell-associates.co.uk

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.

New equipment for hire including Nor848 Acoustic Camera

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

- P8 BSI EH/1/6 – Rory Sullivan has been leading the BAG feedback to the working group committee
- BS8233 / ISO414 – Rory Sullivan has been leading the BAG response
- And many more…

We thanked Mike Barron and Alistair Somerville as they stepped down from their positions as BAG committee members. We cannot thank them enough for their contribution over many years. In their place we welcomed Alex Krasnic and Rory Sullivan as full members of the committee having being co-opted for a number of years.

2013 looks like being another exciting year with the IOA spring meeting which is being organised collectively by many of the specialist groups including BAG. We are very much looking forward to meeting the new CEO and are excited that this could bring a new dynamism and energy to everything that the IOA does.

Thank you to all the people who have given their time so generously. We really couldn't do it without you.

Electro-acoustics Group

During 2012, the Electro-acoustics Group committee organised and put on Reproduced Sound 2012, the annual two-day conference that has run every year since 1984. This was held at the Thistle Hotel in Brighton and was once again well attended by both regulars and new faces. Feedback (questionnaire forms) was sought from the attendees and these have been scrutinised to help with future events, especially the input from the new influx of student attendees.

It was announced at RS2011, and confirmed at RS2012, that Reproduced Sound 2013 would be in Manchester, making full use of links established with BBC Salford, MediaCityUK and the University of Salford. Themes will include the role of audio in broadcast, with the scope widening to include video conferencing and "new media" distribution. As ever, abstracts from the wider range of subjects affecting electro-acoustics will be welcomed.

At the EAG AGM, held at RS2012, the 2013 committee was agreed. Paul Malpas remains as Chairman, and Helen Goddard as Secretary. Other offices had been developed within the EAG Committee, and this being a definite team effort, the contributions of all members were acknowledged and appreciated.

Environmental Noise Group

In June and October 2012 the IOA hosted one-day workshops to consider the implications of the government's new National Planning Policy Framework including the removal of Planning Policy Guidance 24 (PPG24). Graham Parry led the meetings, with break out sessions discussing various aspects of how members work on the planning arena would be affected by new government policy.

During the year the ENG committee considered four public consultations and prepared responses to two; the European Commission's consultation on the implementation and effectiveness of EC Directive 2002-49, the Environmental Noise Directive, and a Department for Transport consultation on aviation noise policy. In response to the need to involve a wider membership, notifications of the consultations were issued by email through *Acoustics Update* and members were invited to respond alone or to contribute to the Institute's response. The IOA responses are now routinely posted on the website.

Four committee meetings were held in 2012 and the committee analysed the IOA member survey responses, reporting to Council on members' requests, and proposed actions, including the need to continue to hold workshops, to publish technical articles in the *Acoustics Bulletin* and to facilitate information on revisions to standards and guidelines.

Measurement and Instrumentation Group

During the past year the group has organised two one-day meetings. In March, the first one-day meeting was held at the Royal Society in London entitled Environmental Noise Propagation – definitions, measuring and control aspects which attracted 76 delegates and nine authors to a wide-ranging set of topics ranging from weather and vegetation effects to exhaust stacks and sonic crystal barriers.

Later than originally planned, in November, a one-day meeting was organised in conjunction with the Young Members' Group and was entitled Basics of Measurement - Practical Implementations, which was primarily aimed at spreading good measurement practices to people who may be either new to the measurement field or in need of some refreshment of the principles involved. Forty-two people attended the session held at the Building Research Establishment in Watford, which also included a short tour of their facilities. The group's AGM was also held during this meeting.

Over the past year, the group's committee members have continued contributing to the regular Instrumentation Corner article in *Acoustics Bulletin*, which has produced some interesting discussion and articles, and this is scheduled to continue for the forthcoming year.

A programme of three one-day meetings has been planned for 2013, with the first of these covering the latest vibration measuring techniques scheduled for 21 March at the HSL in Buxton, Derbyshire.

Thanks go to all members of the committee for the active roles they take in all aspects of the group's activities and to Martin Armstrong for his secretarial skills on behalf of the group.

Musical Acoustics Group

Progress continues with revitalising the Musical Acoustics Group (MAG) although there have been some set-backs. Firstly, the proposed one-day meeting due to be held at the National Museum, Cardiff in May had to be abandoned due to lack of support. It would appear that the geographic location and timing of this event close to the conference in Nantes may have been contributory factors. Secondly, the MAG AGM that should have been held at London South Bank University had to be abandoned due to the fact that only the acting Group Chairman was present. Nevertheless, it was agreed by Council that further efforts should be made to "spark new life" into the group as there were a significant number of members who supported the MAG. The 2012 Institute's membership survey showed that 45 members, out of total of 1,077 members who responded, indicated that they belonged to the MAG and 48 members positively responded as being interested in the group. With a total of just under 3,000 members in the Institute there could well be many others who did not respond to the survey but are, nevertheless, interested in the MAG. However, over half of the respondents to the survey were consultants and it would seem that some members in this sector would also like to take interest if they had time to do so.

As a move to spark new life into the MAG, it is considered essential that events should be held and a call for papers for a one-day meeting in London entitled Acoustic Challenges in Quires and Places Where They Sing went out in November 2012. However, some concerns over the cost of one-day meetings have been expressed by members of the MAG and efforts will be made to explore ideas for further events that involve less cost. A MAG newsletter is also proposed and it is also hoped that the MAG will host sessions in the 2013 Spring Conference.

Getting together a formal committee has been a problem as travelling distances may still discourage attendance. The possibility of holding group AGMs by teleconferencing is also being considered. Whilst this method may be possible for ordinary committee meetings, at the present time, the IOA terms of reference for specialist groups would prevent holding an AGM in this way until details of how such a method encompassing the committee election process can be worked out. At present, Michael Wright is acting Group Chairman with David Sharp as Group Secretary. It is proposed that an informal meeting of the group will be held at the IOA HQ in early 2013 with teleconferencing facilities arranged to enable all interested members to participate. It is hoped that following this meeting, the group will be in a position to move further forward. P12

P10 **Noise and Vibration Engineering Group**

Five committee meetings were held during the year, mainly by teleconference, supplemented by smaller subgroup meetings to develop specific events. The committee meetings focused on planning events of interest to the membership.

The group assisted in the organisation of Acoustics 2012 by co-organising a session on noise and vibration engineering with our SFA colleagues. Malcolm Smith also chaired a plenary session. An event organised jointly with HSE on Buy Quiet/Design Quiet was planned for December, but a change in committee membership (Tim Ward from HSE being replaced by Sarah Haynes) led to this meeting being delayed until March 2013. A meeting on vehicle NVH was also planned at Loughborough University, but this is now going to form a session in the Spring 2013 Conference.

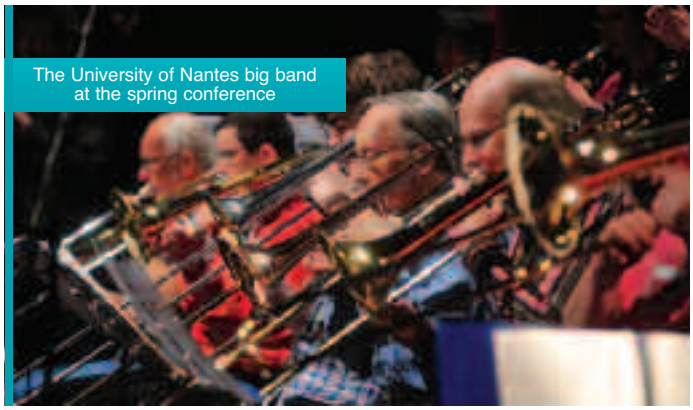
Other changes and contributions to the IOA include: Reuben Peckam has been appointed as an examiner for the Noise and Vibration Control Diploma; Simon Stephenson has joined the committee; Dave Lewis has decided to turn the NVEG newsletter into a contribution to *Acoustics Update*.

Physical Acoustics Group

The Anglo-French Physical Acoustics Conference (AFPAC) was held in Brighton at the Thistle Hotel from 18-20 January 2012. This was a joint meeting with the GAPSUS group of the Société Française d'Acoustique, and brought together acousticians from both countries. The meeting was well attended with 44 papers being presented. The conference was widely acclaimed as being very successful.

A tutorial day on physical acoustics was held at the Institute of Physics in London in September. Three external speakers presented tutorials that were accessible to non-specialists in their field. This year's theme was Modelling Techniques in Physical Acoustics with presentations by Dr Steve Langdon (University of Reading), Dr Patrick Macy (PACSYS Ltd) and Dr Andrew Nowacki (University of Bristol). At the meeting the Bob Chivers Prize, for the best published paper in physical acoustics by a PhD student, was presented to Pierre Gélat of the National Physical Laboratory and University College London for his paper on modelling the acoustic field of a high intensity focussed ultrasound array scattered by human ribs.

Attendees debate a point during the river cruise at the spring conference



The University of Nantes big band at the spring conference

Senior Members' Group

The Senior Members' Group is progressing slowly – the more so as we get older! All communications have been by email, particularly with the committee, and this seems to have worked.

Two meetings have been held during the past year. The first was our AGM which was kindly hosted at Ecophon. Geoff Leventhall was our speaker. The timing in January was based on our first AGM and was not found to be ideal so it is planned to have our next AGM on 19 March 2013 at IOA headquarters in St Albans. An autumn meeting that had to be delayed took place in December at Stansted Airport on the subject of aircraft noise. Rupert Taylor, our speaker, gave us an interesting review of airport noise. The participants at this meeting came from across the IOA membership.

The SMG had three volunteers who have been cooperating on testing the new website.

SMG members attended a one-day meeting at the Royal Society to offer advice and guidance to young and potential members to the IOA. SMG have not held any formal joint meetings with the YMG.

SMG members took part in the Webinar trial.

The Chairman of SMG has been in touch with the CPD Committee and attended the September meeting of the Membership Committee when the CPD Committee reported. The work of the CPD Committee is completed apart from full implementation. The SMG has offered to find volunteers if the IOA requires surveillance of the scheme.

The History Project is progressing under the guidance of Geoff Kerry with assistance from SMG members.

Speech and Hearing Group

The Speech and Hearing Group held two events during 2012. The first was a talk entitled Progress and Prospects in Spoken Language Processing by Professor Roger Moore of the University of Sheffield, held in April (and followed by the group's AGM). The other, co-organised by the London Branch, was an talk in May given by Johnny Robinson, introducing the National Sound Archives at the British Library, and was very well attended. A further meeting, a talk on protecting the Professional Ear by Andy Shiach of Advanced Communication Solutions, was also co-organised with the London Branch and scheduled to be held in December, but had to be postponed due to unforeseen circumstances. An alternative date is being investigated.

Members of the group were active in the organisation (particularly with respect to reviewing submitted papers) of the sessions on topics relating to speech and hearing at the joint SFA & IOA Acoustics 2012 conference held in Nantes, France, in April.

Discussions are under way with the British Society for Audiology to hold a joint workshop on Good Practice in Speech Audiometry during 2013. The group is also liaising with the British Library to arrange a visit to, and talk on, their Sound & Vision Section. A talk on Looking after your Voice, and a follow-up to the successful one-day tutorial workshop on Speech Recording and Analysis, held in London in 2010, are also planned.

The group committee met five times (in February, April, July,

Attendees visit the Nantes conference exhibition

October and November) during 2012. The group's AGM, as noted above, was held in April 2012. This meeting was quorate, but attendance was rather disappointing, possibly due to it taking place on a Friday afternoon.

During the course of the year, Graham Frost (due to poor health) and Ed Weston (who was taking a career break) resigned or stood down from the group's committee. Dr. Bradford Backus was elected as an ordinary member of the committee at the AGM. The remaining committee members due for re-election were re-elected unanimously.

Underwater Acoustics Group

In 2012, the Underwater Acoustics Group continued to concentrate on the dissemination of knowledge via its conferences, primarily through the organisation of the 11th European Conference on Underwater Acoustics, 2-6 July in Edinburgh at Heriot-Watt University. The event was organised by a committee led by Chris Capus, and we thank Chris for his efforts. The conference attracted more than 400 papers and close to a record number of attendees. In particular, the social events were very popular, and included a Scottish themed conference dinner, a whisky tasting and a musical evening at the Reid Concert Hall Museum of Instruments. A number of major sponsors supported the event, including the US Office of Naval Research (ONR), the Acoustical Society of America (ASA), Ultra Electronics, Wildlife Acoustics, Hydrason and Webistem. A new venture was the on-line publication of proceedings via the ASA's open-access journal Proceedings of Meetings on Acoustics (POMA). Following this success, the group is dedicating its efforts to future meetings, including a session at the IOA spring conference 2013.

Young Members' Group

The Young Members' committee meets quarterly. We have a representative on most of the specialist groups and regional branches.

We have made good progress this year in terms of raising the profile of the group and involving more of the members.

The group has held two technical seminars this year on public inquiry procedures. The seminars were open to all, although aimed at those in the early stages of their career or wanting to better understand the public inquiry procedures. The seminars addressed procedural issues followed by a mock inquiry. The seminars held in London and Manchester were very well attended with positive feedback. A third seminar is planned for Birmingham in 2013.

The group has also jointly organised one-day meetings. For example, in September, we assisted the Building Acoustics Group in organising the Acoustic Challenges in Green Buildings one-day conference. In November we teamed up with the Measurement and Instrumentation Group to assist in organising the conference on The Basics of Measurement.

We have also been keen to promote networking and social evenings for the members. We held a sponsored pizza and pub quiz evening in London and drinks at Christmas.

We plan to continue providing technical seminars in 2013 and involving the young members of the Institute as much as possible.

Regional Branches

The regional branches of the Institute exist to further the technical and social activities of the Institute at local level.

Central Branch

Central Branch held eight meetings during 2012 with an average attendance of 20, attracting a total of 89 different people (including the speakers). The length of the first meeting's title Uncertainty in Field Measurements and in Prediction of Sound Pressure Levels, which was presented by Colin Cobbing and Bob Peters and well attended at NHBC, could be considered to be an indicator of the importance of this subject, although there is probably no correlation between these factors.

This was followed up a few months later by the University of Salford team's presentation on Human Response to Vibration in P14

P13 Residential Environments again at NHBC, which tied with the later railway noise meeting for the highest number of attendees (26).

The National Physical Laboratory kindly hosted a fascinating visit covering a wide range of research topics in June, with Richard Tyler's Have You Been Set Up – Calibration talk hosted by Casella in July. The Open University hosted September's meeting on Current Acoustics Research at the OU, which provided an interesting insight into aspects of acoustics that are beyond the experience of most acousticians working in commercial environments.

In October, Dani Fiumicelli facilitated a topical discussion about the National Planning Policy Framework and Noise Policy Statement for England. The aim was to consider how these policies are being implemented in practice and what effect this is having. November's meeting on Railway Noise – What Every Acoustician Should Know, presented by Brian Hemsworth, was again hosted by NHBC and provided a well explained and comprehensive insight into many of the factors affecting the level and propagation of noise from railways. The year was rounded off with a tour of Marshall Amplification's production facility in Milton Keynes which provided an opportunity to see some audio equipment being built that most musicians can only ever aspire to own or even use.

Our grateful thanks are extended to all the speakers and the venues for hosting for the meetings.

Eastern Branch

The branch has had a successful year with six meetings on various subjects at various locations to cover the large geographical area covered by the branch. It has always been a source of bemusement as to what influences a member's decision to attend a meeting, whether it is the subject matter, the speaker, the location, the time or what is on television! Having varied all the above (with the exception of the TV schedule) we are still none the wiser but the turnout for our varied presentations has been encouraging, whether it has been a site visit at Perkins diesel engines acoustic facility in Peterborough or a demonstration on the certification of instrumentation calibration at Campbell Associates laboratory in Great Dunmow. The branch is extremely grateful to all speakers and hosts who offer their time, knowledge and experience for the benefit of the members.

The occasional committee meeting was replaced this year with email discussion and a can do attitude to arrange many of the speakers and locations by individual members, not least through Clive Pink, our secretary, who has provided sterling support to the branch once more.

Having steered the Eastern Branch for four years, the Chairman, Colin Batchelor, took a final bow and handed over the reins into the capable hands of Martin Jones of Pace Consult, passing the sphere of influence from local authority to consultancy once more. We wish Martin well during his tenure and look forward to another action packed year of acoustic enlightenment.

Irish Branch

Two events were organised by the Irish Branch in 2012.

In mid July we held our AGM at a one-day meeting to allow for local discussion on the recent release of the IOA's A good practice guide to the application of ETSU-R-97 for wind turbine noise assessment. At the AGM Brian McManus stepped down from committee after 12 years of service. The meeting itself was very informative and had very positive feedback from all attendees.

In October we held the seventh annual Gerry McCullagh Memorial Lecture at which Wolfgang Babisch of the Federal Environment Agency of Germany gave a most interesting talk on The Burden of Disease from Environmental Noise. This was very different to the more typical discussion of what noise limits are considered appropriate (particularly for planning scenarios where environmental health and consultants need to come to an agreed point) and where the discussion was more on the particular health effects (heart disease and other associated illnesses). These are considered to be associated with exposure to noise events that cause the body's natural instincts to react, but where the person does not physically react and hence there becomes a build-up of "toxins". This led to one of our longest discussion periods for some time.

London Branch

Our evening meetings have been successfully held for the third year at WSP's offices. Attendance began well this year, with two sessions drawing 60 and 84 attendees in January and March respectively. Attendance at all other meetings has typically been between 20 and 30 people.

ECUA gets under way

Michael Buckingham addresses an ECUA session

Visitors at the ECUA exhibition

Delegates mingle during a break at ECUA

It has been another very busy year which has included nine events comprising seven evening meetings, a one-day meeting held at London South Bank University and our annual dinner.

As usual, the topics for the evening meetings have been very varied in nature, covering subjects such as the British Library sound archives; human response to vibration; and the sound of Stonehenge.

2012 was an iconic and unforgettable year, dominated by the Olympic Games. The first evening meeting of the year set the scene, with Vanguardia Consulting's Olly Creedy discussing the development of the noise prediction and noise management plans for the Olympic Park. This presentation was followed in February by a talk by Dan Saunders, of Brüel & Kjær, on internet-enabled instrumentation, and how this technology can simplify the way acousticians monitor noise and vibration. In March, David Waddington and James Woodcock presented a summary of the Defra NANR209 project, which investigated human response to vibration in residential environments. This was obviously of great interest, with the highest attendance of any evening meeting in 2012. Three students from London South Bank University presented summaries of their MSc projects for the evening meeting held in April. The three projects were considered the best MSc projects of 2011, and were put forward for the RBA Acoustics prize.

A joint evening meeting in collaboration with the Speech and Hearing Group was held at the British Library in May. This fascinating presentation by Jonnie Robinson, the Curator of the Socio Linguistics, gave an insight into the development of British dialects during the last century. Jonnie also demonstrated a number of online resources developed in-house and reviewed ongoing research.

Music to your ears – outdoor entertainment and environmental noise was the title of the one-day meeting, held at London South Bank University in June. Topics covered included effects of the weather on sound propagation; acoustic control of outdoor events; modelling of stadia and arenas; and licensing. The meeting was followed by the IOA AGM, during which Professor Bridget Shield was inaugurated as IOA President.

Following a two month summer break, Richard Collman and members of the IOA Education Committee discussed the role of Acoustic Ambassadors, and looked at the tools available to use for sound education in schools. October's meeting was hosted by Dr Bruno Fazenda of the University of Salford who reviewed research looking at the "sound of Stonehenge". This was the last evening meeting of 2012. The meeting scheduled for December on hearing loss and hearing protection unfortunately was cancelled at short notice. It is hoped that this can be rescheduled with Andy Shiach for 2013, as the topic was generating a great deal of interest.

November saw a new venue for our annual dinner. Pescatori, an Italian fish and seafood restaurant in Charlotte Street, W1 played host this year, providing good food and a pleasant ambience. During the evening, Derek Sugden, former Arup Associates Chairman and founding principal of Arup Acoustics, was awarded the 2012 IOA Engineering Medal by Bridget Shield. Rupert Thornely-Taylor provided a lighthearted after dinner talk entitled Acoustical reminiscences and prophecies, which looked at the changes in acoustics over the two centuries spanned by his career, examined today's issues facing acousticians and what the future may hold in the industry.

Exciting and interesting talks are already planned for 2013. We would like to thank all the members of the London Branch committee and, of course, the Institute staff at HQ for all their invaluable support throughout 2012. We would also like to thank all London Branch members for their continued support at the meetings and of course all the speakers who have helped make the London Branch such a success.

Midlands Branch

The branch has had another successful year in 2012. We held 12 well attended evening meetings, one each month, with an average attendance of about 30. The meetings covered a wide and P16

P15 interesting range of subjects at seven different venues across the region, as can be seen from the list below. We aim to appeal to the wide range of members' interests in the region. CPD certificates were provided at all meetings, which were as follows:

- 31 January **Noise and Statutory Nuisance**
  David Horrocks (Statutory Nuisance Solutions)
  (Venue: University of Derby)
- 15 February **Human Response to Vibration in Residential Environments**
  David Waddington, Eulalia Peris, Gennaro Sica, James Woodcock (University of Salford)
  (Venue: URS Nottingham)
- 22 March **Aspects of Research at the Institute of Hearing Research**
  Chris Sumner, Ian Wiggins (University of Nottingham IHR)
  (Venue: University of Nottingham)
- 18 April **Improving Management Decisions through the Effective Management of Uncertainty**
  Colin Cobbing (ARM Environment), Bob Peters (Applied Acoustic Design)
  (Venue: Atkins, Birmingham)
- 23 May **Ground-borne Noise and Vibration: Prediction and Mitigation for the Thameslink-Canal Tunnels Project**
  Steve Cawser (URS), Barnaby Temple (LB Foster)
  (Venue: Aston Court Hotel, Derby, jointly with the RPWI)
- 20 June **Hospital Noise – is it really a problem?**
  Nicola Shiers (London South Bank University)
  (Venue: URS Nottingham)
- 18 July **Environment Agency Regulation of Noise**
  Tony Clayton (Environment Agency England and Wales)
  (Venue: Atkins Birmingham)
- 22 August **Responding to the END by Demonstrating the Benefits of Rail Grinding on the GB Railway Network**
  Oliver Bewes (Arup Acoustics)
  (Venue: Arup Campus, Solihull)
- 25 September **IOA Diploma Student Projects, University of Derby**
  Noise Exposure of Amateur Brass Musicians and Noise Reduction Methods
  Martin Hamer
  An Investigation into the Efficacy of a Commercially Available Acoustic Absorbent Material in Reducing the Airborne Sound Transfer of an Acoustic Guitar through a Suspended Floor
  Matthew Barnes
  (Venue: University of Derby)
- 18 October **Underwater Bioacoustic Research**
  Paul Lepper (University of Loughborough)
  (Venue: University of Loughborough)
- 28 November **Wind Turbine Noise: A Brief History and some Technical Issues**
  Andy McKenzie (Hayes McKenzie)
  (Venue: University of Derby)
- 11 December **Environmental Noise and Effects on Health: Recent Developments**
  Bernard Berry (Berry Environmental)
  (Venue: University of Derby)

The branch committee would like to thank the speakers for their excellent technical contributions, and the various sponsoring venues: Atkins Birmingham, Arup Solihull, URS Nottingham and the Universities of Derby, Loughborough and Nottingham, who provided the vital facilities and refreshments. Finally, thank you to the branch members who have supported us so well again this year.

The committee is unchanged for 2013.

North West Branch

During 2012 the energised branch committee with its influx of some new faces organised six successful meetings starting in February at BDP with a presentation by Lisa Lavia of the Noise Abatement Society. Lisa covered the dual subjects of Quiet Night Time Deliveries and Using a Soundscape Approach to Address Night Noise Issues in Brighton, where good practice in delivering goods near residential properties at night and the calming effects of a pleasant acoustic environment on late night street life were described.

In March, a one-day meeting was organised by the NW Branch, ably assisted by HQ, on Sustainability and Renewable Energy at the Victoria and Albert Hotel, Manchester. The topics included BREEAM assessments, sustainability in building design, the effect of electric vehicles, the acoustic issues associated with building services plant in sustainable buildings and the measurement of air source heat pumps, plus the ongoing impact of wind turbines, but this time due to smaller scale types. Much of the organisation was undertaken by Will Martin and Paul Freeborn.

A limited number of participants undertook a tour of the Liverpool Institute for Performing Arts (LIPA) in June. LIPA was co-founded by Sir Paul McCartney and Mark Featherstone-Witty and is housed in Paul McCartney's old school. Pete Philipson of LIPA gave a fascinating conducted tour that included the Paul McCartney auditorium and main recording studios, and illustrated the acoustic requirements and design of the spaces. The trip was arranged by Dave Poley.

In September, Dr Paul Lepper of the Underwater Acoustic Research Department at Loughborough University provided a talk on the Effects of Underwater Noise on the Marine Environment at BDP. Paul fascinated the audience, many of whom were new to underwater acoustics, describing the potential impact of man-made noise on a variety of marine species.

The AGM in October held at BDP provided the starter to a presentation by Peter Mapp who discussed his vast experience in the design of sound systems for a wide range of project environments in From Harry Potter to the Mersey Tunnels via multipurpose spaces – can sound systems really overcome poor or inappropriate acoustics? Peter took the opportunity of expressing his concern that acoustic conditions are being relaxed by acoustic consultants. He asked, are they under pressure from the "value engineering" exercise, to a position where the design of appropriate sound systems becomes difficult or impossible.

The last meeting was held in November at the renowned Chethams School of Music, where Steve Swan of Arup Acoustics led a tour of the new music teaching building. Steve, who had led the acoustics consultancy team, introduced a large group of interested observers to the new £31million building with its many teaching rooms, rehearsal rooms, recording studios and 100 seat recital hall, not to mention the huge cavernous space for a future 350 seat concert hall.

Thanks to BDP for hosting most of the meetings during the year and all those who provide the backup at the venues.

Scottish Branch

2012 has been a relatively quiet year in terms of branch meetings. We hope to be much more active in 2013.

However, Scottish branch members have been active in responding to several Scottish Government Consultations, including the proposed Technical Guidance for Section 7 of the Non Domestic Technical Handbooks on Sustainability Labelling for Schools. Thanks to Chris Steel for feeding into the Building Acoustic Group's response and Ann Budd for coordinating this.

Scottish Branch, via the IOA Accreditation Board members, also responded to the Scottish Government Building Standards Division review of the Sound and Air-tightness Testing document. Thanks go to Alistair for coordinating the Scottish Branch response to this consultation.

The IOA's accreditation scheme for sound insulation testing accredited its first member in 2012. This scheme differs from the ANC scheme in that it is exclusively an accreditation of the individual tester rather than being linked to an organisation. Congratulations to David Barbour in becoming the first Scottish Branch member to be accredited under the IOA scheme.

The Chairman, Secretary, Treasurer and Young Person's Representative of the Scottish Branch remain unchanged. Many thanks to Andy Watson for continuing to look after Scottish Branch financial matters, to Nicola Robertson for her continued commitment as Young Person's Representative and to Committee members for their support.

Southern Branch

The branch has been inactive during 2012 but is now in the ▶

process of being revitalised; with the aim of serving its members in 2013. An interim committee has been formed comprising Peter Rogers as acting Chairman and Daniel Saunders as acting Secretary. A vacant place is available for a young member on the committee to assist in delivering this year's evening meetings, so please do express an interest to us if you fancy the challenge.

The year will start with an AGM at the end of January to formally elect new committee members. Presentations on calibration and railway noise have already been organised with updates on planning and wind turbine noise also expected during 2013. Ideas for future topics are always welcome and the committee would be pleased to hear of these and other ideas for how the branch could best serve members.

South West Branch

The branch organised a meeting on Sustainability and Ecominimalism: The Architect and the Engineer in October. This was held at Atkins' Bristol office and was presented by architect Lee Fordham, of Archetype and Nick Cullen, head of R&D at Hoare Lea.

The meeting provided a fascinating insight into some emerging trends in building design and how this can affect acoustics among other fields. This can sometimes have bonuses for acoustics, for example the very good performance of façades using the Passivhaus system.

The branch was represented at the Groups and Branches meeting at head office by secretary Dan Pope.

Other than this, the branch had a outwardly peaceful year as several planned talks did not come to pass, but these are now back on track and we look forward to a more active 2013.

Welsh Branch

2012 was another modest but successful year for the Welsh Branch with one well attended event organised. Wind Turbine Noise 7 was held in January at the SWALEC Stadium, Cardiff. The event was fully subscribed in advance and drew attendees from government, local authorities and consultants.

The day itself went very well with a mixture of leading industry speakers and an engaged audience contributing to a robust and healthy debate. Another event is expected for 2013 on another topic and it is hoped that it will be as successful as the event held in 2012.

Yorkshire and North East Branch

The branch held two meetings in 2012, at the University of York and the University of Bradford.

At the meeting at the University of York, Dr Dave Chesmore gave a talk entitled The Hidden World of Sounds. This covered infra-, ultra- underwater and vibrational sounds, concentrating on animals and insects. Many examples were given, and sound detection and identification was discussed. Dr Chesmore also discussed sound evolving in different habitats. Some examples included mole crickets excavating an acoustic chamber that can generate sounds in excess of 70dB and caterpillars talking to each other, and in conflict having acoustic battles!

The meeting in Bradford was preceded by our branch AGM, the main issue being the election of the committee. The following were elected:

- Chairman: Dave Chesmore
- Secretary: Dave Daniels
- General Committee:
  Niall Smith, James MacKay, Simon Clothier, Kirill Horoshenkov
- Young Members Rep: Michael Pimlott

Professor Horoshenkov then gave a talk entitled Natural Means for Noise Control. He discussed the factors influencing a Tranquility Rating (TR), and the acoustic absorption of soils, plants, etc. The involvement of visual and acoustic interaction determining what is tranquil was presented, and the derivation of a Tranquillity Scale.

There were two stages, photographic assessment and subjective assessment using audio/visual stimuli. Equations for TR were derived through Linear Regression Analysis, also cultural differences on what is tranquil.

Pot plants were put in an impedance tube, different types of plants with different leaf types, with/without soil, measuring the equivalent flow resistivity (tortuosity) of the plant. He concluded that by selecting soil/plants, noise can be controlled.

MEMBERSHIP		
Grade	2011	2012
Hon Fellow	34	35
Fellow	179	173
Member	1698	1722
Associate Member	742	733
Affiliate	67	65
Technician Member	78	81
Student	79	67
Totals	2931	2930
Key Sponsor	3	3
Sponsor	51	51

P18

P17

GROUP MEMBERSHIP		
Group	**2011**	**2012**
Building Acoustics	1206	1226
Electro acoustics	311	322
Environmental Noise	1500	1540
Measurement & Instrumentation	455	499
Musical Acoustics	286	280
Noise and Vibration Engineering	968	984
Physical Acoustics	183	199
Senior Members	81	104
Speech & Hearing	193	186
Underwater Acoustics	156	172
Young Members	116	145

BRANCH MEMBERSHIP		
Branch	**2011**	**2012**
Central	148	172
Eastern	262	260
Irish	131	127
London	732	767
Midlands	395	387
North West	378	386
Overseas	315	326
Scottish	163	160
South West	265	265
Southern	456	454
Welsh	67	71
Yorkshire & North East	213	224

DETAILS OF EMPLOYMENT		
Employment Category	**2011**	**2012**
Architectural Practice	42	43
Consultancy	1397	1420
Education	244	221
Industry/Commerce	369	365
Public Authority	390	370
Research & Development	219	219
Retired	146	149
Other	88	91

MEETINGS ATTENDANCE IN 2012			
Topic	**Date**	**Venue**	**Attendance**
Wind Turbine Noise	26 January	Cardiff	85
Sustainability & Renewable Energy	1 March	Manchester	27
Environmental Noise Propagation	21 March	London	54
Acoustics 2012	23-27 April	France	960
Music to Your Ears	12 June	London	74
National Planning Policy Framework	28 June	London	75
ECUA 2012	2 – 6 July	Edinburgh	411
Good Practice Guide on Wind Turbine Noise	18 July	Dublin	29
Good Practice Guide on Wind Turbine Noise	13 September	London	40
Acoustic Challenges in Green Buildings	26 September	Watford	30
National Planning Policy Framework	2 October	Birmingham	69
Autumn Annual Conference 2012	6 November	Birmingham	102
RS2012	14-16 November	Brighton	97
Basics of Measurement	27 November	Watford	42

INSTITUTE PERSONNEL AT 31 DECEMBER 2012		
COUNCIL	**Officers**	**Ordinary Members**
President	Prof B M Shield HonFIOA	Ms L D Beamish MIOA
President Elect	Mr W Egan MIOA	Mrs A L Budd MIOA
Immediate Past President	Prof T J Cox MIOA	Mr K Dibble FIOA
Honorary Secretary	Dr N D Cogger FIOA	Dr E E Greenland MIOA
Honorary Treasurer	Dr M R Lester FIOA	Dr P A Lepper MIOA
Vice President: Engineering	Mr R A Perkins MIOA	Mr R Mackenzie MIOA
Vice President: Groups & Branches	Mr G Kerry HonFIOA	Mr G A Parry MIOA
Vice President: International	Dr W J Davies MIOA	Mr A W M Somerville MIOA
		Mr D L Watts FIOA
Committees & Sub Committees		**Chairman**
Education		Mr S W Kahn MIOA
Diploma in Acoustics and Noise Control, Board of Examiners		Mr S J C Dyne FIOA
Certificate of Competence in Environmental Noise Measurement		Dr M E Fillery FIOA
Certificate of Competence in Workplace Noise Assessment		Mr G Brown MIOA
Certificate of Proficiency in Anti-Social Behaviour (Scotland) Act 2004 (IOA/REHIS)		Mr S Williamson MIOA
Certificate in the Management of Occupational Exposure to Hand Arm Vibration		Mr T M South MIOA
Engineering Division		Mr R A Perkins MIOA
Medals & Awards		Prof B M Shield HonFIOA
Meetings		Mr J P Newton MIOA
Membership		Mr P T Freeborn FIOA
Publications		Mr A Lawrence MIOA
Research Co-ordination		Prof K Horoshenkov FIOA
Specialist Groups	**Chairman**	**Secretary**
Building Acoustics	Mr R O Kelly MIOA	Mrs A L Budd MIOA
Electroacoustics	Mr P R Malpas MIOA	Ms H M Goddard FIOA
Environmental Noise	Mr S C Mitchell MIOA	Ms N D Porter MIOA
Measurement & Instrumentation	Mr R G Tyler FIOA	Mr M J Armstrong MIOA
Musical Acoustics	Mr M Wright MIOA	Mr D Sharp MIOA
Noise and Vibration Engineering	Dr M G Smith MIOA	Mr M D Hewett MIOA
Physical Acoustics (Joint with the Institute of Physics)	Prof V F Humphrey FIOA	Prof M Lowe
Senior Members' Group	Mr R J Weston MIOA	Mr M R Forrest MIOA
Speech & Hearing	Dr G J Hunter MIOA	Mr D Nash MIOA
Underwater Acoustics	Dr P F Dobbins FIOA	Dr R A Hazelwood MIOA
Young Members' Group	Ms L D Beamish MIOA	Ms E Keon MIOA
Regional Branches	**Chairman**	**Secretary**
Central	Mr R A Collman MIOA	Mr M Breslin MIOA
Eastern	Mr C L Batchelor MIOA	Mr C M Pink AMIOA
Irish	Dr M R Lester FIOA	Mr S Bell MIOA
London	Mr J E T Griffiths FIOA	Mrs N Stedman-Jones MIOA
Midlands	Mr P J Shields MIOA	Mr K Howell MIOA
North West	Mr P E Sacre MIOA	Mr P J Michel MIOA
Scottish	Mr A W M Somerville MIOA	Ms L Lauder MIOA
Southern	Dr N D Cogger FIOA	Mr S J Gosling MIOA
South West	Ms H G Kent MIOA	Mr D C Pope MIOA
Welsh	Mr G O Mapp MIOA	Mr J M Keen AMIOA
Yorkshire & North East	Dr D Chesmore FIOA	Mr D Daniels MIOA
Chief Executive:	Mr R Bratby	

Work under way on blueprint for IOA's future

By Charles Ellis

Work has begun on drawing up an action plan that will shape the future of the Institute of Acoustics over the next five years.

The move is the result of a day-long strategy workshop held in St Albans in early March involving the Council, committee chairmen and others representing all grades of membership and interests.

The day saw those present decide on 11 priorities for action – and it is these that Chief Executive Allan Chesney and the Executive Committee are now in the process of turning into a concrete plan.

Each goal in the plan will be "owned" by a project manager – either a member of staff or an Institute member – who will report to the relevant committee.

At the plan's heart will be a major upgrading of the head office IT systems and website to enable the Institute to be far more proactive in how it goes about its business.

Although some goals will not be become reality for another year or so, it is intended that others, for example the website upgrade, will be up and running within the next few months.

Bridget Shield, President, said: "Our new strategy will play a vital role in shaping how the Institute evolves over the next few years. Council is working with Allan Chesney, building on our past achievements and reflecting what members are telling us they want now, to set new goals and ensure that we turn those goals into reality. With our 40th anniversary coming up next year, it's an important moment in the Institute's history and what we are doing now will have a lasting influence on how we develop over the next 40 years." P20

Some of the ideas put forward

P19 The workshop began with the 30 attendees splitting into groups of six and being asked "what makes us proud?" of the Institute and "what drives us crazy?"

They were then asked to study five strategic areas drawn up by the Executive Committee and decide the top three outcomes for each one, what steps could be taken to achieve them and how progress could be measured. The five areas were:

- Influencing the acoustics agenda
- Developing tomorrow's professionals
- Maintaining standards and improving members' skills
- Delivering an excellent service to members
- Honouring our commitment to public benefit.

Finally each attendee was asked to choose his or her three main priorities, with all their choices eventually being consolidated into 11 priorities. The outcomes are ranked with the score in brackets:

- There is a clear, shared understanding of how the IOA works (15)
- A clear and effective development framework, with members proactively seeking development opportunities to maintain professional currency and with competency formally recognised (13)
- Acoustics-related study and career pathways are widely recognised with better education about the role that acoustics play in society (9)
- Policymakers recognise that acoustics play a role in relevant decision-making processes, with better informed public policy through sharing IOA expertise (8)
- Other professionals recognise the significance of acoustics in their role (8)
- Information is disseminated efficiently and effectively (6)
- Good practice is widely recognised and implemented (5)
- A clear and well-promoted system of financial support that is open to the public (3)
- Improved quality standards (3)
- Meetings and events are well structured and effective (2)
- A diverse, engaged and thriving student membership (2)

Members discuss what they want to see

What makes us proud?

Our status
- Professional image
- International credibility
- Involvement in standards guidance

Our membership
- High quality engineers
- Breadth of professions involved

Our offer
- High quality core staff
- A wide range of activities
- Networking opportunities
- Recognised professional qualifications
- High quality of conferences (good speakers, good subjects)

Our ethos
- Camaraderie
- Inclusiveness
- Strong commitment of volunteers
- Good atmosphere within the Institute

What drives us crazy?

Our systems and processes
- Governance not working efficiently, leading to slow decision making
- Restricted lines of communications e.g. between groups
- Slow and unclear accountancy and budgeting
- Slowness to adapt to more modern ways of working e.g. e-meeting notes, live streaming of meetings
- Lack of ability to analyse the membership
- Poor website functionality
- Some members don't feel they have a stake

Insufficient diversity amongst membership
- Lack of student members
- "Same faces" at events
- Limited diversity among members (ethnicity, gender)

Insufficient profile in some area
- General lack of status/low awareness of acoustics amongst wider public
- Not having a presence amongst architects

Insufficient development support
- Lack of learning materials for members
- Lack of sufficient encouragement for students to progress
- Insufficient work opportunities after the Diploma
- Insufficient focus on CPD

Please contact us for more information or download demo versions :
www.soundplan.eu

Distributor in Ireland
Marshall Day Acoustics
028 308 98009
shane.carr@marshallday.co.uk

UK Distributor
David Winterbottom
SoundPLAN UK&I

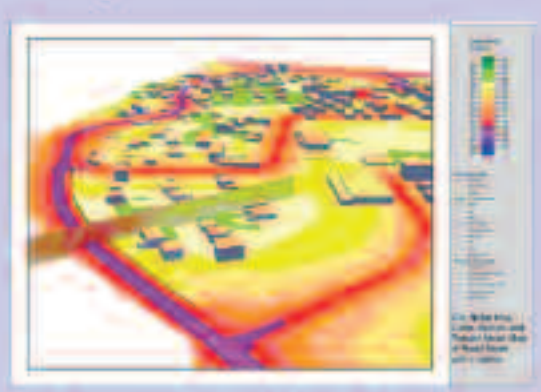
david@soundplanuk.co.uk
01223 911950 / 07050 116 950
Skype david.winterbottom
www.soundplan-uk.com

SoundPLAN

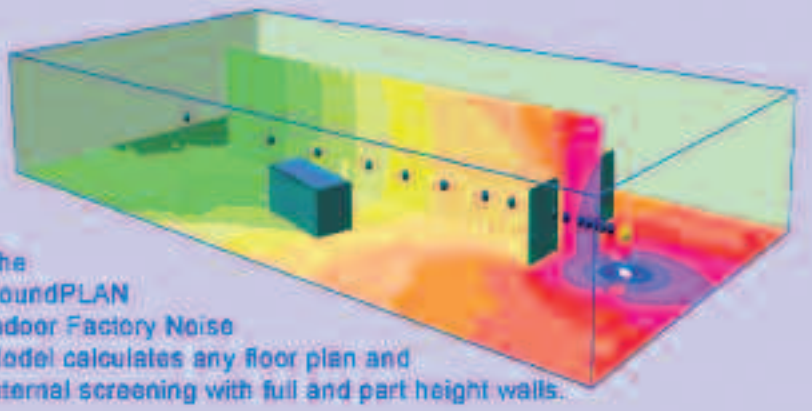
More than 5000 users in 50+ countries.

SoundPLAN Version 7.1

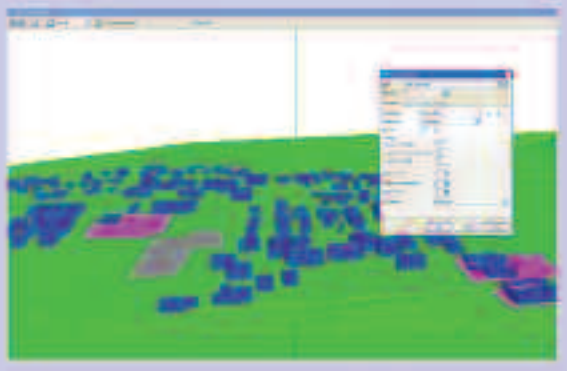
Our dynamic search method makes it the [illegible] noise control software on the market .

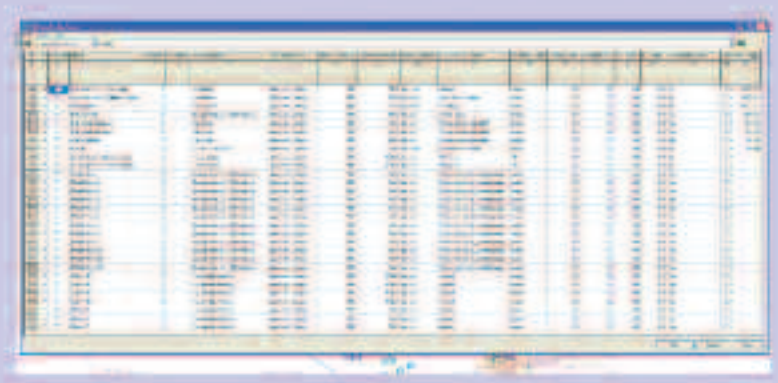


Stunning, easy to use Graphics.



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

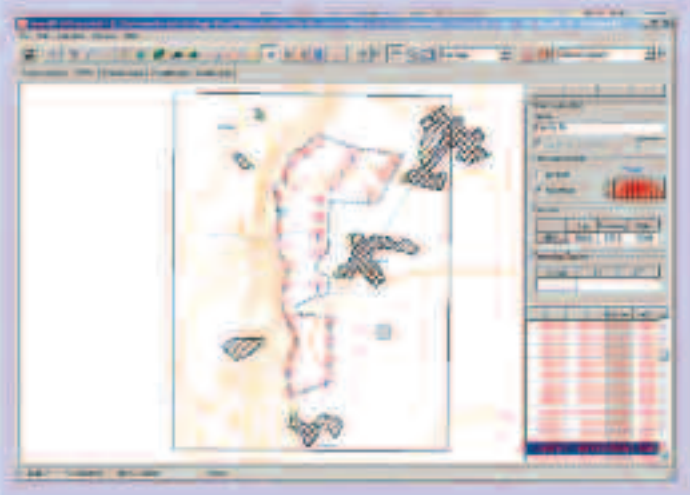


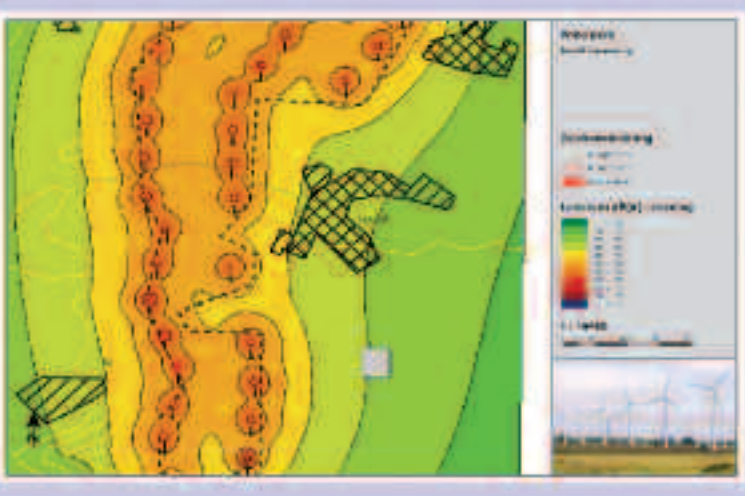


Simple and direct editing of objects in 2D, 3D or in the Attribute Explorer tables

SoundPLAN *essential* 2.0

SoundPLAN *Essential* is a compact version for occasional users and less complex projects at a very competitive price. Road, Rail, Point Line and Area Source Types. Choice of internationl standards. No model size restrictions. Simple to use.





Institute gives full support to new music research group

The Institute of Acoustics is giving its full support to the setting up of a new organisation to be called Music Research Consortium UK (MRCUK), which will be formally launched in London on 25 October.

Its main aims will be to support, promote and encourage music studies and research and collaboration between organisations involved in music – and in the process improve communication and develop cross-disciplinary discussions and links with practitioners and professional bodies.

The decision to launch it was taken at a meeting, held in London in March, of heads and deputies of music learned societies and some 18 other institutions and societies in the field of education, composing, performing, recording, musical instruments etc.

Among those invited to attend was Mike Wright, Chairman of the IOA Musical Acoustics Group (MAG), who gave a brief outline of the group's activities.

Afterwards he said: "I feel that it could be very much be in the interests of the Institute to take an active role in MRCUK. I believe there will be a number of benefits to interested members, particularly those in the MAG as well as some within the Electro-acoustics Group."

The meeting, chaired by Professor Mark Everist, University of Southampton and President of the Royal Musical Association (RMA), followed discussions within the RMA last year after which the RMA's council agreed that it should seek to establish bilateral links between sibling organisations in the UK.

A preliminary meeting was held in December 2012 by Professor Everist with "learned representatives" from a number of organisations to test the viability of the idea. This was prior to the IOA being represented where they considered a number of possibilities as quoted below:

- Provide an environment for the advocacy for, and defence of, the scholarly study of music.
- Enhance the RMA and others' web pages with links to sibling organisations.
- Share distribution lists and publicity.
- Bilateral sharing of other data (calendars, dates and scheduling);
- Invite sponsorship of sessions at the RMA annual conference from 2013 onwards.
- Run a summit event to discuss the state of musical scholarship and to develop a coherent set of relationships.
- Create a class of Council membership for representatives from other organisations (which they might expect to be reciprocal).

Launch of women and families working group

By Bridget Shield

As a charity, the IOA has a responsibility to the Charity Commission to "recognise, promote and value equality and diversity in all aspects of our activities". The results of last year's membership survey showed that our membership is not very diverse, so this is an area that needs to be addressed.

As a first move, a small women and families working group has been set up to consider the situation in relation to women members, and others who may be affected by issues traditionally regarded as pertaining to women, such as childcare. The group consists of Anne Budd (anne_louise_budd@hotmail.co.uk) Emma Greenland (emma.greenland@WSPGroup.com) and Hilary Notley (hilary.notley@gmail.com); they will liaise with other members, particularly the Young Members' Group, as necessary.

One of its first tasks is to collect data on the numbers and profiles of women members; how those numbers have changed over the years; and how the IOA compares with other engineering and science organisations, for example the Institute of Physics, CIBSE and IMechE. Unfortunately, the IOA does not hold past records of members so attempts will have to be made to source this data from elsewhere, such as attendance records at branch meetings, and numbers of students on the IOA Diploma and university courses over the years.

A particular concern among other institutions is the comparatively large number of women who drop out of careers in engineering or science. The group will seek to establish reasons why women may have given up a career in acoustics, or membership of the Institute. It is possible that specific problems faced by women members, such as difficulties caused by taking career breaks or part time working, will be identified. Some of the issues may apply to other members, for example parents of small children, other carers, members with long term illnesses, and their views will also be sought by the group. The group may recommend that the Institute should provide support to assist such members in continuing or returning to acoustics.

The group will also report on relevant initiatives introduced by other institutions, such as the Diversity Panel recently launched by CIBSE, and will consider whether there is a need for the IOA to establish a similar group.

The working group is due to complete its work, and submit a report, by the end of this year, during which time it will be providing interim reports to Council. Updates will be published in the Bulletin and/or the e-newsletter. If any members have information or experience which they think is relevant, please contact one of the members of the working group. Any information or suggestions provided will remain confidential.

Publication of IOA Good Practice Guide

The long-awaited *A Good Practice Guide to the application of ETSU-R-97 for wind turbine noise assessment* will be launched at a one day meeting in Bristol on 21 May.

An IOA working group has been collecting information on good practice on how to rate and assess wind turbine noise using the methodology in ETSU-R-97.

The guide represents the current status of good practice on matters such as noise, wind and rain data collection, data analysis to derive the noise limits for the scheme, and current practice in calculating the propagation of turbine noise.

It sets apart the technical methodology from the policy aspect of the noise limits, the latter being excluded from the document and a matter for Government.

Richard Perkins, working group chairman, said: "The intent of the guide is to dispel a great many myths around wind turbine assessment methods and to share current good practice. Debate though on aspects of the methodology is bound to continue, such as the article in the technical contributions section in this Bulletin. Members should read these articles in the context of the good practice guide when it is published, and further commentary from the working group on those aspects not reflected in the good practice guide will follow."

One hundred more membership applications approved by IOA Council

One hundred and one applications for Institute membership were approved by Council in March following recommendations by the Membership Committee.

Of the total, 78 applications were for new or re-instated membership and the remainder were for upgrades.

Fellow
Woodger N

Member
Aremu O
Birchby A
Boatman J
Butler M J
Conetta R A
Creedy O
Dickerson D S
Dodds N
Eaves D M J
Galikowski T
Gray D R
Harmon J A
Hewitt S
Knowles P J
Kwok K T
Lemieux F M
Luckhurst K
McAlister M P
Nixon S J G
Smith L
Thomas D M
Thompson D L
Trill J J
West R
Whitman M P
Yao K

Associate Member
Allen S
Bailey D F
Barlow M
Baron M
Bartlett I R
Bierwas S
Bourzoukos M
Brezas S
Bronka M A
Brown C R
Bryan C
Cartwright B R
Cloke M
Collins D A
Cosgrove R
Currie C L
Dickson K S
Earis R
Ford T
German K
Griffiths R E
Hamer M S
Hardy M J
Hickling M W
Hill A
Honey R
Honywill S P
Hopwood D
Hunter J B
Jamieson R I
Lee E
Masey R J
McCollin C
McLaughlin D
Moisey J W
Morton D
Mroz J
Nelson J
Newell A
North J
Palmer J J
Pawson E
Rawlings C
Rendell L R
Roberts L
Ross J P
Stephens K D
Turner S R
Walker M P
Walsh J
Whittle J
Williams G B

Affiliate
Yendell C

Technician
Durham M
Dwyer J W
Green D
Hajdar J
McDonald K
Wardle A
Wood N

Student
Banovic L
Clark A T B
Dallos M
Hardman T
Melling J D
Migliori D
Munns J R
Singleton L R
Speleoto M
Walke A
Wallace D J
Wiriyasubpachai N
Wiseman M T L
Yoon D

Buy Quiet/ Design Quiet

Report by Russell Tipping

Nottingham 5 March saw a joint meeting organised by the Noise and Vibration Engineering Group (NVEG) and the Health and Safety Executive (HSE) on the subject of Buy Quiet/Design Quiet, inspired by HSE's Buy Quiet campaign (http://www.hse.gov.uk/noise/buy-quiet/about.htm).

The meeting, at the HRMC campus, was introduced by Malcolm Smith, NVEG Chairman, and Sarah Haynes, HSE, highlighting the vision of creating a demand for quiet machinery from purchasers so as to encourage manufacturers to improve their designs.

The opening presentation was given by Sarah who, as one of the driving forces behind Buy Quiet, spoke on The Importance of Buying and Designing Quiet and the Legal Framework. Her summary and introduction to the concept of the HSE campaign began with a review of the reality of industrial noise control in the UK, where after nearly 40 years of action on workplace noise there are still too many noisy factories and machines. Employers continue to resist change, believing that noise control is expensive and reduces productivity.

The need for HSE enforcement has led to the implementation of various legal requirements, including declaration of noise emissions of work equipment, although it was pointed out that in the recent NOMAD project, which looked at how machinery meets these legal requirements, approximately 80% of machines tested failed to meet the requirements. In conclusion Sarah summarised the challenges to the sale of quieter machinery:

- Employers to demand quieter equipment:
  - Benefits of quieter equipment recognised
  - Unnecessarily noisy equipment should be 'not suitable'
- Manufacturers aware of noise control technology:
  - Designs evolve to include noise control
  - European Market Surveillance of noise control
- Manufacturers to provide good noise information:
  - Adequate harmonised standards for noise measurements
- Employers to use noise information.

The second talk, Holistic Approach to Plant Design by Jon Richards (KBR), focused on the problems and techniques of contractors and designers working on larger and more complex process plants, often involving hundreds or even thousands of noise sources. The talk reviewed methods of how to assign noise levels to different equipment items within a plant, starting with the required noise limit and working back to an overall plant sound power level. This overall power can then be divided out amongst equipment items and piping, and a sound pressure limit can also be derived.

Delegates discuss an issue

The benefits of noise modelling were also highlighted, showing how predictions can be used to compare different noise control strategies, although Jon did warn that "computer modelling is only as good as the data it is built on". The presentation concluded with an insight into the usefulness of the ALARP (As Low As Reasonably Practicable) approach to equipment selection.

The next case study was presented by Ludovic Desvard (Dyson) who gave a comprehensive and insightful talk on the Acoustic Development of High Speed Hand-dryers, showing how with good noise control engineering an already popular and successful product can be improved with negligible impact on performance. During development of the second generation Dyson hand-dryer, it was identified that the noise spectrum contained specific undesirable tones. By using a smaller "digital motor", space was made available for a Helmholtz resonator and additional absorption, both of which reduced the level of the annoying tones. The resulting design, although not significantly lower in overall sound power because of the flow noise, was a softer and more desirable sound. The talk highlighted how, when acoustic requirements are considered at an early design phase, the incorporation of a succinct and elegant solution is far more practical and cost efficient.

The final presentation before lunch, entitled 'Designing Quiet Products', was delivered by Peter Wilson (INVC), who captured the spirit of the meeting with the statement: *'Designing a quiet product is an engineering problem, not a safety issue, and a change of mindset is key'*. His meaning was that, where high noise levels are seen only as a safety issue, an expensive off-the-shelf treatment may be installed rather than investigating and resolving the cause. Approaching the problem with an engineering focus allows the machine to be analysed and the source of the noise be established and assessed, resulting in a more efficient and cost effective solution being determined.

The need for an engineering approach was expanded on by a discussion of how to assess a noise problem. One such method is a BPM (Best Practical Means) diagnosis, this involves:

- Listing all noise sources
- Rank the sources
- Assess all the noise control options for the dominant source
- If engineering solution is not practical for the dominant source, then you have proved that enclosures/screens are the only option.

The talk concluded with a summary of the benefits of noise control at source, which includes:

- Reduced maintenance and running costs
- Improved productivity
- Reduced risk management costs.

After lunch Bruce Appleton (HSE - OSD) gave a review from personal experience of the reality of Noise and Vibration Control in Off-Shore Design. Although there appears to be a general reduction of blanket hearing protection in the off-shore industry, there still exist many outdated attitudes towards high noise levels. A good example is platform owner documentation which refers to a "noise survey" rather than a "noise assessment".

The presentation went on to point out that high noise levels are not just a concern with regard to hearing loss, but also impact concentration and the audibility of fire alarms. Bruce concluded by suggesting that avoidance of noise control and a reluctance to Buy Quiet is a result of a lack of knowledge and understanding, a view reflected by several other speakers.

Peter Wilson returned to present a review of some of his Engineering Noise Control Examples at INVC, including a

comparison of a conventional approach versus the BPM approach. A notable example was a toothpaste tube filling machine, where the unmodified machine generated a sound pressure level of 94 dB(A), due mainly to cooling pipes used to seal the ends of the tubes. The proposed solution was an enclosure which would have been a high cost solution with hygiene and productivity issues. Following the BPM diagnosis the dominant noise source was identified as coanda effect nozzles, and the solution provided a reduction of 12 dB together with improved performance, lower air consumption and no effect on access or operation.

The final presentation of the meeting, given by Malcolm Smith (ISVR Consulting), provided a guide to techniques of noise source identification. The talk reiterated the need for clear identification of dominant sources, but also emphasised how the accurate estimation of the level of secondary sources relative to the primary source is often a key factor in successful low noise design.

After a practical example of how the source identification techniques were used to identify a way of reducing noise from a crane, without impact its lifting capacity, the presentation concluded with the priorities for low noise design:

- Control primary excitation mechanisms where possible
- Use isolation and damping to block and absorb energy along transmission paths
- Minimise the efficiency of sound radiation using perforated panels, or local enclosure where necessary
- Avoid resonances at all stages.

After a short break, the floor was opened to questions and a free flowing discussion followed. The panel of speakers was asked if, in their opinion, the fear of personnel injury claims was a driver for companies to be more proactive in the reduction of noise levels within the workplace. The consensus of the panel was that this was not the case. Sarah Haynes added that in her experience some insurance companies had paid out even when the company had had a good noise policy framework in-place.

The discussion continued on to the subject of responsibility, and who should be driving change within industry. General opinion was that the driving force behind any real change needed to be legislation, combined with effective enforcement. Comparison was made with the regulation and successful enforcement for hand/arm and whole body vibration protection and the possible lessons that could be learnt from this.

Finally, led by Malcolm Smith, the discussion concluded on the subject of education of vendors and purchasers, which highlighted the need for suitable training courses.

In general the day seemed to be a great success, a view that was reflected in the positive feedback from delegates. A particular strength was the healthy mix of non-IOA members, including machine vendors and manufacturers, and a strong cohort of acousticians and noise control materials suppliers. This diverse audience encouraged debate throughout the day, as well as giving all parties an excellent networking opportunity.

The Noise and Vibration Group would like to thank the HMRC for the use of the meeting room, Sarah Haynes and Malcolm Smith for coordinating the arrangements and all of the speakers for volunteering their time and experience.

See Quiet house aims to be 'Ideal Home' on page 34.

Senior Members continue to offer their skills for Institute's benefit

Senior Members' Group members have continued to play an active role in applying their skills and experience for the benefit of the Institute, Chairman Ralph Weston told the AGM, held at the IOA offices in St Albans in March.

Their activities had included helping with continuous professional development, assisting the Young Members' Group, reviewing and contributing articles for *Acoustics Bulletin*, website testing and supporting the History Project.

The group had also staged two half-day meetings in 2012 – the first at Ecophon in Hampshire involved a presentation by Geoff Leventhall on low-frequency noise and the second, at Stansted, featured a talk on aircraft noise – and he said it was hoped to hold further meetings in 2013.

Ralph was re-elected as chairman for a further two years, after which he will stand down, and Michael Forrest was re-elected as secretary for a further year. Martin Armstrong, Bernard Berry and Ian Campbell were re-elected to the committee and have been joined by newcomers Kay Crittenden, Rodger Munt and Mike Wright.

Following the closure of the AGM, IOA President Bridget Shield updated members on the latest plans for the Institute's 40th anniversary celebrations in 2014.

It was intended to hold a two or three day conference, probably in London, in the autumn covering all subjects and featuring some "big name" speakers which would probably overlap with the Reproduced Sound conference. A major social event was also planned to raise money for bursaries for acoustics students.

Geoff Kerry, Vice-President Groups and Branches, who is in charge of the History Project, said excellent progress had again been made in 2012 thanks to sterling efforts by volunteers.

Although no publication date had yet been set, the aim was to produce an A4 booklet to coincide with the 40th anniversary celebrations. More volunteers were still required, in particular to help with editing and proofreading and, as ever, anecdotes and pictures from the Institute's early days were needed.

The meeting concluded with a well-received paper by Mike Wright, Chairman of the Musical Acoustics Group, entitled *What is the Right Note, Pitch or Temperament in Music?* in which he discussed how "classical" composers in Africa had written piano music tuned to the European convention which used a 12-note scale. Mike's presentation was also enjoyed by more than 20 people not able to be present at the meeting thanks to a webinar organised by David Trew.

Changes in Institute event advertising

Would all readers please note that, as from this issue, no flyers containing details of forthcoming IOA events will be inserted in the Bulletin. This is being done to save costs, reduce unnecessary use of paper and ensure staff time is spent more productively.

In future details of all such events will only be sent electronically, via *Acoustics Update* and by separate email, so do check all such correspondence from the IOA to ensure you do not miss out.

The Institute's conference programme will continue to be listed on page 5 of the Bulletin and event details be posted on the IOA website.

Acoustic design for schools for special education needs and the hearing impaired

London Branch meeting

Report by Vicky Stewart

In February Konca Saher of Atkins presented a talk on *Acoustic Design of Schools for Special Educational Needs and Hearing Impaired* to the London Branch.

According to recent studies, 15% of the population of England suffer from some sort of hearing impairment. Of the people who are mentally challenged, 35% are hearing impaired, and of the people with Down Syndrome, 57% are hearing impaired. WHO reports that the prevalence of hearing impairment among the general population is expected to be around 25% in the next 30 years.

The majority of children who are hearing impaired and SEN (special educational needs) are now educated in mainstream schools. The acoustic design of schools is vitally important, as a poor acoustic environment can be a significant barrier to their inclusion and learning.

The term "hearing difficulty" can account for many different levels of hearing problems. Many of the hearing problems affect the ability to hear high frequency sounds, including the higher frequency consonant sounds such as S, which can make plural words difficult to hear.

Children have neurological immaturity, are inefficient listeners, have limited language proficiency and are more distracted by noise and reverberation than adults. This can result in concentration problems and then learning difficulties. It is important that schools create the right acoustic environment for all students.

The presentation focused on auralisations to demonstrate the acoustical experience in a SEN school by normal hearing and hearing impaired children. In particular, two aural demonstrations were provided which demonstrated that a combination of wall and ceiling treatments which reduces the low frequency noise in a classroom provides the best listening environment for those who are hearing impaired.

The branch would like to thank Konca for giving a very interesting presentation, which proved to be extremely popular. The committee would also like to thank WSP for providing the venue.

Making smooth the rough – the latest in human vibration measuring

Report by Liz Brueck

On 21 March the Health and Safety Laboratory (HSL), in Buxton, Derbyshire, was the venue for the Measurement and Instrumentation Group's meeting Making Smooth the Rough on the latest innovations in human vibration measurement. HSL is itself a centre of expertise for the measurement of the human vibration and the diagnosis of Hand Arm Vibration Syndrome (HAVS), making it an appropriate venue for the event. Richard Tyler, Chairman of the Measurement and Instrumentation Group, was the event organiser and chaired the meeting.

The meeting opened with an overview of standards work. Paul Pitts (HSL), convenor of the ISO working group revising ISO 8041 Human response to vibration – Measuring instrumentation, gave us a history of the standard before considering what is possibly going into the revision. Vibration exposure meters, simpler verification tests using mechanical rather than electrical testing, and alternative validation tests for one-off instruments/systems are all being considered. Martin Armstrong (Alcor S&V) followed with a detailed review of calibration methods. Martin described standard laboratory calibration techniques for transducers (given in the BS ISO 16063 series) before moving on to field calibrators. Field calibrators currently only merit a normative Annex in ISO 8041:2005, but a new standard is being developed. Martin explained the factors that govern calibrator performance and calibration uncertainty.

Moving away from standards, John Shelton (Svantek UK) gave us a practical look at MEMS-based transducers for monitoring hand-arm vibration exposure. John talked about how resonance issues associated with transducer mounting limit hand-arm

Lee Trowsdale (Castle Group Ltd) giving an overview of current instrumentation

Sue Hewitt (with RichardTyler left) preparing to show us that tool vibration data is meaningless if you don't keep up with tool maintenance

vibration measurement to measurements on the tool rather than the person. With MEMS technology devices are being developed that measure both acceleration and grip force. John suggested such MEMS technology might allow us to assess not just the vibration emission of the tool but the vibration energy transmitted to the operator.

Peter Henson (Bickerdike Allen Partners) took us into the world of ground vibration measurement in his paper on a project trying to predict the effect of a new Metro tunnel below the proposed site of a new office building. He described the practical challenges of siting measurement instrumentation by rail tracks and onto deep ground piles that simulated building foundations. The measurements proved track vibration control pads were far more effective at reducing the transmitted vibration through the piles than at reducing the track side vibration. While fortunate for the building architects, it proved a mystery that highlights the uncertainties in trying to predict and control vibration transmission.

Lee Trowsdale (Castle Group) gave an informative talk on current instrumentation for hand-arm and whole body vibration measurement. Lee described the range of vibration meters, exposure meters and exposure timers from a range of manufacturers. He gave advice on the pros and cons of each instrument including the simplicity (or not) of operation, the display, whether the instrument was going to stand up to workplace wear and tear, and cost. It was a down-to-earth, useful overview for anyone wanting advice on what is currently available.

Richard Greer (Director, Arup Acoustics) talked about the new ANC guidelines (Red Book) for the measurement of ground-borne vibration. This revision has been out for a year and includes updated information on standards, guidance and exposure response knowledge as well as practical measurements issues such as the use of transducers, and the available instrumentation. Richard said the revised guidelines are not necessarily to be taken as gospel and asked for continued feedback on the validity of some of the standards and documents that form the basis of the guidance.

Kerrie Serrao (Institute of Naval Medicine) followed with a paper describing some of the practical complications of performing whole body vibration measurements in high speed military boats. She told us of the problems and challenges of safely securing not just the transducers but all the data acquisition equipment and even the sea sick scientists. This paper left us on a cliff hanger ending without the results and the solutions to the vibration and shock issues. I, for one, will look forward to Kerrie bringing out the sequel to this presentation.

Sue Hewitt (HSL) and Chris Gilbert (Acoustic Associates) rounded off our day with two entertaining presentations that demonstrated the limitations of measurement when trying to predict risk or human response. Sue took two identical angle grinders, one equipped with a new grinding disc, the other with a worn disc. With the worn disc Sue measured vibration levels between 15 and 33m/s^2 depending on where the transducer was located on the handle. With the new disc the vibration level on the handle was no more than 4 m/s^2. This was not just a party trick. Sue showed us some real world results with a similar variation, making the point that without maintenance and control measurements can be meaningless. Chris Gilbert gave us three entertaining case studies of ground-borne vibration issues. He looked at road repairs in a street of nervous antique dealers, vibration in homes close to a print works and washing machines disturbing neighbours in a block of flats. He asked the question does noise and vibration equate to the annoyance. The answer from these case studies was clearly no. Human reaction to noise and vibration is complex and often bears no relation to the level of vibration or noise.

That was the end of the meeting and we hope everyone made it safely home. The next morning the Health and Safety Laboratory was cut off by snow.

Have you been set up?

Midlands Branch reports

By Kevin Howell

A large audience gathered at URS Nottingham in February to hear Richard Tyler of AVI explain how to correctly calibrate and prepare acoustic measuring equipment when out in the field.

Richard summarised some of the equipment standards that we should all be familiar with and explained some of the changes that have occurred in recent times. However, he concentrated on site procedures and how to ensure that we get the most accurate measurements possible. For many working in the field of acoustics this is something that we may feel is routine and straightforward, but it became clear that we need a presentation such as this, from time to time, to remind us exactly what we should be doing and to highlight areas where bad practice may have crept in.

Richard spent some time identifying some of the most common errors. I suspect that there were few in the audience who didn't feel they had been gently rapped across the knuckles on one issue or another. The questions at the end further demonstrated what a useful opportunity this was to clear up some uncertainties.

Thank you to Richard for his presentation and for getting our 2013 season off to a good start. Thanks also again to URS for providing the venue.

Acoustic design of schools for SEN and hearing impaired

In March the branch meeting was hosted at Atkins offices in Birmingham where Konca Saher of Atkins treated us to the above presentation which included auralisation techniques to demonstrate the effect that poor acoustic environments in classrooms have on both normal hearing and hearing impaired children. This presentation is similar to that previously presented to London Branch and which is reported in more detail on page 26.

Thank you to Konca and to Atkins for hosting the meeting.

Instrumentation Corner

Electret microphones in the field; care and the effects of the environment and damage

By Dave Robinson of Cirrus Research

Much technical literature exists regarding the performance of pre-polarized electret microphone capsules, yet information regarding their practical use in the environments typical of noise measurements is often overlooked. Considering the fragile nature of these devices and their susceptibility to damage, or at least detrimental effects to their performance by the operating environment, such information is vital to the user in order to ensure reliability of measurements.

Physical design features

One of the most affecting design features of the electret condenser microphone is the pure Nickel membrane, which is typically 0.003mm thick, highly tensioned and, consequentially, very fragile. Functionally, the membrane presents a physical barrier between the outside air and the capsule inner chamber and must be thin enough that even a minuscule 0.0002Pa (20dBA) pressure differential between the two spaces causes deflection of the membrane. A 20-25µm air gap, roughly four times smaller than the width of a human hair, separates the membrane and the backplate inside the capsule. Variation in the membrane displacement then alters the distance between the two surfaces and therefore the capacitance. While a flexible membrane material would give a high displacement per unit pressure and thus a higher sensitivity, such a material would have a poor response to high frequencies.

Common causes of physical damage

It is of utmost importance that the membrane is never P30

Figure 1a & 1b (left, centre): Capsules with torn diaphragms used in tests. Figure 1c (right): Capsule with obvious wrinkling, most likely caused by dropping


OSCAR
Elite
Oscar Elite acoustic plaster applied directly to soffit & inside of light well. Oscar Elite appears typically smoother than most conventional painted plaster surfaces.
01474 854 902
www.oscar-acoustics.co.uk
OSCAR
ACOUSTICS

P28 touched, even for cleaning. By simple analysis, placing one's finger evenly over the membrane of a ½" capsule (working diaphragm area c. 50mm²) with a force of 1N (100g) would exert a pressure of 0.02N/mm². Working in more typical acoustic units, this is 20000Pa; the equivalent of an 180dB peak acoustic wave! In practice, with this level of force, the membrane would in fact be pushed onto the surface of the backplate. Any significant contact force upon the membrane can cause permanent deformation of the membrane and thus tension; capsule sensitivity will then increase at the detriment of the high-frequency response. The only cleaning procedures recommended are the use of very light blasts of air, then liquid solvents and, when absolutely necessary, very gentle use of solvent-soaked cotton wool to remove stubborn particles.

The unavoidable fragility of the membrane and the high shear forces exerted upon it due to the manner in which it is attached and tensioned result in tears being quite commonplace following rough handling or accidental damage. Overly quick removal of a calibrator is enough to cause the membrane to be torn; it is also commonplace for such tears to be invisible to the naked eye. Even more surprising is that the capsule will still function as a microphone, producing quite believable measurements. The charts seen in figure 2 are capsules with entirely torn membranes, measured acoustically at 94dBA using a B&K 4226 multi-frequency acoustic calibrator.

Due to the relatively unchanged response at mid frequencies, users may experience an apparent successful calibration. When performing measurements, if low frequencies are measured lower than might be expected and eccentric measurements are seen in the high-frequency ranges, a visual inspection of the membrane is the first point of call; however, while severe damage is easy to spot, slight damage is not. A torn membrane of any size can be detected by pressure testing, although it is readily appreciated that the sensitivity and accuracy of the pressures involved requires specialist equipment.

In order that the membrane is held as ideally flat and parallel to the backplate as possible, the top surface of the body to which the membrane is attached is extremely flat, on a par with that of optical surfaces. Dropping the capsule can cause deformation of the body, possibly resulting in clear wrinkling of the membrane, as seen in figure 3, which displays a 25µm trough depth. While these features are obvious (the capsule failed to attain type-2), visual inspection may fail to realise similar defects from lesser levels of damage. For example, take the visually perfectly flat membrane of a good capsule... now consider figure 4... that 3µm 'bowing' is perfectly normal, caused by the electrostatic attraction of the electret upon the membrane and essentially undetectable to the naked eye; visual inspection sometimes is not sufficient to determine whether damage has been caused.

More severe cases of damage from dropping can cause the sapphire – the component providing electrical insulation between the casing and contact pin – to crack. This can also occur from over-tightening a capsule onto the pre-amplifier contact (although using properly-designed, IEC-specification equipment, this should never be possible). This does not necessarily render the capsule entirely non-operational; the major problem is the increase in air leakage through the sapphire. Capsules incorporate a very narrow 'bleed' capillary to allow for pressure equalisation; sub-10Hz waves are of sufficient period for the pressure wave to propagate through the bleed during the wave period; hence, low frequency response tails off toward zero. Hairline fractures in the sapphire 'could' have very little effect, but a shattered one would be expected to exhibit poor response below 100Hz. As the sapphire is the mounting for the backplate, the air gap distance could also have altered, which could decrease or *increase* the sensitivity.

Outdoor applications can see a capsule being placed in a harsh, dirty environment and regular cleaning is often required; the effects of dirt and corrosion are of current investigation.

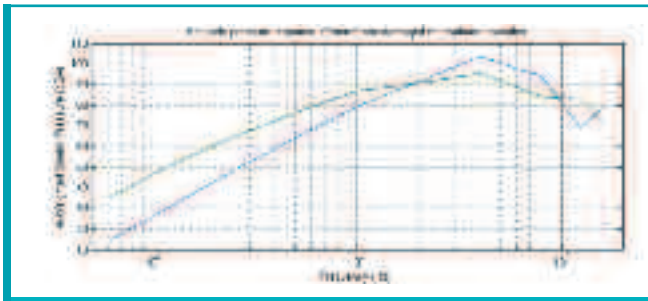


Figure 2: Performance of membrane-damaged capsules

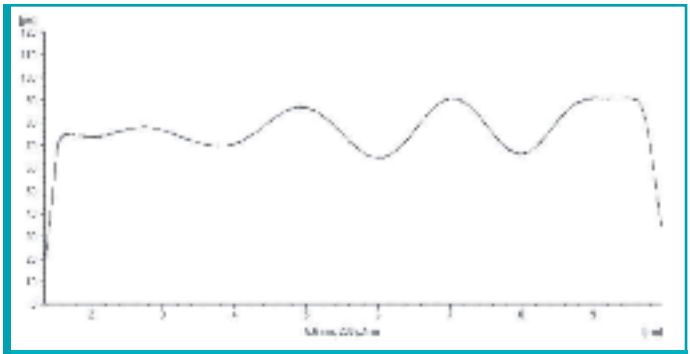


Figure 3: Membrane profile of a dropped capsule

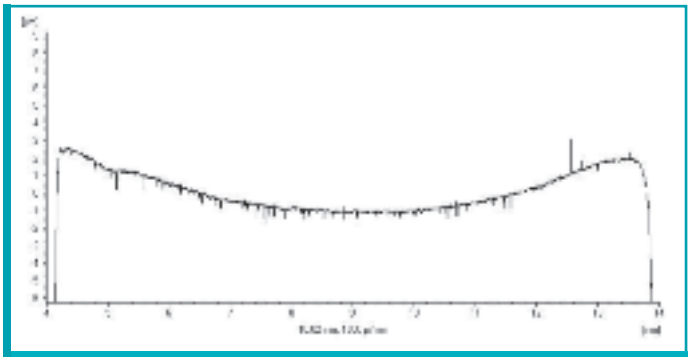


Figure 4: Displacement of the membrane on a good capsule

Conclusions

Much older sound level meters, with entirely analogue electronics, will exhibit drift over time; while this is slightly less of an issue with modern, digitally-controlled equipment, the microphone capsule remains fundamentally the same design. Regular calibration is intrinsic to the use of sound level metering equipment to ensure that the stringent specifications of IEC 61672-1:2002 are being held to. With the increased reliability over time of the electronics, it is generally more common for the cause of an out-of-specification metering system to be the capsule.

Microphone capsules are devices that require high levels of care in use. Typical damage caused to a capsule may not be immediately visible, nor detectable by a basic 1kHz calibration on a SLM and consequent measurements following damage to a capsule will have dubious reliability. It is highly advisable that, after any suspected damage, the frequency response of the capsule is investigated for the characteristics of damage as described; this should at least indicate that there may be reasonable worth in having the capsule properly tested.

This article continues in the next issue when it will look at the effects upon performance, and the problems that can arise from various environmental conditions.

New Government aviation policy aims to reduce aircraft noise nuisance

The Government has promised to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise.

This will be done through better technology, implementation of noise 'envelopes' around airports and further use of noise abatement operational procedures.

The policy is contained in its newly published aviation policy framework which sets out its objectives for the sector and updates the 2003 Air Transport White Paper.

The Government says the policy is consistent with its noise policy, as set out in the Noise Policy Statement for England (NPSE) which aims to avoid significant adverse impacts on health and quality of life.

From a noise perspective the main features of the framework are:

- Industry must continue to reduce and mitigate noise and as noise levels fall with technology improvements the aviation industry should be expected to share the benefits from these improvements.
- A recognition that there is some evidence that people's sensitivity to aircraft noise appears to have increased in recent years, but that there are still large uncertainties around the precise change in relationship between annoyance and the exposure to aircraft noise.
- Noise exposure maps to continue to be produced for the noise-designated airports on an annual basis providing results down to a level of 57dB LAeq 16 hour.
- Airports are not precluded from producing results to a lower level or using other indicators to describe the noise impact of their operations.
- Separate night noise contours for the eight-hour night period (11pm–7am) are to be regularly produced for the designated airports.
- Average noise contours should not be the only measure used when airports seek to explain how locations under flight paths are affected by aircraft.
- Encourage airport operators to use alternative measures which better reflect how aircraft noise is experienced in different localities developing these measures in consultation with their consultative committee and local communities.
- Continue to treat the 57dB LAeq 16 hour contour as the average level of daytime aircraft noise marking the approximate onset of significant community annoyance.
- Airports should set suitable noise controls, such as departure noise limits, minimum height requirements, noise-preferential routes and adherence to continuous descent approach, and where appropriate to enforce these with dissuasive and proportionate penalties. Both the controls and the levels of penalties should be reviewed regularly (at least as often as the Noise Action Plan).

For full details go to **https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/153776/aviation-policy-framework.pdf**

Research study reveals children's reading harmed by aircraft noise

Children living under the Heathrow flight path are suffering two-month lags in their reading development as a result of aircraft noise.

Hounslow council claims pupils in the borough have to put up with "continual disruption", and warned the problem will worsen if the airport expands to three or more runways.

Around 40 schools are directly under the flight path with planes landing and taking off all through the daytime. The council cites an international study into aircraft noise which found it led to a "significant impairment" in reading development, as well as affecting long-term memory and motivation.

The research, led by the University of London, found that pupils under the Heathrow flight path suffered an average two-month delay in reading.

Hounslow's environment spokesman Colin Ellar said: "Our children's education is suffering from the continual disruption from low-flying jets and it's up to the airport to be a good neighbour and ensure they do all they can to reduce the nuisance. The problem will only get worse if it expands with a third runway."

Katharine Harper-Quinn, head teacher of Hounslow Heath Infants and Nursery School, said: "It's extremely disruptive. Outside play for the children is dominated by ear-deafening interruptions every two minutes as landing aircraft pass a few hundred feet over their heads.

"Inside, if you don't have triple-glazing the interruptions to lessons can be relentless. It's really difficult to keep the children focused. It can be really, really hard for the staff."

The school, with 500 pupils aged three to seven, is two miles from the airport and has planes going overhead every 90 seconds unless runway alternation is in operation. It has shelters in the playground so children can escape the noise."

Traffic noise annoyance depends on housing type

A recent pan-European study has reviewed the factors which influence how annoyed a person feels about road traffic and aircraft noise. Among its findings, residents in terraced housing or apartments were less annoyed by road traffic noise than residents in semi-detached or detached housing.

People who are exposed to long-term noise may experience annoyance as well as health problems, including high blood pressure (hypertension). This study, conducted under the EU HYENA project1, focuses on factors, such as type and layout of housing, which might influence the effects of noise from aircraft and road traffic near airports on blood pressure and annoyance levels of local residents.

The researchers interviewed a total of 4,861, people living near seven European airports (London-Heathrow, Berlin-Tegel, Amsterdam-Schiphol, Stockholm-Arlanda, Milan-Malpensa, Athens-Elephterios Venizelos and the City Airport (Bromma)-Stockholm) between 2003 and 2005. The participants were asked about their homes, experiences of the noise and ways of dealing with it.

People who were exposed to high levels of road traffic noise and who had not moved for more than 25 years had a higher occurrence of high blood pressure compared with those who lived there for less than 25 years. Particularly, the long-term exposure to noise caused adverse cardiovascular health effects, which is plausible if chronic noise stress is considered as a hazardous factor. People who usually opened the living room windows during summer or winter, when in the room, tended to have a higher risk of high blood pressure if they lived on a noisy street, compared with those who had the windows closed. In situations where noise levels are high, better sound insulation had a beneficial effect on cardiovascular health.

Residents who tried to reduce noise levels by closing windows or shutters were more annoyed with road traffic noise, and their annoyance levels increased as the noise grew louder. It is possible that these people felt there was little they could do to control the noise and their reactions were more to do with the perceived disturbance than the actual measures taken to reduce the noise. However, increased aircraft noise was more annoying to people who had not modified their homes to reduce noise levels. For example, those who only had single glazed windows in the living room or bedroom expressed greater annoyance than those with better insulated windows.

Traffic noise can affect blood pressure

This shows that noise causes adverse effects even in subjects who are not annoyed by the noise, for example by non-conscious disturbances during sleep.

People who had their living room or bedroom facing away from the noisy street reported less annoyance with road noise, and with increasing levels of traffic noise compared with those people whose rooms faced the street.

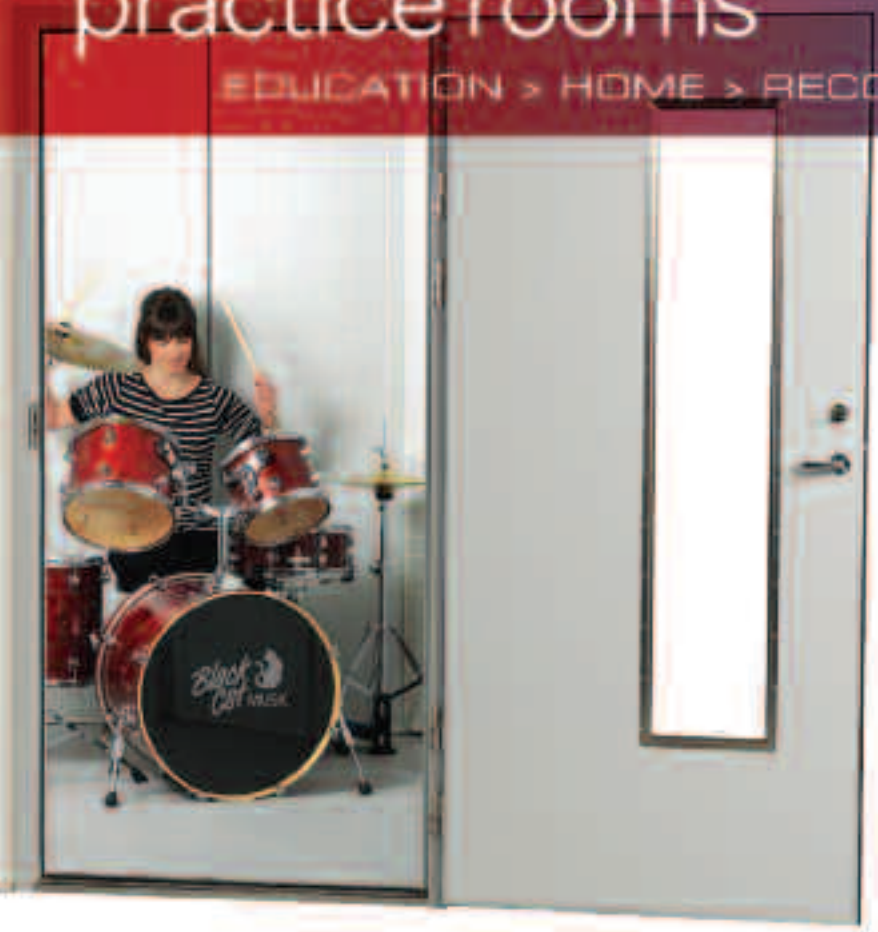
The study found that people living in semi- or detached properties were more likely to be annoyed by noise – possibly because they are more likely to own their homes and to seek a better quality of life. They may have higher expectations regarding the quality of their acoustic environment at low and moderate noise levels. At higher noise levels no difference was found compared with those who live in semi-detached or detached housing, meaning that both groups consider high noise levels equally annoying.

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

Sound-isolating practice rooms

EDUCATION > HOME > RECORDING

MUSIC
practice rooms.com



Having enough space to practise is often an issue in music departments; our modular, relocatable Music Practice Rooms provide an excellent solution to this problem. Each module offers an individual space for solo or ensemble practice, whilst providing an effective acoustic barrier to avoid disturbing other classrooms.

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

The rooms, from MusicPracticeRooms.com, use a prefabricated panel design that is affordable, easy to install and allows rooms to be custom configured to suit available space. "We are very happy having them here," continued Pete French.

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

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

Pete French, Head of Music, Lancaster and Morecambe College

To watch the video of this interview scan here or go to youtube.com/musicpracticerooms

Brought to you by Black Cat MUSIC

Get in touch

Telephone: 0844 846 9740

www.musicpracticerooms.com

Piccadilly Line the noisiest Tube line

By Stephen Dance, The Acoustics Group, Department of Urban Engineering, London South Bank University

Travellers using the northern section of the Piccadilly Line suffer the noisiest journey on the Tube network, it has been revealed.

A study undertaken by Antony Gregson as part of his MSc dissertation at London South Bank University showed passengers endured a noise level of 87 dB $dBL_{Aeq,T}$ between Bounds Green and Southgate.

Close behind were the Northern, Central, Bakerloo and Victoria Lines where between station noise levels reached 85 $dBL_{Aeq,T}$. In comparison, noise levels on the overground sections of the Tube were between 68 $dBL_{Aeq,T}$ and 75 $dBL_{Aeq,T}$.

Anthony, now with the Temple Group, used a hand-held NTI XL2 sound level meter to measure the overall average noise level between stations from a central seat carriage position in each direction of travel. The measurements were taken during the summer of 2011. A graphical representation of the measurement is presented in Figure 1.

The noise levels were found to be highest in the deep subsurface stations, the thicker lines. The faster the train speed, the greater the noise level, hence the highest noise levels were found to be between Bounds Green and Southgate, a noise level of 87 dB $dBL_{Aeq,T}$.

Figure 1. The overall $dBL_{Aeq,T}$ noise levels on London Tube trains

Of course, the average Underground commute is approximately 30 minutes in either direction and hence a 40% noise dose is an entirely realistic exposure for the three million journeys per day on the deep subsurface lines.

Quiet House aims to be 'Ideal Home'

By Mike Goldsmith

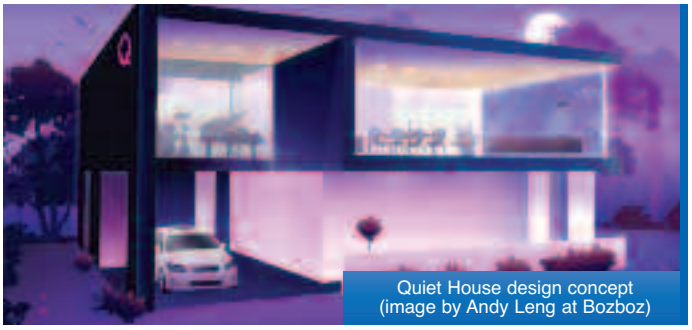
Good acoustic design of every new road, car, train, and plane is now well accepted – and expected – and in consequence many of the soundscapes we work in and travel through have steadily improved over the last half-century. When a customer comes buying any of these things, quietness is likely to be high on their shopping list.

In the home, however, it's a different story: though some manufacturers and designers do strive for quieter appliances, there is seemingly little to show for their efforts in terms of sales or profit. This is not, however, due to a lack of interest in the users of those appliances: the AEG-Electrolux Noise Report 2007 (http://newsroom.electrolux.com/uk/files/2010/04/AEG-Electrolux-Noise-Report-2007.pdf) found that 40% of respondents regarded the noise of domestic equipment as one of the "curses of modern life". Nevertheless, only about one in four of them considered the noise of a domestic appliance when they shopped for it. But many wished they had: 42% of those who bought vacuum cleaners, 33% of those buying cooker hoods, and 29% of purchasers of washing machines, "wished they had taken noise into account to a greater degree when they bought it".

Odd behaviour? Not really: the problem is of course that it's not easy to find out how noisy a purchase is until one gets it home, plumbs it in and switches in on. Or it wasn't until now. Quiet Mark, a not-for-profit arm of the Noise Abatement Society (http://www.quietmark.com), provides at last a system of rating appliances according to their sound level.

Individual quiet appliances are a valuable addition to any home but their main impact would be as components of a quieter kitchen – better still, a quieter house. And so, this spring, Quiet Mark launched just that: the Quiet House at the Ideal Home Show showcased not only a range of Quiet Marked products, but some quiet building features too – and even a quiet band.

For successful noise reduction, a holistic approach is essential, which requires contributions from many fields, ranging not only from across the natural sciences, but from arts and social sciences too. Consequently, realising the Quiet House exhibit involved such unlikely bedfellows as ex-Human Leaguer Martyn Ware (who created the soundscapes of the house), interior designer Martin Hulbert, and a Silent Range of musical instruments from Yamaha, all housed in a shell designed by Gregory Phillips Architects, with Rockwool-insulated walls and Cantifix windows.



Quiet House design concept (image by Andy Leng at Bozboz)

The music provided by a quiet band (mostly via headphones) was great fun but the Quiet House is a serious solution to a serious problem: according to a 2007 Ipsos Mori poll (http://www.ipsos-mori.com/researchpublications/researcharchive/222/Noise-Bothers-Seven-In-Ten-People-At-Home.aspx), 2% of people in the UK moved house in the previous year to escape neighbourhood noise (which is roughly one in six of all movers).

The key to the Quiet Mark approach is letting people know that there is a simple system they can use to identify quieter (but nevertheless effective) products before purchase. The expectation is that the demand for such products will grow as a result, encouraging manufacturers to make further improvements so that a virtuous circle results. This could happen even if such products should remain somewhat more expensive than their louder cousins: the AEG-Electrolux report found that about half those asked would pay 10% more for domestic appliances that "made half the noise".

Similarly, since acoustic features are more economic, aesthetic and effective to build into a home while it is being constructed rather than to retrofit, good soundscapes must be on the agenda of every new build from the moment of its inception. The Quiet House reminds us of what can be achieved.

Consultant calls for review of Irish traffic noise assessment

A complete review is needed of Ireland's National Roads Authority guidance document for road schemes, says IOA member Diarmuid Keaney.

This is one of the main conclusions he draws in his newly published book *The Assessment of Road Traffic Noise Impact at Rural Locations: An Irish Case Study*, which aims to help consultants quickly understand how traffic noise assessment is prescribed by the NRA.

In the book Diarmuid examines the environmental consideration of traffic noise in Environmental Impact Statements and how it is assessed for roads through rural locations in Ireland.

He critically reviews the methodology prescribed by the NRA for all national road schemes, with a focus on its current application in rural Ireland, and contrasts it with the methods used in the UK.

He highlights what he sees as a number of shortfalls, one of which being the authorities' prescription of the shortened CRTN method for rural baseline studies, using a single (typical) rural location which is not dominated by traffic noise.

Diarmuid, a Noise and Vibration Consultant at ICAN Acoustics, Galway, said: "At the end I offer a number of conclusions which, in my opinion, highlight the need for a complete review of the NRA guidance document, as well as a review of the design targets for future EU compliance."


Diarmuid Keaney

The book is available on Amazon and can be found in the books section under "traffic noise assessment". It costs £98. For more information and discounts offered to IOA members, contact **diarmuid@acoustics.ie**.

A neglected source of uncertainty in potential wind farm noise assessment using the ETSU-R-97 process

By Rod Greenough, Emeritus Reader in Physics, University of Hull, and David Unwin, Emeritus Professor in Geography, Birkbeck University of London

Introduction

The process outlined by the (UK) panel on wind turbine noise in ETSU-R-97 (ETSU-R-97, 1996) has two key inputs, a prediction of the turbine generated noise at selected receptors and survey data on the background noise using the $L_{A90\ 10min}$ weighted measure established over a range of wind speeds referenced to 10m above ground level (AGL). Since its formulation, this assessment process has been criticised and, for better or worse, a suggested improvement, the so-called 'article' method has been widely adopted (see Bowdler, 2006, 2009; Bowdler *et al.*, 2009; Stigwood, 2011; REF, 2012). To date the debate has been on the need to assess the impact of high wind shear on both the extrapolated wind speeds at hub height and the 10m AGL reference height in the height range now spanned by turbines that are significantly larger (now typically 80m AGL) than they were when ETSU-R-97 was defined.

Uncertainties relating to the turbine noise output and manufacturing tolerances (Broneske, 2009), the assumed ground absorption, atmospheric attenuation, the accuracy and resolution of the sound recording instruments, and their ability to filter true background from noise induced by the wind itself have also been considered and the related uncertainties in noise margins (the difference between the predicted noise at a receptor site and the allowed noise level according to ETSU) will be analysed in a future publication.

Our principal concern here is prompted by a comparison of several wind farm applications in which the applicants claim, correctly, that the ETSU-R-97 regulations have been adhered to. The problem arises when the recommended procedures for the analysis of measured data reach the stage when the onus is on the applicants to adopt reasonable and meaningful analytical methods. Without employing models based on well-established data analysis and statistical techniques, each applicant performs regression analysis as a basis to determine the allowed ETSU noise levels. After surveying many applications, it is evident that there is a marked lack of consistency in these analyses. It is this source of uncertainty, which arises from the models used by applicants in the establishment of an average background noise curve as a function of the 10m AGL wind (V_{10}), which is addressed in this note.

Background: ETSU-R-97and the background polynomials

ETSU-R-97 (page 101) outlines how the panel expected background curves for noise to be obtained as follows:

"For each sub-set, a "best fit" curve should be fitted to the data using a least squares approach, usually a polynomial model (of no more than 4th order). Where there is considerable scatter in the data, it may be more appropriate to bin the acoustic data into 1m/s bins before identifying a best fit model. These two curves, referred to as the 'day-time curve' and the 'night-time curve', provide a characterisation of the prevailing background noise level for day-and-night respectively, as function of wind speed from zero to 12m/s at 10m height. Note that whatever model is used to describe the measured data, this should not be extrapolated outside the range of the measured wind speed data."

Further we are also told that:

"The variation in background noise level with wind speed will be determined by correlating $L_{a90,10min}$ noise measurements taken over a period of time with the average wind speeds measured over the same 10-minute periods and then fitting a curve to these data."

The ETSU-R-97 advice most frequently followed is to fit a best fit polynomial curve to the background noise data using the standard 'ordinary least squares' (OLS) criterion of fit, which under some well-understood assumptions provides the best linear unbiased estimates for the coefficients that define this curve. These fits have the general form $Y = F(x)$ in which Y is the background sound level in dBA (ten-minute average) at a neighbouring dwelling's amenity area, x the measured or inferred wind speed at 10m AGL (V_{10}) at the wind turbine site, and F denotes 'some function'. It would seem that the ETSU-R-97 panel were of the opinion that specification of a polynomial of up to the 4th degree for F(x), coupled with the use of the phrase 'best fit' were sufficient to ensure a reasonably objective and robust result on which the planning process could rely. Fits to the observed data are usually reported using the *coefficient of determination*, or R^2, a statistic that is probably better thought of as the *percentage of the variance explained* by the fitted curve. These curves are what here we call *models* of the underlying data, but the guidance says very little about why these quite complex polynomials have been used, or any caveats that should perhaps be attached to them, yet the establishment of a reliable curve for the background noise is critical for determining noise impact on neighbouring dwellings and setting fair noise conditions to protect amenity.

At the outset, it is worth commenting on several statistical issues that arise from this approach:

- The coefficients arrived at by so-called ordinary least squares (OLS) multiple regression are themselves *estimates* of some *unknown parameters* in the full population from which the sample background ($L_{A90\ 10min}$) and wind (x, V_{10}) were sampled and as such are themselves subject to an uncertainty that should be expressed as a confidence interval around the plotted line;
- ETSU-R-97 assumes that the main driver for the observed variation in background is wind speed and it is utterly reliant on these plots and fitted functions. We have yet to read a justification for the implied correlation either in theory or by means of careful measurement at proper free field locations using correctly shielded ground level microphones. At some sites the major cause of variation in background might well be some other process of which the regular hum of traffic close to a main road is probably the most important example. Background in such cases would correlate more closely with time of day and wind direction than with wind speed;
- The 'explained variance' given by the R^2 value refers to a statistical notion of an 'explanation' that should not necessarily be equated with scientific causation;
- Although we are advised that polynomials of degree higher than four should not be used, this is without any additional comment or justification and fifth order polynomial fits are not unknown;
- A major failing of ETSU-R-97 lies in the way that the measured data are assumed to be unproblematic. They are not. Typically, an Environmental Impact Statement (EIS) required by the Local Planning Authority (LPA) will have an assessment of the likely noise nuisance at selected receptors for both 'quiet daytime' and 'night-time' conditions based on the established curve of background noise plotted against V_{10} winds using observations collected over at most a few weeks simultaneous recording of both $L_{A90\ 10min}$ (dBA) at the receptors and V_{10} (m/s) at the

wind farm site and either inferred from the wind profile at a high mast or measured using a meteorologically standard 10m mast. The uncertainties related to how the V10 derived from a mast are 'standardised' have been well documented (Bowdler, 2009), but what is often forgotten is that these data are a usually a very poor sample in both time and space. In time they are a snapshot of background noise for a very limited portion of the year, an issue that REF (2012) demonstrate could introduce +/- 5dBA difference, and hence uncertainty, in the fitted curves;

- In space, reliance on V_{10} measure at a single point in what typically will be a moderately large area of possibly highly spatially varying wind regime introduces even more uncertainty that has yet to be quantified. Moreover, contamination of the data by transients will frequently occur and the possible influence of wind induced noise at inadequately shielded microphones has yet to be resolved, giving yet more uncertainty;
- What is almost always forgotten is that this curve fitting procedure, using classical regression, that has been known and used since the mid-nineteenth century, assumes that the data are an independent random sample from a defined population of possible values. The method evolved when, rather than being a very large data file downloaded from an automatic recording device, each and every data point was likely to be hard won by careful hand measurement;
- Both numbers, the background and the reference wind speed, come from a time series sampled over ten-minute intervals. It is inevitable that such data will to a greater or lesser extent exhibit *auto-* or *self- correlation*. Autocorrelation can be understood by a simple thought experiment. Suppose that at some time the anemometer records a V_{10} of 10m/s, what is the value likely to be in ten minutes time? Given that meteorological elements show persistence in time it is highly unlikely to be either 0 m/s or, say, 25m/s. Chances are that it will be fairly close to 10 m/s. In other words successive data are correlated with themselves. Yet statistical inference assumes that each case is independent or uncorrelated with the others. The effect on the result is to bias the standard error because the standard goodness of fit measures are tricked into believing that there is a larger sample than actually exists. Larger samples give smaller standard errors and better statistical significance;
- Finally, the number of sample points (n) is not only large but is to a very large extent *arbitrary*; it can be almost as large as the analyst likes (for example by using more weeks data, or decreasing the sampling time interval), but the impact on the statistical significance of any results is to make any change, not matter how small, almost certain to pass the standard tests. There is a real risk here of conflating the statistical notion of 'significance' with the scientific one and it cannot be stressed too highly that they are not the same thing.

This is not the place to enter into a long exegesis of the assumptions of linear regression and their impacts on the fitted curves, nor do we argue for complete statistical purism: there are literally millions of successful scientific studies that at some point break one or more of these assumptions.

What we should point out is that regression was introduced as a means by which specific scientific hypotheses, for example those generated from physical reasoning, could be tested and/or calibrated against observation of the real world. The ESU-R-97 document and hence the process it mandates says absolutely nothing about the underlying physics of wind generated noise. At no point in the ETSU document or anywhere else in the literature, can we find any physical justification in physics, acoustics or meteorology for the choice of model to be fitted. This has some serious consequences for the reliability of the entire process.

Any background line will do?

In all the environmental impact statements (EIS) associated with wind farm noise assessments we have examined what we find are polynomial curves of degree $p = 2$ (quadratic), $p = 3$ (cubic), sometimes $p = 4$ (quartic), and in one case even a degree $p = 5$ (quintic) fitted to the background and wind data. The occasional commentary in the text shows that the fitting process seems almost always to be driven by an obsession with the idea *best fit* being equivalent to 'highest coefficient of determination, R^2, I can get'. Table 1 illustrates the uncertainties this model choice introduces into an assessment with results from various equations used in the analysis of data (825 data points) from a recent wind farm case.

Type of fit	Equation	R^2
Linear p=1	$y = 1.7655x + 21.011$	0.59
Quadratic p=2	$y = 0.0312x^2 + 1.3689x + 22.081$	0.59
Cubic p=3	$y = 0.0289 x^3 - 0.5175 x^2 + 4.3399x + 18.243$	0.60
Quartic p=4	$y = -0.0049x^4 + 0.1585x^3 - 1.6772x^2 + 8.2981x + 14.558$	0.61
Quintic p=5	$y = -0.0028 x^5 + 0.0853x^4 - 0.9268x^3 + 4.1847x^2 - 5.2866 x + 24.408$	0.62
Exponential	$y = 22.329 e^{0.0555x}$	0.61

Table 1: Results from various model fits to background noise data and the corresponding regression coefficients In these equation Y is the dependent variable $L_{A90\ 10min}$ (dBA) and the independent variable x is the inferred wind speed at 10m AGL (m/s)

The polynomials of degree $p = 2$ or $p = 3$ are those that almost certainly would have been accepted as appropriate models on which to base the ETSU assessment, but we cannot resist pointing out that an alternative, equally plausible, model that actually fits the data better than all but the degree $p = 5$ polynomial is the rather elegant exponential.

Unless this is to be a scientific hall of mirrors, which of these models should be used in the assessment or will any curve do the job just as well? All suggest that with no wind the background is somewhere between $L_{A90\ 10\ min} = 14.558$ and 24.408 dBA, which seems reasonable for a quiet rural location, and all describe the data reasonably well, giving coefficients of determination in the range $R^2 = 0.59 – 0.62$. We suspect that, faced with this choice and secure in the knowledge that almost every planning decision maker would accept their 'professional judgment', it would be a brave acoustics consultant who did not chose the model that best suited their employer's objectives but statistical analysis and physical logic can help a little in this choice.

One formal statistical option can be understood by the observation that straight line, degree $p = 1$, polynomial requires estimation of two coefficients whereas the degree $p = 5$ quintic one requires estimation of 6 for a gain in 'explanation' in the above example of just 3% (=100 x (0.62-0.59)). Statistically speaking, there is a clear case here for an appeal to Occam's Razor P38

P37 suggesting that the simplest model that is consistent with the data is the one that should be fitted. As polynomials of progressively higher degree are used they allow the curve to add points of inflexion around which it can twist to accommodate the observed data. It is inevitable that this added flexibility will increase the R^2 and so in some sense be a 'better fit', but the danger is that of *over-fitting*, introducing features into the curve that are artefacts solely of the degree of function chosen (p) and have nothing to do with nature itself. It follows that the statistical question that should be asked is NOT '*is this new model of degree p+1 a better fit to the data than the model of degree p', but 'given that we have to estimate another coefficient, does this new model of degree p+1 significantly improve on the fit given by the model of degree p?*' This is a question well known in data analysis in general and specifically to geostatisticians in the context of fitting polynomial regressions, called trend surfaces, to the locational coordinates of mapped information (see for example O'Sullivan and Unwin, 2010, pages 279-287) and a simple analysis of variance approach has been adopted to handle it. Applying this approach to this case, what we find is that, even with such a large number of data points, the addition of the quadratic is only just significant at the 95% level (i.e. one chance in twenty of being wrong) , but not at 99%. Similarly the very large, n, of strongly autocorrelated data points made available by courtesy of the recording devices, ensures that the cubic and higher order terms are also just statistically significant, but almost any statistician confronted with these results would counsel caution and warn against over-fitting.

It should be stressed that in standard noise assessments any of these models could have been presented, accepted as definitive, and used to set what would have been asserted to be ETSU-R-97 compliant limits. Much of the difficulty that the approach defined in ETSU-R-97 generates could be avoided by making it clear that this step is one of model *selection* in which the objective is to choose the model that gives the best predictions from a range of possibilities. As computing power has increased, modern statisticians have developed a number of strategies and measures for precisely this purpose. Of these the Akaike Information Criterion (see Akaike, 1974), which combines a measure of the model fit with a penalty related to the number of parameters that have to be estimated, is the best known and most widely used.

Using other regression diagnostics?

There are alternative ways of fitting curves to plots and there are alternative regression diagnostics to the crude R^2 coefficient of determination. Using a simple statistics package there is often the facility to identify *unusual observations* that are either badly fitted or that exercise undue influence (called their *leverage*, see Unwin & Wrigley, 1987). Of interest in the context of model selection is the distribution of *unusual observations*, something that is not necessarily apparent from a visual examination of the plotted line and the scatter of data points

For the linear fit, degree $p = 1$ polynomial in the example from Table 1, the software we have used (MINITAB) identifies 86 unusual observations of which 32 are badly fitted having a high *standardised residual* (the value divided by its standard deviation) and 54 have undue *influence* on the fitted line indicated by a high *leverage*. Of the badly fitted points the majority (24 from 32) have negative residuals. Of rather more significance to our argument are the 54 observations that exert undue leverage on the solution. Leverage is also known by the phrase 'distance to the centre of the data' and in the example this is very evident, but with a particular bias towards observations at low winds. In fact 52 of these points are at V_{10} winds less than 2.0m/s which leads directly to a very important point of principle: *although most assessments might choose to ignore the data at low winds less than 'cut in' of the turbine, these data have disproportionate importance in 'fixing' the shape of the model fitted to the entire data set.* In fact, the behaviour of the model close to the V_{10}=0, no wind, axis is critical. This is unfortunate, not least because in such very light air cup-based anemometry is not very reliable and there may be issues relating to the calibration, zeroing, and possible drift of the instruments used.

As can be seen from an examination of the estimated coefficients, and the similarity in R^2, in Table 1 fitting the quadratic makes very little difference and the same issues emerge. In this case 89 observations are identified of which 30 are badly fitted and 59 now have undue influence on the fitted line indicated by a high *leverage*. In passing, note that reliance on the linear curve gives the possibility of departures at some time or other of up to +/- 10dBA which is a doubling or halving of the predicted sound level from the curve

Appeals to logic?

We have already noted that, in the seeming absence of any theoretical expected forms for these curves there is clearly a blind reliance on getting a good fit as measured by the *coefficient of determination*, R^2. However, even without the benefit of acoustic theory, we can make some progress by appeals to simple logic and can illustrate this by a sequence of no less than three models offered in response to various objections at another recent public inquiry, again for the quiet daytime at an obviously at-risk receptor.

The initial attempt, shown here as Figure 1, used a simple degree p= 2 quadratic with a plot showing all of the data down to close to V_{10}=0 m/s, but did not report the R^2:

Degree p= 2: $L_{A90\ 10min} = Y = 0.0587x^2 + 0.5167x + 30.548$ dBA

Note that this suggests an arguably high background in a very quiet rural area at V_{10}=0 m/s of $L_{A90\ 10min}$ = 30.548dBA. Responding to a query from the local environmental health officer, the next attempt used a different method of referencing the winds to 10m AGL and some additional survey data to produce the degree p=3 cubic model shown as Figure 2:

Degree p= 3: $L_{a90\ 10min} = Y = -0.0513x^3 + 1.1815x^2 - 6.1697x + 39.99$ dBA (R^2= 0.5551)

P40

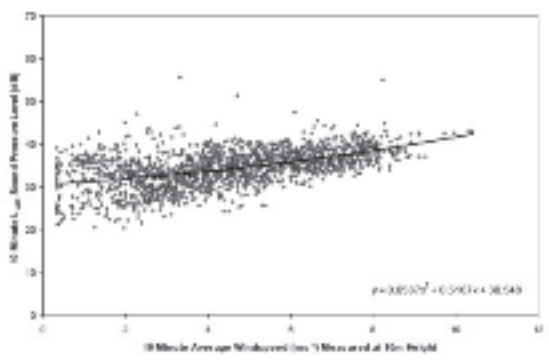


Figure 1: The quadratic model

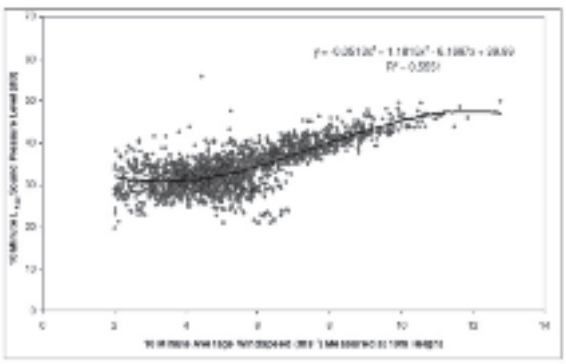


Figure 2: The cubic model

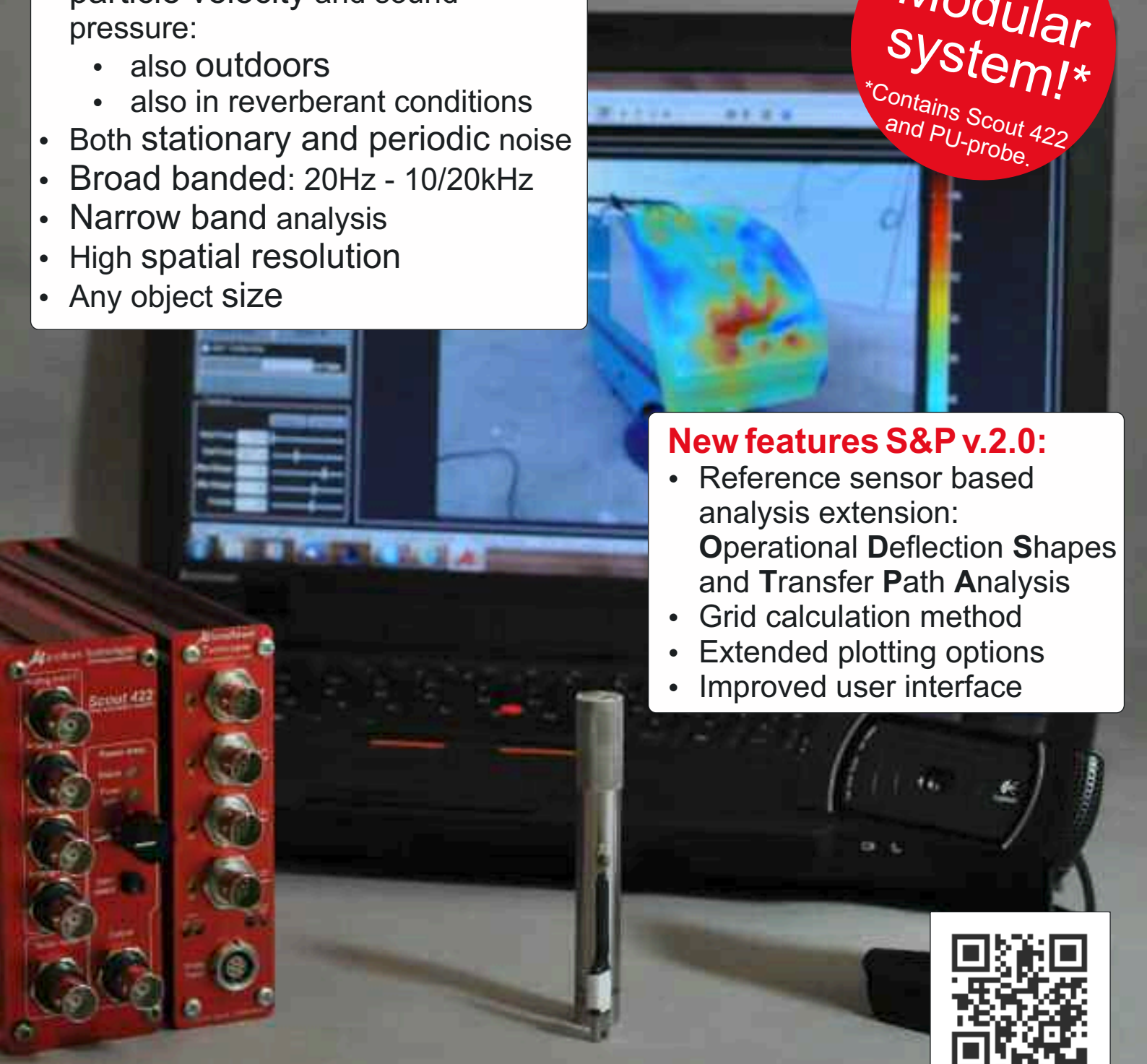
Microflown Technologies
Charting sound fields

Scan&Paint - is now BRUSHED UP!

Scan&Paint characteristics:

- Direct measurement of acoustic particle velocity and sound pressure:
  - also outdoors
  - also in reverberant conditions
- Both stationary and periodic noise
- Broad banded: 20Hz - 10/20kHz
- Narrow band analysis
- High spatial resolution
- Any object size

Modular system!*
*Contains Scout 422 and PU-probe.



New features S&P v.2.0:

- Reference sensor based analysis extension: **O**perational **D**eflection **S**hapes and **T**ransfer **P**ath **A**nalysis
- Grid calculation method
- Extended plotting options
- Improved user interface

www.microflown.com/brushup

Microflown Technologies, PO Box 2205, 6802 CE, Arnhem, the Netherlands
W: www.microflown.com E: info@microflown.com T: +31 880 010 800 F: +31 880 010 810

P38 At least this reports the rather modest fit that is inevitably higher than that for the quadratic, but at what cost in logic do we get this improvement? Notice that the introduction of a cubic term (x^3) into the equation means that we now allow the function to have two points of inflection at which its curvature changes from being concave upward (positive curvature) at low wind speeds to concave downwards (negative curvature) at higher speeds. What matters here isn't whether or not the additional term significantly improves the fit but whether or not it makes sense in simple logic. It does not.

Many wind farm noise assessments argue that below the cut in speed of the turbines (say 4m/s at hub height) the shape of these curves is not important; in fact the behaviour of the function used as it approaches and meets the background noise vertical Y-axis is critical. There are two important physical considerations. First, the intercept at the Y-axis represents the background noise at any chosen site in the absence of wind. Logically, and from simple physical considerations, when there is no wind *we would expect similar geographical locations scattered around the wind farm turbines in the same area to have consistently similar values for background noise.* Second, *we would expect the curve to flatten steadily towards the same axis and, to have a zero gradient where it meets the axis.*

Neither of these conditions is met in the example shown in Figure 2. First, at V_{10}= 0 m/s it predicts a background in the quiet daytime hours at a site in a very quiet rural area of an extremely unlikely $L_{A90\ 10min}$ = 39.99dBA. Second, although the full extent of this feature is hidden by the 'blanking out' on the plot of many of these data from V_{10} = 0 to around V_{10} = 3 m/s, it suggests that as the wind increases so the background noise gets less, which is equally unlikely. In our opinion both features, the high intercept and the negative gradient, have nothing to do with nature and everything to do with over-fitting a cubic model to data that do not warrant it. Any cubic function will inevitably bend through two points of inflection and that it is inevitable that this extra freedom for bend will increase the goodness of fit as measured by the R^2. If a cubic function fitted by least squares doesn't show two points of inflection in the range of the data, logically it must be the wrong function: a quadratic would have done the job just as well. Finally, at a late stage in the planning process a third model that attempted to correct some of these problems was offered and is shown in Figure 3.

Degree p= 3: $L_{A90\ 10min} = Y = -0.021x^3 + 0.4936x^2 - 1.7502x + 31.703$ dBA (R^2= 0.6766)

This has the same cubic shape as before and a better fit. Other than the use of a properly estimated V_{10} wind and the fact that the correlation seems to be improved we are not told anything more about how it was derived. It can be seen that it removes all the data for V_{10} speed below 2m/s so concealing the fact that once again we have a negative gradient in this range. At $L_{A90\ 10min}$ = 31.703 dBA the background at V_{10}=0m/s once again appears on the high side.

Does it matter?

Does it matter that in the range of wind speeds that are of concern that we have different versions of the background curve that the ETSU-R-97 process requires? For the various models listed in Table 1, at V_{10} = 5m/s the background curve value to be used in the assessment is as is given as in Table 2

Model fitted	Background at V_{10}=5m/s $L_{A90\ 10min}$ (dB)
Polynomial, degree 1	25.35
Polynomial, degree 2	24.48
Polynomial, degree 3	24.10
Polynomial, degree 4	23.99

Table 2: Background noise $L_{A90\ 10min}$ (dBA), at V10=5m/s Case 1

Model fitted	Background at V_{10}=5m/s $L_{A90\ 10min}$ (dB)
Initial Quadratic	34.60
Polynomial Degree 3, Model (2)	32.27
Polynomial Degree 3, Model (3)	32.67

Table 3: Background noise $L_{A90\ 10min}$ (dB), at V10=5m/s Case 2

For the models presented in our second example in Section (5) the equivalent background values are as in Table 3.

In both cases even at V_{10}=5.0m/s there is a range of background values of around 1.4 - 2.0dBA in the $L_{A90\ 10min}$, which increases at V_{10} lower than this and decreases as V_{10} increases above it. This range has very little to do with nature and everything to do with the choice of model fitted to the data. The uncertainty is less than that reported as arising with different corrections for wind shear (Stigwood, 2011) and, although modest, it could well be important in any decision made with receptor sites that are marginal in the ETSU-R-97guidance.

It should be stressed that *any* of these curves could well have been used in determination of an application to build a wind farm and/or in the determination of critical limits for related conditions. That any one or other of them increases or decreases the reference values at the receptor sites, and so does or does not favour a developer, is in our opinion irrelevant. Just as by manipulation a developer might be able to raise the background by choice of data and function, so could any competent data analyst find a function that would lower it by the same, or even greater, amount. The difference is that an honest data analyst would be well aware of this fact, report the uncertainty, and suggest allowing for it in any decisions based on it.

Is there an alternative?

Given these scatter plots, there are at least three alternative ways of reaching the representative values on which ETSU-R-97 relies.

(i) *Locally Weighted Scatterplot Smoothing*

First, professional statisticians would undoubtedly suggest alternative ways of fitting and assessing the fit that would address issues of model choice and the 'messy' character of the data. Of these the most obvious is *locally weighted scatterplot smoothing or local regression* (LOESS), that fits local models that derive their form from the data themselves rather than having to be specified *a priori* by the analyst is an approach that is widely used to isolate the 'signal' from the 'noise' in this type of plot and (see for example Cleveland, Grosse and Shyu, 1992). This type of smoothing is available in several software packages, but it relies on the user supplying a parameter that controls the degree to which the data are smoothed and so is open to possible manipulation by the analyst.

(ii) *Direct use of mean values with 'binned' data*

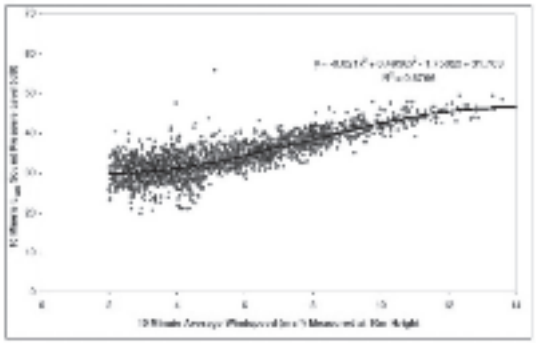


Figure 3: A second cubic model

Case Number (Day/Night)	Background at Zero wind constrained Method $L_{a90,\ 10min}$ (dB)	R^2 constrained Method (%)
Day 1	23.5	72
Day 2	20.9	58
Day 3	22.0	62
Day 4	23.4	73
Day 5	21.6	64
Day 6	23.4	73
Night 1	17.4	82
Night 2	16.5	69
Night 3	15.8	74
Night 4	17.7	80
Night 5	19.4	64
Night 6	19.8	70

Table 4: Summary values for polynomial of degree p=4 fitted to six different receptors (1-6) for both day and night time conditions in a wind farm noise assessment from eastern England.

Second, and much more transparently, referring back to the original ETSU-R-97 recommendations we find a sentence (page 101) that indicates that the panel were aware of a simpler alternative, which is to smooth the data before undertaking the regression analysis:

Where there is considerable scatter in the data, it may be more appropriate to bin the acoustic data into 1m/s bins before identifying a best fit model.

For reasons that we do not understand, this simple option seems subsequently to have been totally ignored and in fact there is no need whatsoever to undertake any regression analysis. Figure 4 shows a summary of the data used to prepare Table 1 ' binned' at the nearest whole number wind speeds and presented as a sequence of stacked box plots.

In each graphic the vertical line shows the total range of the data in each bin whilst the rectangle shows the inter-quartile range and the horizontal line is at the median value for that bin. This display has the merit of showing the very considerable scatter that exists around any measure of the central tendency in each wind speed bin. In every example we have examined such a display would have been sufficient, and there is no need to go further and use regression analysis on the binned means or medians, but if there is an insistence on finding a 'best fit' function the most appropriate shape seems obvious. Binning data in this way has two disadvantages. First, it literally 'throws away' information that could be of use and, secondly, it introduces a dependence on the arbitrary boundaries of the bins. A clear advantage is that, although it might make the choice of function and variation around that function easier, each of the bins can be carried forward, complete with their individual gauges of uncertainty, for incorporation in the ETSU-R-97 assessment of noise margins without any need to fit a function. Indeed, presentation of boxplots for each integer wind speed together with the predicted wind turbine noise on the same graph would have the great merit of showing how safe the allowed headroom in ETSU-R-97 would be for each and every receptor and time period.

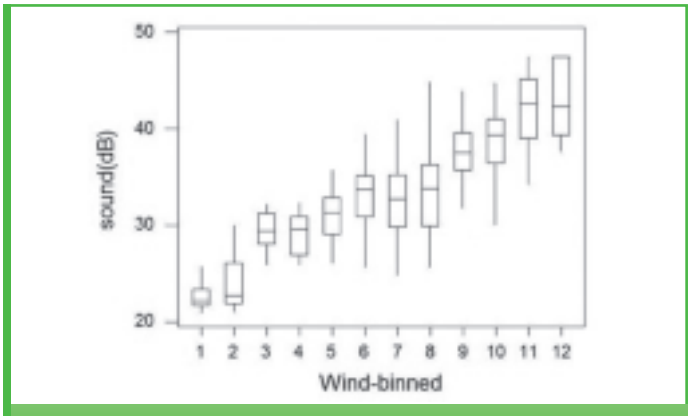


Figure 4: Stacked box plots at each whole number wind speed

(iii) *The zero-gradient at the Y axis approach*

In Section 5 we note that a simple constraint on the fitted curve is provided by the observation that at the point it intersects the background noise (vertical) axis, the rate of change of noise with wind speed must be zero. This constraint is easy to apply if we rely on polynomials of degree that are an even number, in practice either a quadratic (p=2) or quartic (p=4).

Figure 5 shows results from data typical of background noise as a function of wind speed. In the first plot is a conventional quartic (p=4) polynomials fitted to these data. This is followed by a second plot using a quartic function constrained to cross the Y-axis with zero gradient. We would argue that this is a much more plausible curve for these data which also gives a zero wind background of just 17.5dBA. The loss of fit, as measured by the R^2, is negligible.

The advantages of this approach can be illustrated by comparing it to the conventional approach for six 'at risk' receptors at a proposed site in eastern England with the results as shown Table 4 for the constrained fits using exactly the same data as measured and used by the applicant for each receptor site. In every case the function fitted was a quartic, p=4, polynomial.

There are a number of features of note in the comparison of the conventional and constrained results. First, according to the applicants ES, using the standard method without any P42

P41 gradient constraint, the applicant's curves all clearly overlay the daytime data points just as the standard method illustrates in Figure 5. However they generate wildly varying values for the background noise at zero wind that span a range of 50dBA and include physically impossible negative values. The night time values using the standard approach are much more stable covering a range of 4dBA but seem inappropriately high for what is a very quiet rural location. As shown in Table 4, imposition of a zero gradient at the Y-axis constraint has a marked and welcome effect on both day and night time zero wind speed background noise values at all six sites. There are several consequences. During the day the effect is to stabilise them in the range 20.9 to 23.5dBA which, given the similarity of the locations, is much more plausible. At night the same effect is seen, but now there is a reduction to a barely measureable background of 16.5 to 19.8dBA. Although in every case the constrained curve data R2 shown in the final column will be necessarily less than that obtained with the unconstrained method, this reduction in value is at most only 1 to 2%. Our view is that, by its use of simple physical reasoning, this is the best of the three suggested options in this Section and for all the cases we have examined, this easy approach to the curve fitting process provides much more consistent estimates of the 'zero wind' background noise and a shape of curve that is in accord with common experience.

Conclusion

In conclusion, we note that the variation in the fitted curves and their impact on the values taken as representative of the background noise at each and every at risk receptor generates a neglected, but very real, *uncertainty* in the entire ETSU-R-97 process. We have demonstrated that replacing the blanket recommendation that a 'best fit' polynomial curve should be fitted to summarise these data before comparison with the predicted turbine noise by either a simple locally weighted average smoothing, a smoothing using the already binned data, a simple set of boxplots of these binned data without any accompanying function, or a curved constrained to intersect the Y-axis at zero gradient results in a reduction in this uncertainty.

Our analysis does not of course include other uncertainties related to the time period of the sampling of the sound data, calibration and related instrumental errors in the meters used, the type of turbines to be installed, variation in sound output from nominally the same machinery, the noise prediction methodology adopted (especially the allowance for ground absorption and/or reflection), and the way that both the wind at hub height and 10m AGL are adjusted to allow for the continuously variable wind shear. Even quite modest estimates of all these uncertainties suggests 'worst case' scenarios that could easily double or halve the background at a receptor. Given that wind farm consents are routinely given with headroom values in the operational range of the turbines of a few decibels and do not recognise the uncertainties that surround the estimates used, it seems inevitable that breaches of any imposed planning conditions will occur. Since we know of no case where noise nuisance has resulted in a consent being denied, the reverse, that consents are being denied when the same considerations of uncertainty should suggest the reverse, does not apply.

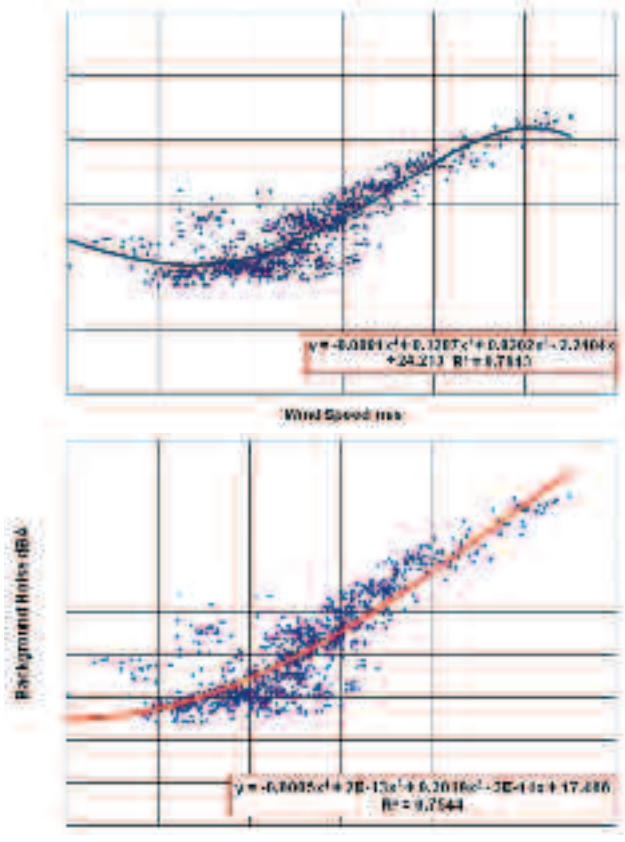


Figure 5: The standard ETSU-R-97 suggested approach compared with application of a zero gradient constraint using typical background noise data

References

1. Akaike, H. (1974) A new look at statistical model identification. IEEE Transactions on Automatic Control 19, 716–723.
2. Bowdler, D. (2006) *ETSU-R-97: Why it is wrong.* Dick Bowdler, Acoustic Consultant, 8 pages
3. Bowdler, D. (2009) Wind shear and its effect on noise assessment of wind turbines. Dick Bowdler, Acoustic Consultant, 14 pages
4. Bowdler, D. , Bullmore, A., David, B., Hayes, M., Jiggins, M., Leventhal, G. and A. McKenzie. (2009) Prediction and assessment of wind turbine noise. *Acoustics Bulletin*, 34(2): 35-37
5. Broneske, S. (2009) *Comparison of wind turbine manufacturer's noise data for use in wind farm assessments.* Paper presented at Third International Meeting on Wind Turbine Noise, Aalborg, Denmark, 17-19 June 2009, 10 pages.
6. Cleveland, W.S., Grosse, E. and M. J. Shyu (1992). Local Regression Models In J. M. Chambers and T. Hastie, (eds) *Statistical Models in S*, (New York, Chapman and Hall), pages 309-376.
7. Cox, R, Unwin D & T. Sherman, (2012) *Wind Farm Noise Assessment: Where ETSU is silent* (80 pages)
8. Davis, J.C. (2002) *Statistics and Data Analysis in Geology*, 3RD Edition pages 407-411 (Wiley: Chichester and New York)
9. ETSU-R-97(1996) *The Assessment and Rating of Noise from Wind Farms*, (The Working Group on Noise from Wind Turbines, Harwell, Oxon), 150 pages
10. Hayes McKenzie Partnership (2011) *Analysis of How Noise Impacts are considered in the Determination of Wind Farm Planning Applications*, HM 2293/R1
11. O'Sullivan, D. and Unwin, D.J. (2010) *Geographic Information Analysis* (New York, John Wiley and Sons, Second Edition)
12. REF Renewable Energy Foundation (2012) *A Critique of the IoA Treatment of Background Noise for Wind Farm Noise Assessments* Available at http://www.ref.org.uk/publications/255-ioa-critique
13. Stigwood, M. (2011) *The effect of a common wind shear adjustment methodology on the assessment of wind farms when applying ETSU-R-97.* MAS Environmental, 56 pages
14. Unwin, D.J. and Wrigley, N. (1987) Towards a general theory of control point distribution effects in trend surface models, *Computers & Geosciences*, 13: 351 355.
15. Van den Berg, G.P. (2006) Wind-induced noise in a screened microphone. *J. Acoust. Soc. Am.*, 119: 824-833.

Characteristics of speech source: an important aspect for accurate and meaningful speech intelligibility and privacy assessment

Report by Francis F. Li, Acoustics Research Centre, University of Salford

Introduction

A good number of metrics have been developed in the past few decades to predict speech intelligibility in noisy conditions. Some of them also take into account transmission channel distortions. Speech interference level (SIL), articulation index (AI), its refined version speech intelligibility index (SII), and speech transmission index (STI) are well known to room acousticians. Speech intelligibility and privacy depend upon three distinctive elements, namely acoustic characteristics of sources, transmission channel effects including noise, reverberation and other distortions, and talker-listener matching. Transmission channel effects might be quantified by tailored physical properties, the STI is a typical example, combining noise and reverberation effects on intelligibility. Physical properties of speech transmission channels have been studied extensively, but acoustic characteristics and properties of speech itself have been neglected to some extent. To set up an intelligibility test, speech level should be determined first; to interpret physical measures of intelligibility or privacy, speech levels in real use and their variations must be fully understood. This article summarises the results and insights gained from a large scale study into statistical features of speech levels, or more precisely vocal effort levels, in anechoic conditions. The dataset may provide a baseline reference in speech intelligibility and privacy assessments.

Some problems in speech intelligibility and privacy assessments

A sandwich model for speech comprehension

Speech intelligibility and privacy are important concerns in the design of built and human environments, such as classrooms and lecture theatres, where lecturers' voices need to be clearly delivered, transportation hubs where the clarity of Tannoy broadcast is important, and offices or meeting rooms in which intended speech communication should be intelligible but neighboring conversations often need to be kept private. Over the past few decades speech intelligibility and privacy have been one of the research foci of building and architectural acoustics, accumulating a good number of assessment methods and a fairly large knowledgebase. Strictly speaking, intelligibility of speech should be referred to as the amount of information carried in the speech of a talker that can be decoded by a human listener via an acoustic or electronic transmission channel, while privacy should be a measure of information leakage. Under such definitions, levels and clarity of the original speech, quality of transmission channel (or sound insulation mechanisms in the case of speech privacy) and prosody matching between the talker and the listener can all affect speech intelligibility or privacy, hence complicating the case.

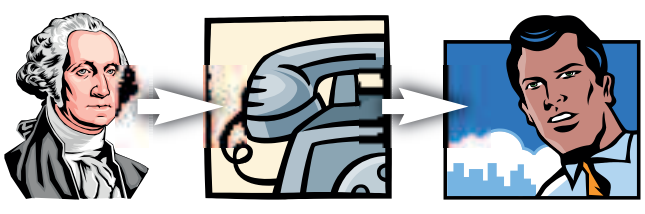


Figure 1 A sandwich model for speech intelligibility/privacy: Loudness and clarity of the source, degradation caused by the transmission channel, and talker-listener prosody matching

There are good reasons to single out a transmission channel and define its own "intelligibility" as a quality index. In building, architectural and acoustics, intelligibility of a space or a system is usual deemed as a physical or objective measure independent of the talkers and listeners, but best correlated to subjective intelligibility in a general sense. This is based upon certain assumptions, i.e. a "typical" speech source and source level, similar prosodies between talkers and listeners. In essence, objective intelligibility and privacy assessment methods evaluate signal to noise ratios and channel distortions in critical sub-bands. While channel distortions are determined solely by the physical channel itself, signal to noise ratios are related to both the source and noise levels. The underlying mechanism that makes intelligibility measures objective parameters is the assumption of a "standard" talker in terms of sound pressure level, spectrum and clarity of articulation, in addition a typical talker-listener match scenario. In telecommunications, there are also demands to assess usability or Quality of Service (QoS) of voice communications channels in terms of perceived speech quality or intelligibility. In parallel with acoustics research, a set of related but somehow diverse assessment regimes were developed. Perceptual Evaluation of Speech Quality (PESQ) is a typical example. At the first glance, it seems that the system gain in telecommunications systems can often be increased at the user end by tuning the volume up, nonetheless modern voice telecommunications systems are subject to digitization, non-linear codecs, acoustic and electronic noises. Vocal levels at the signal acquisition end do have a significant impact on the overall signal to noise ratio. In audiology and hearing aids research, it is important to understand how loud people normally talk in various settings of speech communication. For speech privacy, how loud people normally talk and the variation of speech level play a crucial role in the determination of necessary sound insulation or masking.

All the above examples suggest the necessity of a knowledge base about speech levels, directivities and their variations in various speech communication settings. Moreover, as an engineering approach to the problems, a standardised "artificial talker" would make measurement easier, more repeatable and reliable. However the review below will show a lack of consistency in datasets found in literature and the limitations of the existing knowledge base.

Acoustic characteristics of speech source in the literature

Vocal Effort Level (VEL) also quoted as speech intensity level is often used to quantify how loud a talker talks in a particular communication setting. It is defined as an A-weighted or unweighted equivalent continuous sound pressure level (SPL) of speech. In this text, the vocal effort level is more specifically defined as the on-axis A-weighted sound pressure level, or unweighted 1/3 octave band SPL measured at 1 metre from the lips of a human speaker under anechoic conditions. The VEL is a key variable for the prediction of intelligibility of speech communications systems. It is also a critical reference value for the acoustical design to achieve desired speech intelligibility and/or P44

P43 privacy. In the light of its importance, the interest of quantifying VELs in various speech communication settings started from the era when communications systems emerged and measurement techniques became available. Early establishment of a small knowledgebase about the speech level was based on a series of scattered research activities that took place from the 20s to 50s. Further studies in the 60s and early 70s made some enrichment to the body of knowledge. These early studies suffered from small number of samples, limited measurement techniques and less well-defined measurement conditions.

Crandall and Mackenzie made the first endeavor in defining "normal" speech level, but free-field microphone calibration was not available in their 1922 study[1]. In 1940 Dunn and White established the "normal" vocal effort level dataset in terms of long-term RMS and 1/8-second peak sound pressure levels at 30 cm from lips under anechoic conditions[2]. But the experiments used only six male and five female subjects. In 1947 French and Steinberg[3], and Benson and Hirsch[4] in1953 replicated the findings by Dunn and White with a larger number of subjects. Vocal effort level specified in the classical text by Beranek published in 1947[5] was largely based on the above studies. Thus the early days' "standard" speech level of 60-65 dB (long term RMS) at 1 metre from a male speaker's lips was established. Brandt et al. quantified the relation between changes in loudness and speech effort in 1969[6]. In 1976, Brown further argued that "comfortable effort level", as often instructed in speech related experiments, was not sufficiently constant[7]. All these authors called for a more detailed and accurate knowledgebase about vocal effort level distribution under stipulated efforts, e.g. casual, soft, normal, loud and shout, and more reliable statistical results from a larger number of subjects. Alongside the study of the "standard" or "normal" vocal levels, efforts were made to quantify Lombard effect – the phenomenon first described by Lombard in 1911 that speakers tend to increase their vocal levels when the ambient noise increases[8]. Klumpp[9] and Gardner[10] made important contributions in this area prior to the publication of the Pearsons report in 1977[11].

Pearsons, Bennett, and Fidel were commissioned to carry out a large-scale research into the VELs in both controlled laboratory conditions and real-life settings[11]. This was an important milestone. The report published in 1977 is often deemed as the "definitive" reference for English language vocal effort levels in anechoic conditions. No other anechoic chamber based study into the vocal effort level (English language) of a similar scale was documented in the literature. Given its importance, 21 years later Olsen published a summary of the report in 1998 as a journal paper[12]. (One most recent large-scale study in 2004 by Corthals[13] obtained speech levels of 400 normal subjects reading the "Dutch rainbow passage". However, the measurements were not carried out in an anechoic chamber and the results may not represent English language speech levels.) Given the larger number of subjects used, the better controlled and calibrated laboratory conditions, and more up-to-date equipment, statistical results of the anechoic chamber measurements from Pearsons report should override the ones published prior to 1977.

The post 1977 era has seen some more research confirming the results from Pearsons' study and enriching the body of knowledge by adding more data and details, for example, directivity information and VEL adaptation. Major contributions include directivities of sound field around human talkers, vocal effort levels from more field measurements, refined coefficients for Lombard effect, and adaptation of vocal effort levels due to other variables such as communication distance. Chu and Warnock[14] reported detailed directivity information of human speakers. Bozzoli and Farina measured speech levels in cars[15,16]. Warnock[17], Bradley[18], Gover and Bradley[19], Gover and Bradley[20], Bradley and Gover[21] presented results from large-scale studies into speech levels in offices and meeting rooms. Navarra and Pimentel[22] and Hodgson et al. [23] measured speech levels in food courts and dining spaces. Variation of speech levels due to age, communication distance and ambient noise levels (Lombard effect) were studied by many authors. Hodge et al.[24], Huber et al.[25], Lienard and Benedetto[26], Brungart and Scott[27], Giguere et al.[28], and Pick et al.[29] all made important contributions.

Limitation and problems in existing knowledge base

Literature review showed that there were continuous efforts over the past 90 years to characterise speech sources in terms of their intensity and directivities. However, there is no single standard definition for the vocal effort level, speech level, or speech intensity. Individual studies were reported from diverse fields, with dissimilar acoustic environments and different measurement procedures. This makes the comparison and merging of the accumulated datasets difficult.

The most comprehensive study of vocal effort level in the past is probably the one carried out by Pearsons et al. The study was carried out in the United States 30 years ago. Although the controlled laboratory conditions are unlikely to change over time, the real-life settings 30 years ago in America may not represent the current reality in the UK. For example, the change of sizes of public venues may cause changes to background noise levels. Modern vehicles and road conditions in the UK are not identical to those in the US 30 years ago. Moreover, the stipulated vocal efforts used in Pearsons experiments are not clearly explained, it is speculated that subjects may interpret them differently.

Subjects involved in the Pearsons study spoke American English. It is unknown whether there is a vocal effort discrepancy between British and American accents. Directivity data and vocal effort levels in offices published by National Research Council Canada were measured from a population of circa 90% English speakers and 10% French speakers. Whether there is a vocal effort level difference between English and French speakers is again unknown.

Lombard effect and Lombard slope is a useful and arguably robust prediction tool for vocal effort levels in noisy environment. However, there is a large divergence in Lombard coefficients reported by different authors.

Several authors implied that the "normal speech levels" assumed by the current ANSI and ISO standards for speech intelligibility were too high to represent actual speech levels in certain real-life settings. For example, a lower speech level of 50.2 dB(A) was suggested by Bradley[18] for the assessment of intelligibility in open offices. Private conversations might have speech levels even lower than those of casual conversations. The data of such "hushed" speech levels are crucial in the assessment of the viability of certain speech transmission systems. Unfortunately, statistical data about speech levels below casual conversations are not available from the literature.

Directivities of talkers again require more work. Several authors reported different data. There are also papers reporting large directivity discrepancies amongst the commercially available HATS and real human talkers: Responses of artificial mouth simulators of B&K HATS 4128, B&K 4227 and Head Acoustics HMS II.3 were compared against human talkers and non trivial discrepancies have been noted[30].

Recent work

Vocal effort level of British English speakers in anechoic conditions

To verify Pearsons' anechoic vocal effort levels, similar experiments were carried out with 50 native British English speakers. The experiments aimed to (1) identify if American and British accents would affect the vocal effort levels, (2) extend the database to include "hushed" speech levels, and (3) mitigate the deviations in Pearsons dataset by giving clearer descriptions with examples.

Recordings were made in an anechoic chamber to determine the average vocal effort levels and spectra of adult males and females, using a 01dB-Metravib NetdB 12 kit, which allows for the simultaneous recording of multiple microphone signals. Five Omni-directional microphones (G.R.A.S. Type 26CA) were used: (1) at a 1m distance in front of the talker, (2) at 0.5m in front, (3) at 1m to the left, (4) at 1m to the right and (5) at 1m behind. All microphones were placed at the same height as the subjects' mouths. Voices ▶

from 50 subjects with an average age of 30 years were recorded. No subjects reported any hearing or speech impairments.

Subjects were instructed to repeat the sentence "Joe took father's shoe bench out, she was waiting at my lawn" three times with five different vocal efforts, namely hushed, normal, raised, loud and shouted. This particular phonetically balanced short sentence was chosen as it was used in the work by Pearsons, which would make the comparison between the two studies straightforward and robust. The second reason is due to its short length, as higher vocal efforts can be difficult to sustain for a long time and can risk damaging the vocal cords. In Pearsons' experiments, only very brief descriptions of the vocal efforts were given, with no examples of typical scenarios attached to each of the stipulated vocal effort labels. For example, the entire description for "shout" was simply "speak at a shouted level". It was speculated that the lack of detailed descriptions could lead to ambiguous interpretations and subsequently a lager spread of data. In the current study, detailed descriptions (as shown in Table 1) of each vocal effort were given with typical scenarios as examples to the subjects prior to starting the recording.

Hushed	This is the quietest level of voiced speech – just louder than whispering. Typically this speech level would be used in intimate situations where privacy is an issue; for example talking in a library so as not to disturb others, or talking in a doctor's waiting room.
Normal	This is a normal, everyday conversational speech level. Typically this speech level would be used in small quiet room with no more than two or three people involved in the conversation.
Raised	This speech level would typically be used when addressing multiple people in a medium sized room, or when in the presence of background noise such as a car or train.
Loud	This speech level would typically be used when issuing commands or attracting attention, expressing anger or assertiveness. A situation where this speech level would be used is when addressing a large number of people in a very large room without the aid of amplification.
Shout	This is the loudest possible speech level one can manage, without straining or hurting the vocal cords.

Table 1: Descriptions of vocal effort labels

Average vocal effort levels from the 1m microphone are presented in Table 2. All results are rounded to the nearest decibel. For a comparison purpose, Pearsons' results are shown in Table 3.

Stipulated level	Hushed	Normal	Raised	Loud	Shout
Males	47 [52] (2)	58 [62] (3)	67 [69] (5)	76 [77] (6)	89 [89] (6)
Female	46 [49] (2)	56 [58] (3)	64 [66] (4)	70 [71] (4)	82 [82] (3)

Table 2: Vocal effort levels in anechoic conditions acquired in the current study, measured at 1m. Data are presented in the format: "A-weighted [unweighted] (standard deviation)."

Stipulated level	Casual	Normal	Raised	Loud	Shout
Males	52 [56] (4)	58 [61] (4)	65 [68] (5	76 [77] (6)	89 [89] (7)
Female	50 [54] (4)	55 [58] (4)	63 [65] (4)	71 [72] (6)	82 [82] (7)

Table 3: Results from Pearsons et al.

Figures 2 & 3 show the statistical distribution of each vocal effort level in terms of un-weighted and A-weighted sound pressure levels for male and female talkers. Both groups show an increase in between-subject variation as vocal effort increases, apart from the female shouted levels which decrease in standard deviation. Comparison between ours and Pearsons' results shows that the standard deviations are lower from our results, which might P46

P45 be attributed to the more detailed vocal effort labels used.

For males and females respectively, the difference between A-weighted and unweighted levels is 5 dB and 3 dB for hushed speech, 4 dB and 2 dB for normal speech, 2 dB for raised speech, 1 dB for loud speech and 0 dB for shouted speech. Male speech is consistently louder than female speech, and the difference increases from 1 dB(A) to 7 dB(A) as vocal effort increases from hushed through to shouted speech. As expected, hushed speech shows consistently the lowest average level, approximately 11 dB(A) lower than normal speech for both male and female talkers. Raised speech is 9 dB(A) and 8 dB(A) more intense than normal speech for the male and female groups respectively. Loud speech is 9 dB(A) higher than raised speech for males and 6 dB(A) for females. Shouting speech gives the highest levels, with a 13 dB(A) increase from raised speech for males, and a 12 dB(A) increase for females. Between the two extreme ends of the vocal effort scale, the hushed and the shouted, there is a 42 dB(A) dynamic range for males and a 36 dB(A) for females.

Figures 4 and 5 show averaged one-third octave band speech spectra for male and female talker groups at each different vocal effort level, from the 1m microphone. More details about speech levels and spectra around the talkers can be found in the reference[31].

Stipulated effort	Hushed	Normal	Raised	Loud	Shout
Voiced (dB)	52	62	69	77	89
Unvoiced (dB)	40	46	49	54	65

Table 3: Voiced and unvoiced intensity level (un-weighted) for male subjects

Stipulated effort	Hushed	Normal	Raised	Loud	Shout
Voiced (dB)	49	58	66	71	82
Unvoiced (dB)	36	41	47	49	57

Table 4: Voiced and unvoiced intensity level (un-weighted) for female subjects

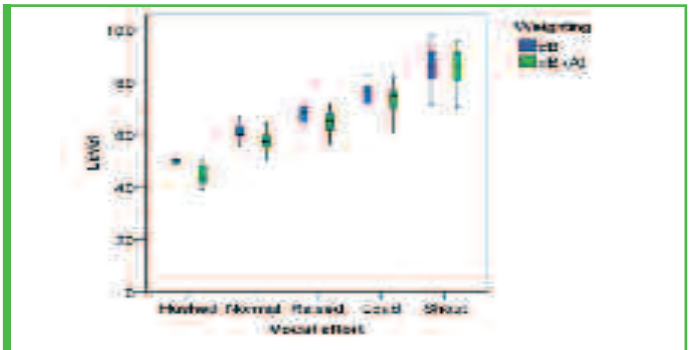


Figure 2 Average vocal effort levels for males (Cushing et al., 2011[31])

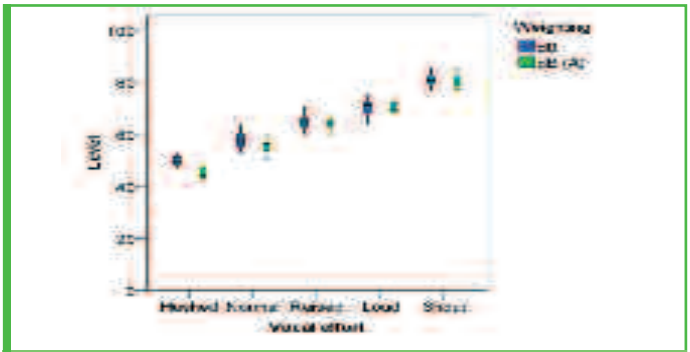


Figure 3 Average vocal effort levels for females (Cushing et al., 2011[31])

Acoustic phonetic feature variations under diverse vocal efforts

It is obvious that the intensity of the whole signal increases as vocal effort does. However, vocal effort variation results in changes of acoustic phonetic features of speech, not just overall energy levels. Increasing the volume of a whispered recording does not mimic a shouted one. Studies were carried out to further identify the detailed changes in acoustic phonetic profiles of speech signals. Speech signals were segmented to voiced and unvoiced parts and their level calculated and shown in Tables 3 & 4.

Increased vocal effort mainly places the stress on voiced segments; it is evident that it is the voiced segments that contribute to the overall sound pressure levels. Tables 3 & 4 also show that the differences between the voiced and unvoiced parts increase with vocal efforts, which means the unvoiced parts, i.e. consonants, do not increase as much as the voiced ones do. For males, the difference in intensity between the voiced and unvoiced parts is 12 dB for hushed speech, 16 dB for normal speech, 20 dB for raised speech, 23 dB for loud speech and 24 dB for shouted speech. For females, the differences are 13 dB for hushed speech, 17 dB for normal speech, 19 dB for raised speech, 22 dB for loud speech and 25 dB for shouted speech respectively.

Fundamental frequency F_0 or pitch is another important attribute of speech. F_0 significantly increases when vocal effort becomes intense. Figure 6 shows the variation in F0 with different vocal efforts.

Relations between vocal effort and perceived clarity

Given the non-proportional changes in acoustic-phonetic profiles of speech signals, the intrinsic clarity of speech may vary under different vocal efforts even if the signals are electronically amplified or attenuated to an identical level. It is therefore interesting to identify the relations between vocal effort and perceived clarity of speech.

A total of 4,340 phonetically balanced nonsense CVC words were collected in anechoic conditions to form a corpus: 816 hushed, 864 normal, 882 raised, 882 loud and 896 shouted words. A hundred words selected randomly from the corpus were used for each listening test. The overall sound level was equalised across all stimuli to the same L_{eq}. This was to remove the

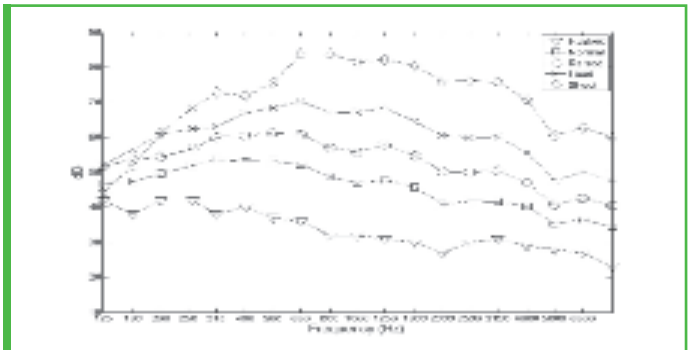


Figure 4 Speech spectra for male talkers at different vocal effort levels (Cushing et al., 2011[31])

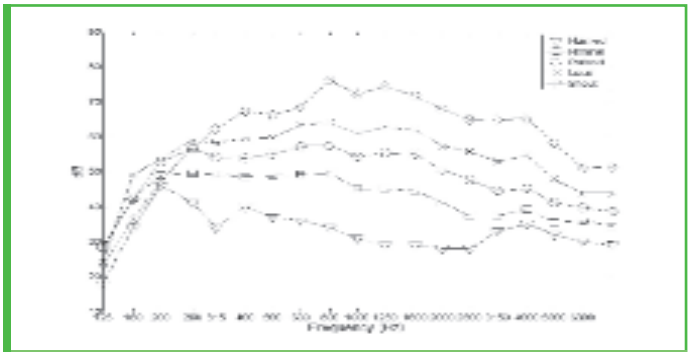


Figure 5 Speech spectra for female talkers at different vocal effort levels (Cushing et al., 2011[31])

variance in volume and ensure that subjects only use the subtle phonetic cues of the speech to complete the task. Stimuli were presented over reference headphones. During the first 5 trial tests, listeners were allowed to adjust the volume to a "comfortable" level, which then remained unchanged throughout the testing.

The following description of clarity of articulation was given: "how well the speaker enunciates the word; how defined and clear the articulation is. Good clarity of articulation is where each individual speech sound is easily heard and recognised, whereas poor clarity of articulation would be if the speaker mumbles or it is difficult to recognise what they are saying". Subjects were asked to rate the clarity using a one to five MOS score, with one being the poorest and five being the best. Twenty-five normal hearing native English-speaking subjects participated in the listening experiments; 14 males and 11 females. The average age of subjects was 35. No subjects had any experience in speech transcription or similar work. Results are shown in Figure 7.

The results clearly show that the words uttered at normal and raised levels have the best perceived clarity of articulation. The words said at a hushed level were rated the lowest. The pattern of the graph suggests that the 'ideal' speech level for the best clarity of articulation is around the normal to raised level. Excessively raising one's voice does not necessarily result in an increase in clarity. Whereas voice raising is typically associated with a P48

Figure 6 Pitch versus vocal efforts

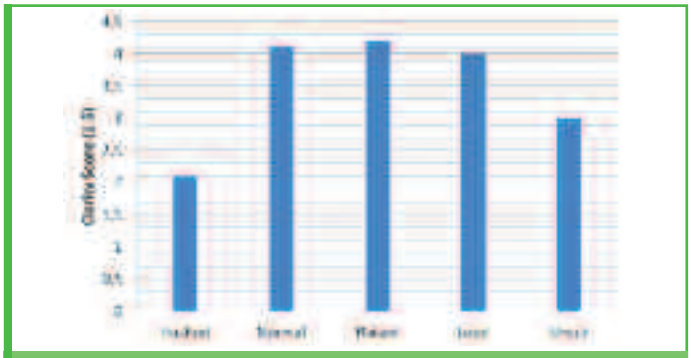


Figure 7. Relations between vocal effort and clarity.

P47 desire to improve intelligibility (against background noise), extreme vocal efforts such as loud and shout can actually have the opposite effect on the intrinsic clarity of the speech itself.

As a result, in intelligibility or privacy testing, changing the volume of speech signal electronically to deliver required source level is not good practice. Speech samples with different vocal efforts should be individually recorded and played back at the similar level.

Concluding remarks and future work

More accurate characterisation and in-depth understanding of speech sources are a step towards more reliable subjective and objective assessments of speech intelligibility and privacy. The speech level reported here can be used as a baseline reference when setting up a speech intelligibility or privacy test. With the use of a more precise instruction given to the subjects, the Salford dataset shows lower variations in vocal effort levels than those reported in Peasons' report. A device that can completely replicate the speech from a typical human talker in terms of its spectrum, dynamic range and directivity does not exist so far, partly because of the lack of statistical data, and partly because of technical challenges to reproduce phonetically dependent directivity patterns of a real speech source. More research is needed to fully establish a knowledge base of statistical distribution of vocal effort levels, their variations in diverse communication settings, directivities and more reliable Lombard coefficients. With the knowledge, beamforming techniques and DSP algorithms, an artificial talker might be possible to completely simulate a human talker.

References

1. Crandall, I. B. and MacKenzie, D. "Analysis of the Energy Distribution in Speech," Physical Review, Vol. 19, Issue 3, 221-232, 1992.
2. Dunn, H. K. and White S. D. "statistical measurements on conversational speech," J. Acoust. Soc. Am. Vol. 11, 278-288, 1940
3. French, N. R. and Steinberg J. C. "Factors governing the intelligibility of speech sounds," J. Acoust. Soc. Am. Vol. 19, 90-119, 1947
4. Benson, R.W. and Hirsh I. J., "Some variables in audio spectrometry", J. Acoust. Soc. Am. Vol. 25, 499-505. 1953.
5. Beranek, L. L., Acoustics, McGraw-Hill, 1954.
6. Brandt, J. F., Ruder, K. F. and Shipp, T. Jr., "Vocal Loudness and Effort in Continuous Speech," J. Acoust. Soc. Am. Vol. 46 (6B), 1543-1548,1969.
7. Brown, W. S. Jr., Murry, T. and Hughes D., "Comfortable effort level: An experimental variable," J. Acoust. Soc. Am. Vol. 60 (3), 696-699, 1976.
8. Lombard, E., "Le signe de l'elevation de la voix," Ann. Maladie Oreille Larynx Nez Pharynx, vol. 37, 101–119, 1911.
9. Klumpp, R. G. and Webster, J. C., "Physical measurements of equally speech-interfering Navy noises," J. Acoust. Soc. Am. 35, 1328-1338., 1963.
10. Gardner, M. B., "Effect of Noise, System Gain, and Assigned Task on Talking Levels in Loudspeaker Communication," J. Acoust. Soc. Am. Vol. 40 (5), 955-965, 1966.
11. Pearsons, K.S., Bennett, R.L., and Fidel, S., "Speech Levels in Various Noise Environments,' EPA-6001-77-025, U. S. Environmental Protection Agency, May 1977, Available from National Technical Information Services as No. PB-270 053, 1977.
12. Wayne O. Olsen, "Average Speech Levels and Spectra in Various Speaking/Listening Conditions- A Summary of the Pearson, Bennett, & Fidell (1977) Report," American Journal of Audiology, Vol.7, 21-25, 1998.
13. Paul Corthals, "Sound pressure level of running speech: percentile level statistics and equivalent continuous sound level," Folia Phoniatrica et Logopaedica, Vol. 56 No. 3, pp. 170-181, 2004.
14. Chu, W. T. and Warnock, A.C.C., "Detailed Directivity of Sound Fields Around Human Talkers," report number IRC-RR-104, National Research Council Canada, January 2002.
15. Bozzoli, F. and Farina, A., "Measurement of Speech Transmission Index Inside Cars Using Throat-Activated Microphone and Analysis of Its Correlation with Drivers' Impression" 117th AES convention, Preprint Number: 6307, San Francisco, USA, 2004.
16. Bozzoli, F. and Farina, A., "Measurement of Active Speech Level Inside Cars using Throat-activated Microphone" 116th AES convention, Preprint Number: 6004, Berlin, Germany, 2004.
17. Warnock, C. C., "Acoustical privacy in the landscaped office," J. Acoust. Soc. Am. 53, 1535–1543, 1973
18. Bradley, J. S., "A Renewed look at open office acoustical design," Report NRCC-46399 ,A version of this document is also published in Inter-Noise 2003, Seogwipo, Korea, pp. 1-8, 2003.
19. Bradley, J. S. and Gover, B. N., "Speech and Noise Levels Associated with Meeting Rooms, IRC, National Research Council Canada, Research Report, IRC RR-170, March, 2004.
20. Gover, B. N. and Bradley, J. S., "Measurement of Architectural Speech Security of Closed Offices and Meeting Rooms," National Research Council Canada (NRCC) technical report 48206, a version has also been published at 119th Audio Engineering Society Convention, New York, NY., Preprint Number: 6529, Oct. 7, 2005.
21. Bradley, J.S., Gover, B. N., "Measurement of Sound Transmission from Meeting Rooms," IRC Research Report, IRC RR-220 (Institute of Research in Construction, National Research council Canada), March, 2006.
22. Navarra, M. P. N. and Pimentel R.L., "Speech interference in food courts of shopping centres," Applied Acoustics 2007, 68(12), 364-375, 2007
23. Hodgson M., Steininger, G. and Razavi, Z., "Measurement and prediction of speech and noise levels and the Lombard effect in eating establishments," J. Acoust. Soc. Am. 121 (4), 2023-2033, 2007.
24. Hodge, F. S. Colton, R. H. and Kelley, R. T., "Vocal Intensity Characteristics in Normal and Elderly Speakers," Journal of Voice Vol. 15, No. 4, pp. 503–511, 2001.
25. Huber, J. E., Stathopoulos, E. T., Curione, G. M., Ash, T. A. and Johnson, A., "Formants of children, women, and men: The effects of vocal intensity variation," J. Acoust. Soc. Am. 106 (3), Pt. 1,1352-1542, 1999.
26. Lienard, J. S. and Benedetto M. G. D., "Effect of vocal effort on spectral properties of vowels," J. Acoust. Soc Am 106, 411-422, 1999.
27. Brungart D. S. and Scott, K. R., "The effect of production and presentation level on auditory distance perception of speech," J. Acoust. Soc Am 110 (1), 425-440, 2001.
28. Giguere, C. et al., "Quantifying the Lombard effect in different background noises" J. Acoust. Soc. Am., Vol. 120 (5), 3378, 2006.
29. Pick, H. L. Jr., Siegel, G.M. and Fox, P.W., "Inhibiting the Lombard effect" J. Acoust Soc. Am. 8 5 (2), 894-900, 1989.
30. Halkosaari, T. and Vaalgamaa, M., "Directivity of human and artificial speech," Workshop on Wideband Speech Quality in Terminals and Networks: Assessment and Prediction, 8th and 9th June 2004 - Mainz, Germany, 2004.
31. Cushing I. R., Li F. F., Cox T. J., Worrall K., Jackson T., "Vocal effort levels in anechoic conditions," Applied Acoustics Vol. 72 pp. 695–701, 2011
32. Montgomery, A.A., Prosek, R.A., Walden, B.E & Cord, M.T., The effects of increasing consonant/vowel intensity ratio on speech loudness. Journal of Rehabilitation Research and Development 24 (4): 221 – 228, 1987.
33. Freyman, R.L., Nerbonne, G.P., The importance of consonant-vowel intensity ratio in the intelligibility of voiceless consonants. Journal of Speech and Hearing Research 32 (3): 524 – 535, 1989.
34. Shoba, N.H., Thomas, T.G & Subbarao, K., Influence of consonant-vowel intensity ratio on speech perception for hearing impaired listeners. Image and Signal Processing 5: 342 – 346, 2008.

Jack Dalziel takes the reins at SRL

SRL Technical Services has appointed Jack Dalziel as its new Managing Director. He joined the company in 2001 as an acoustic consultant and was appointed a director in 2009. Jack has been responsible for the day-to-day operation and strategic direction of the company. His consultancy specialism is architectural acoustics, including design of hospitals and schools, residential, and mixed residential and leisure developments.

Former Managing Director Malcolm Every has taken up a role as non-executive director after 24 years developing the company into the largest independent acoustic consultancy in the country. He said: "I am pleased that the company is in such capable hands and I will enjoy supporting Jack to continue its development."

Jack said he was delighted to be leading SRL. "I have a fantastic team and the company is in an enviable position. I relish taking SRL forward to greater success. We will continue to develop our service offering and provide innovative solutions to our client's issues."

Jack Dalziel

RNSS 'on the ball' at Saracens' new stadium

The new Allianz Park stadium in north London, home to Saracens Rugby Club, aims to raise the bar for audio systems in the world of rugby.

The upgrade to a concert-standard sound system featuring more than 180 speakers and 60 amplifiers was designed and installed by RNSS.

Hi-fidelity sound is now available throughout the 10,000-seater stadium. In addition to the new East stand, it encompasses the three other stands and all internal spaces. This includes the 105 metre long interior space under the East stand which doubles as a match day bar, indoor athletics track, and training area.

All 17 corporate boxes are equipped with individual multi-source audio and local level controls, and the four function rooms have the same capability, plus comprehensive full range audio playback from a variety of audio sources including wireless microphones and CD players via a bespoke control rack.

RNSS addressed local residents' concerns over noise pollution by designing a tightly controlled system which focused all audio directly into the areas occupied by fans within the stadium, while keeping ambient sound levels in the surrounding area to an absolute minimum and well within local authority guidelines.

Saracens' new stadium

Lorient launches acoustic testing suite

Lorient, manufacturer of door sealing systems for acoustic, smoke and fire containment, has created a testing and technical services division at its headquarters at Newton Abbot, Devon.

It offers manufacturers and designers access to a diverse range of specialist testing services to assist the development of new or existing products, investigate new materials, through to durability testing and benchmarking performance.

A variety of different assemblies can be tested including doorsets, windows, glazing systems, door hardware, and dampers.

The centre has an indicative fire test furnace, cycling rigs, air and smoke leakage testing equipment, environmental chambers and an analytical laboratory, as well as a purpose-built acoustic transmission suite, which features the latest Brüel & Kjær sound measurement technology. It has been specifically designed to test doors (single and double), and windows in accordance with BS EN ISO 10140.

A remote, live video feed service is available for clients who are unable to attend testing.

For more details go to **www.lorientuk.com** or call **01626 834252.**

The new acoustic transmission suite

SVAN 971, the new 'pocket rocket' from Svantek

Svantek has unveiled a new lightweight sound level meter, the SVAN 971, which weighs 225 grammes.

Features include a new user interface, a dosimeter function and large time/history logging capability. The Class 1 meter conforms to IEC 61672-1 standard. Recommended uses include industrial hygiene, short period environmental, and general acoustic noise measurement.

The SVAN 971 provides broad-band results with all required weighting filters, as well as 1/1 octave & 1/3 octave analysis. It has a high-contrast colour OLED-type display and, says Svantek, can be operated in a wide range of temperatures and environments.

As a special offer to IOA members, Svantek will upgrade the Octave Band Filters, usually priced at £256, free of charge. Please ring 01296 682 040 or email sales@svantek.co.uk quoting 971/OBF/IOA

The SVAN 971

Weather Station Kit 'will go down a storm'

Outdoor noise measurements are now fully supported in Brüel & Kjær's Type 2250, 2270 and 2250 light sound level meters, with a new Weather Station Kit for measuring noise and weather parameters simultaneously.

Weather conditions significantly affect the propagation of sound and therefore affect measured noise levels. Wind speed and direction must be taken into account when measuring noise outdoors - and consequently most standards governing the measurement of environmental noise define limits for wind speed and direction (e.g. ISO 1996-2:2007).

Weather Station Kit MM-0316-A is designed to fully meet the needs of consultants, by helping them to make environmental noise measurements that document wind conditions during the measurement period. It also helps them to be sure of the legal compliance of their measurements, as they make them, instead of identifying the 'legal' portions of their logging profile afterwards.

The Weather Station Kit in action

The Weather Station Kit is based on the Vaisala WINDCAP Ultrasonic Wind Sensor WMT52.

For more details go to **http://bksv.com/Products/handheld-instruments/sound-level-meters/accessories/MM0316.aspx**

NOVA aims to be a star performer

One of the new NOVA SLMs

Pulsar Instruments has announced the launch of its new NOVA™ range of sound level meters.

Features include:

- Typically 30 hours' battery life on standard alkaline AA cells
- High definition colour OLED, large anti-glare display
- 4GB removable memory card
- Dynamic range of 20dB(A) to 140dB(A) and 143dB(C)
- Metal case
- Simultaneous measurement of all key parameters
- Unique calibration prompt
- Standard and advanced data viewing methods.

For more details, go to **www.pulsarinstruments.com**

Duran Audio announces the arrival of DDA 3.2

Duran Audio has released the latest version of its Digital Directivity Analysis software (DDA), which was first developed as a tool to allow sound designers to implement its Digital Directivity Synthesis (DDS) algorithm.

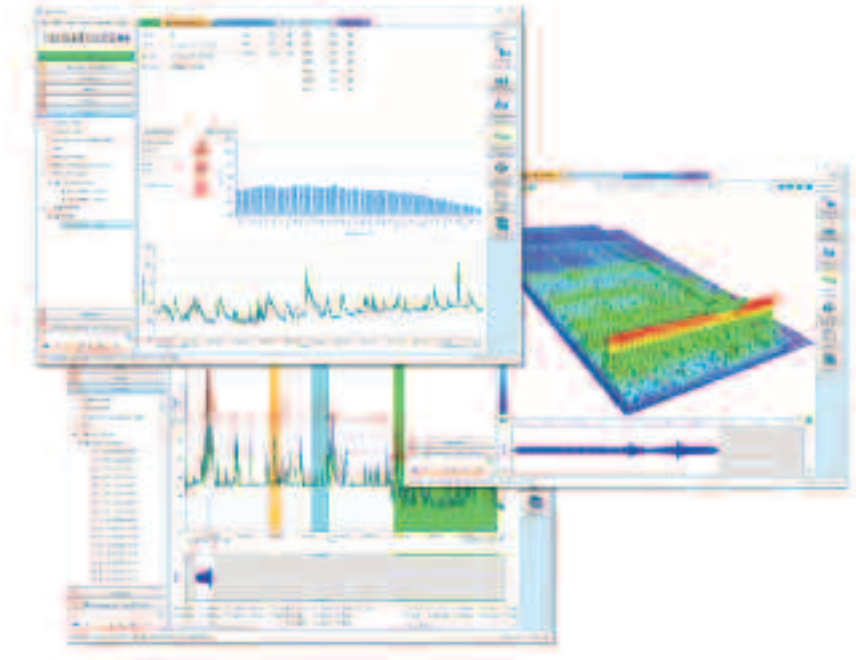
DDS, originally created by Dr Evert Start, is a technology that uses FIR filters to enable sound designers to control both the near field and far field dispersion of a loudspeaker array.

DDA was developed to generate the FIR filters required to synthesize the correct dispersion from an Intellivox or Target array. Now in 2013 it is a full 3D modelling and prediction environment which is intuitive and user friendly, and has features, says Duran, "to suit both newbies and the power users".

The prime function of DDA is to allow designers to define and visualise the directivity of their arrays; aiming the sound where they want it (at the audience) and avoiding those areas where they do not want it (reflective back walls, etc).

12 reasons to go green

1. AuditStore™ – Anti tamper data verification
2. Tonal noise detection*[1]
3. NR & NC Curves viewed on screen*[1]
4. Acoustic Fingerprint™ – Advanced audio recording triggering
5. High resolution audio recording
6. Remote data download & GPS location
7. High level noise measurement
8. Extended Ln capability*[1]
9. Over 10 years data storage*[2]
10. Updated NoiseTools software with licence free installation
11. Up to 32Gb of storage for long term measurements
12. 15 year no quibble warranty



Optimus Green is part of the Optimus range

Cirrus Optimus Green is the leading sound level meter for measuring noise in the environment – with technical know-how as standard.

*[1] features subject to instrument specifications.
*[2] dependent upon audio recording and time history data rates.
Auditstore & Acoustic Fingerprint trademarks pending. Optimus® is a registered trademark of Cirrus Research plc.

Cirrus optimus® sound level meters

To find out more
call us now on **0845 230 2434**
or visit **www.cirrus-optimus.com/green**

Institute of Acoustics sponsoring organisation

Launch of acoustics software code library

Mediterranean Acoustics Research & Development Ltd (PEMARD) has announced the launch of an acoustics software code library, Olive Tree Lab–Acoustics Lib: The Rosetta Stone of Acoustics Library.

OTL-Acoustics Lib is a .Net Framework code library, which allows easy implementation of complicated acoustical calculations. Its main benefits are accuracy, speed and extensibility. OTL-Acoustics Lib powers all PEMARD's products, such as Olive Tree Lab-Terrain, an outdoor sound propagation calculation software application, OTL-BASICS a Building Acoustics application to be announced soon and OTL-Room, a Room Acoustics application to be announced by the end of 2013.

Clients use OTL Acoustics-Lib to develop their custom acoustics software applications for the calculation of various acoustical parameters in 3D environments. OTL Acoustics-Lib is said to be easy to use and allows the development of fully functional code within minutes and new acoustical software applications in matter of hours.

In order to demonstrate its power, PEMARD is offering to write an application using the library based on clients' ideas. PEMARD will provide the client a working demo, with some limitations on its use, for evaluation. The organisation would be able to use the application for a trial period of two months after which it has the option to either buy the application or return the application with no further obligation. For more information visit **www.acousticslib.com** or email **info@mediterraneanacoustics.com**

New vibration meter range from AVI

AVI has introduced the HAAVI range of vibration meters. The triaxial meter (AVI 016T) measures human response to hand-arm vibration, whilst a single axis version is available for hand-held machine monitoring (AVI 016S) or general purpose vibration measuring (AVI 016S1).

All HAAVI meters come with a large colour display, with each axis colour-coded in the triaxial version, large on board data storage and USB download to a bespoke software package, which is included with each meter.

With a large dynamic range and simple calibration system, the meter requires just three buttons to set up and operate, and can be measuring with just one button push after turning on.

On-board or PC calculations define a variety of parameters, including the UK's Exposure points system for calculating worker's exposure, and when monitoring machine vibration, trend analysis is available to detect wear and imbalance before they become catastrophic.

A HAAVI vibration meter

For more details: **ww.avinstruments.co.uk** or telephone **01767 627004**.

Noise Doctor will 'prescribe the right solution'

Cirrus Research has launched a new brand, Noise Doctor, to bring together its advice, products and support services to help clients get the most from their noise measurement equipment.

Noise Doctor offers the following:

- Advice. It offers simple equipment advice, answering questions and suggesting the best options
- Product. It aims to "prescribe" the correct product from its range of sound level meters, noise dosimeters and other noise measurement instruments to best meet specific needs.
- Support. It provides a wide range of support from on the phone advice to on-site training or something more in-depth.

James Tingay, Group Marketing Manager, said: "We're often asked questions such as 'What is the best sound level meter for me to meet the Noise at Work Regulations?' or 'Why do I need to get my sound level meter calibrated?' The Noise Doctor can answer many of these questions and if not, point you in the right direction for further assistance."

For more information visit: **www.cirrusresearch.co.uk** or follow Cirrus Research on **Twitter @cirrusresearch**.

New wind turbine microphone

Campbell Associates has launched the MTG-GFM 920 microphone which has been specifically designed to measure the noise emission of wind turbines in accordance with IEC/EN 61400-11.

Its features include:

- Overall design reduces wind induced noise by 40dB
- A measuring 1/2 " class 1 microphone capsule and pre-amplifier
- A 7 pin Lemo cable to connect to most modern sound level meters
- A flight case.

For more details ring **01371 871030**, visit **www.campbell-associates.co.uk** or go to **info@campbell-associates.co.uk**


The new MTG-GFM 920 microphone in action

Are you a professional acoustician looking to build your knowledge?

Our vocational course is ideal if you already have the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control and now want to gain a masters award in acoustics

It's taught by experienced acousticians who are members of the Institute of Acoustics and we're the leading centre in the Midlands for acoustic courses with over 15 years' experience.

Find out more at www.derby.ac.uk/IOA

Institute Sponsor Members

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

Key Sponsors

Brüel & Kjær

Cirrus Research plc

Sponsoring Organisations
Acrefine Engineering Services Ltd
Acsoft Ltd
Aecom
Ams Acoustics
Anv Measurement Systems
Armstrong World Industries Limited
Arup Acoustics
Bureau Veritas
Campbell Associates
Civil Aviation Authority
CMS Danskin Acoustics
Cole Jarman Ltd
Darchem
Echo Barrier Ltd
Emtec Products Ltd
Farrat Isolevel Ltd
Gracey & Associates
Greenwood Air Management
Hann Tucker Associates
Hilson Moran Partnership Ltd
Industrial Acoustics Co Ltd (IAC Ltd)
Industrial Commercial & Technical Consultants Limited
Isomass Ltd
Mason UK Limited
Noise.co.uk
NPL (National Physical Laboratory)
Pulsar Instruments Plc
RBA Acoustics
Rockfon
RPS Planning & Development Ltd
Saint-Gobain Ecophon Ltd
Sandy Brown Associates
Sharps Redmore Partnership
Siderise Group
Sound Reduction Systems Ltd
Spectrum Acoustic Consultants Ltd
URS
Wakefield Acoustics
Waterman Energy Environment And Design Ltd
WSBL 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 2013

DAY	DATE	TIME	MEETING
Thursday	16 May	11.00	Publications
Wednesday	22 May	10.30	CMOHAV Examiners
Wednesday	22 May	1.30	CMOHAV Committee
Thursday	23 May	11.00	Executive
Tuesday	28 May	10.30	ASBA Examiners
Tuesday	28 May	1.30	ASBA Committee
Thursday	30 May	10.30	Engineering Division
Thursday	**13 June**	**11.00**	**Council**
Wednesday	19 June	10.30	CCENM Examiners
Wednesday	19 June	1.30	CCENM Committee
Thursday	20 June	10.30	Distance Learning Tutors WG
Thursday	20 June	1.30	Education
Thursday	18 July	11.30	Meetings
Tuesday	8 August	10.30	Diploma Moderators Meeting
Thursday	15 August	10.30	Membership
Thursday	5 September	11.00	Executive
Thursday	**19 September**	**11.00**	**Council**
Monday	30 September	11.00	Research Co-ordination
Thursday	3 October	10.30	Diploma Tutors and Examiners
Thursday	3 October	1.30	Education
Thursday	10 October	10.30	Engineering Division
Thursday	17 October	11.00	Publications
Thursday	31 October	10.30	Membership
Tuesday	5 November	10.30	ASBA Examiners
Tuesday	5 November	1.30	ASBA Committee
Thursday	7 November	11.30	Meetings
Thursday	14 November	11.00	Executive
Wednesday	20 November	10.30	CCENM Examiners
Wednesday	20 November	1.30	CCENM Committee
Thursday	21 November	11.00	Publications
Tuesday	3 December	10.30	CCWPNA Examiners
Tuesday	3 December	1.30	CCWPNA Committee
Thursday	**5 December**	**11.00**	**Council**

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

Institute Council

Honorary Officers

President
Prof B M Shield HonFIOA
London South Bank University

President Elect
W Egan MIOA
Brüel & Kjær

Immediate Past President
Prof T J Cox MIOA
University of Salford

Hon Secretary
Dr N D Cogger FIOA
The English Cogger LLP

Hon Treasurer
Dr M R Lester FIOA
Lester Acoustics LLP

Vice Presidents
Dr W J Davies MIOA
University of Salford
R A Perkins MIOA
Parsons Brinckerhoff
G Kerry HonFIOA
University of Salford

Ordinary Members

L D Beamish MIOA
WSP Group
A L Budd MIOA
New Acoustics
K Dibble FIOA
Ken Dibble Acoustics
Dr E E Greenland MIOA
WSP Acoustics
Dr P A Lepper MIOA
Loughborough University
R Mackenzie FIOA
RMP Acoustic Consultants
G A Parry MIOA
Accon UK
A W M Somerville MIOA
City of Edinburgh Council
D L Watts FIOA
AIRO

Chief Executive
Allan Chesney

List of advertisers

Please mention *Acoustics Bulletin* when responding to advertisers

Gracey & Associates

Sound and Vibration Instrument Hire

ISO 9001 - BSI FS 25913
Setting Hire Standards

Since 1972 Gracey & Associates have been serving our customers from our offices in Chelveston.

After 41 years we have finally outgrown our original offices and are pleased to announce we have now completed our move to new premises.

Our new contact details are:

Gracey & Associates	tel: 01234 708 835
Barn Court	fax: 01234 252 332
Shelton Road	
Upper Dean	e-mail: hire@gracey.com
PE28 0NQ	web: www.gracey.com

One thing that hasn't changed is our ability to hire and calibrate an extensive range of sound and vibration meters and accessories, with our usual fast and efficient service.

www.gracey.com

Campbell Associates

Sonitus House
5b Chelmsford Road
Industrial Estate
Great Dunmow
Essex CM6 1HD

t 01371 871030
f 01371 879106
e hotline@campbell-associates.co.uk
w www.acoustic-hire.com
w www.campbell-associates.co.uk

SEE SOUND with the NEW Nor848a Acoustic Camera

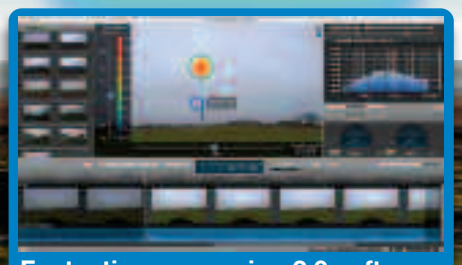
Now available in 3 sizes

NEW DISHES

- **128 microphones** 0.4meter array, compact and low cost
- **256 microphones** 1meter array, only 11kg weight
- **384 microphones** 1.6meter array, for lower frequency analysis

- Real time virtual microphone for you to listen to parts of the image.
- Digital microphones, no extra acquisition unit needed. Single LAN cable to computer.
- Plug and play within 5 minutes. Advanced equipment which is easy enough for everyone to use!
- 12v power for simple mobile use.

The 1m dish is available for hire at **£385 per day**



Fantastic new version 2.0 software

See more details and demo videos at **www.campbell-associates.co.uk** and follow the links to Acoustic Camera.

ANV MEASUREMENT SYSTEMS

The UK Distributor of RION

sales - hire - calibration

Long-Term Monitors

Reliable - Site Proven - Quick & Easy To Use - Realistically Priced

RION Outdoor Protection with Two Layer Outdoor Windshields

- Site proven – years of continuous use at some sites
- Practical simple and effective
- No complicated additional calibration procedures
- Widely deployed on windfarm and construction projects
- Class 1 (WS-15) / Type 1 (WS-03) frequency response with appropriate Rion meters

Remote Control and Download Software (RCDS)

- Downloads & controls noise monitors using the GSM network
- Cost effective and reliable
- User configurable alarm levels
- SMS text alarms to multiple numbers
- Downloaded data in csv format easily imports into online systems
- Software displays live data remotely
- Hundreds of systems already supplied & principally deployed on construction sites
- Automatically downloads up to 30 monitors with auto scheduler (ARDS)

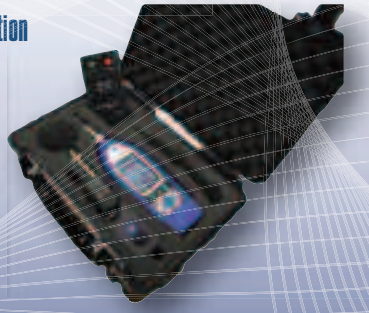
profound Vibra + Designed for Demolition and Construction Monitoring

- Logs PPV and dominant frequency (essential for BS 7385: 2 evaluation)
- Extended frequency range down to 1 Hz
- Measures peak displacement (essential for evaluation of low frequency vibration)
- Accuracy complies with DIN 45669 Class 1
- Integral GPRS modem sends out daily data & alarm e-mails
- User friendly software displays data and exports to csv file
- Real time clock and dominant frequency given for each measurement
- Very easy and intuitive to use

RION NL-52 A Complete Solution for Environmental Noise Measurement

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

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



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

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