Vol 35 No 4 JULY/AUGUST 2010

ACOUSTICS BULLETIN

in this issue... IOA Annual Report for 2009

plus... Mix-and-match instrumentation

Flanking transmission investigation

Traffic noise effects on sleep

Open source software for the acoustician

Institute of Acoustics

ACOUSTICS BULLETIN

Vol 35 No 4 JULY/AUGUST 2010

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Contents

Front cover photograph: The Edinburgh International Conference Centre, photographed here on a cool afternoon in late October 2009, was the venue for the Euronoise 2009 conference. The circular design, which gives the internal flexibility that is such a feature of the building, is shown to advantage. The conference was undoubtedly the highlight of the Institute's year: more than 700 acousticians from all over Europe - and some from the far side of the world - descended on the EICC for 'the best Euronoise ever'. The Annual Report in this issue of *Acoustics Bulletin* gives details of this and other events in another successful year for the Institute, which was no mean achievement in the current economic climate.

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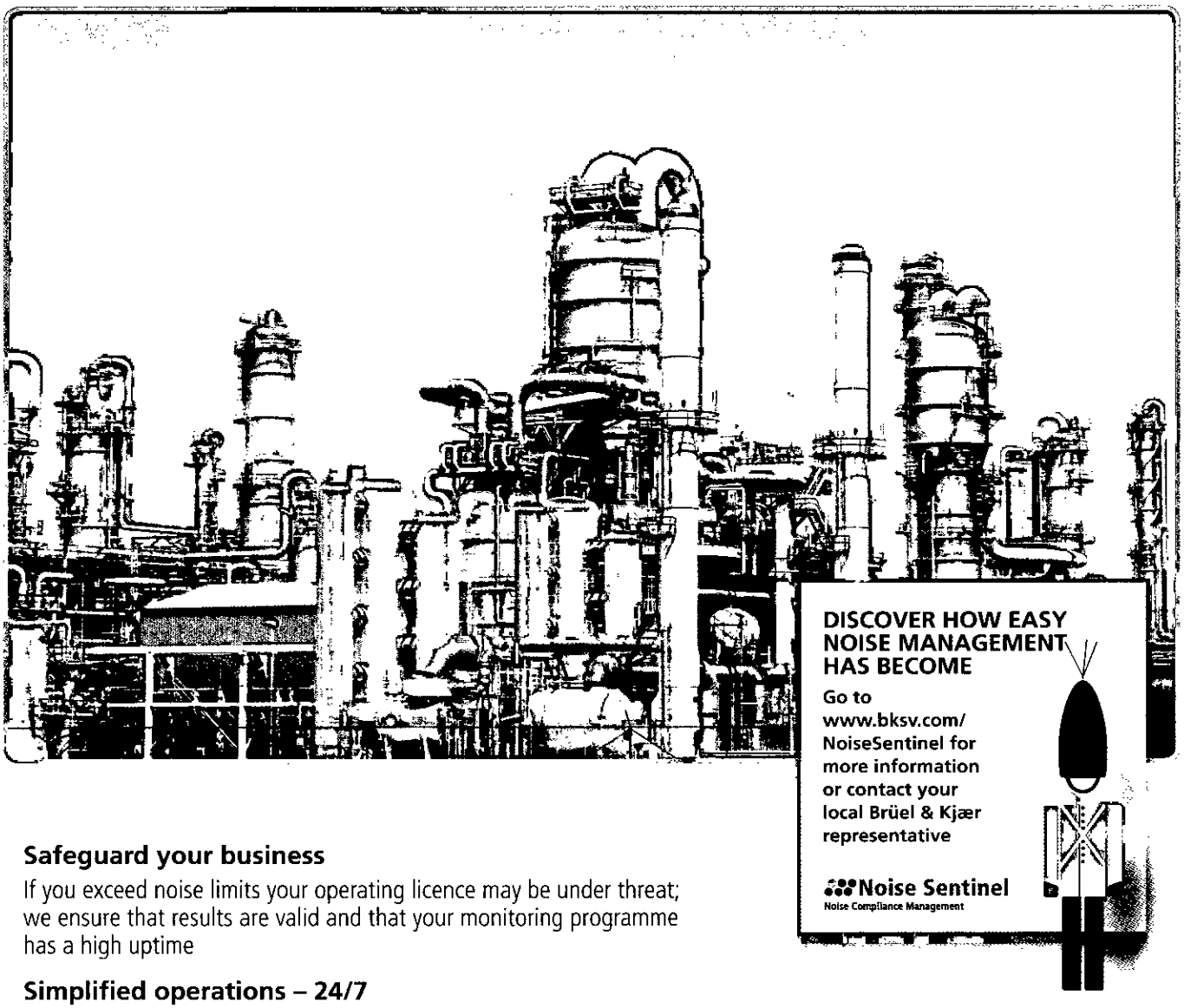

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Dear Members

A few years ago, a previous President of the Institute asked for suggestions to include in the President's Letter. I flippantly replied that he shouldn't worry, because no-one ever reads the letter. So maybe I should commit some terrible faux pas in this letter, like misquoting from a treasured standard such as BS.4142, in order to generate some complaint letters and check whether people are reading!

With economies around the world struggling, I start my presidency at a difficult time financially. However, the Insititute's finances are much healthier than the country's. Although we did lose money last year, which is the first time I can remember this happening, diligent work over many years has given us reserves which allow us to weather difficult times. Nevertheless, we are still going to have to be extra careful with the Institute's finances this year.

During the recession, people have been cutting back on conference attendances, presumably to save money. However, I was pleased to hear that the recent joint meeting between the IOA and ABAV in Ghent this April was a great success with over 75 papers being presented, around 120 delegates, four invited plenary lectures and the Tyndall Medal lecture. According to Bridget Shield, 'the sun shone, Ghent and the conference venue were beautiful, the conference dinner in the castle was delicious and everyone agreed that the event was a great success'. More international conferences are planned over the next couple of years, including ICBEN in London in July 2011.

Incidentally, returning to comparisons between the Institute and the Government, I noticed last week that I'm the same age as our new Prime Minister (which makes me feel old). But I need to be careful with such analogies, because I'm not sure if John Hinton wants to be cast as Gordon Brown!

John has been an excellent President, and among his many achievements I particularly liked his work on Government consultations. You will have noticed an increasing number of consultation reports published in the Bulletin, and this is a direct result of John's hard work to get the Institute more involved in shaping policy and regulations.

One of John's last acts as President was to resolve ongoing negotiations with the EAA (European Acoustics Association) over subscriptions and services. From 2011, we will now be paying more to support the association, and in return, Corporate Members will gain a number of additional benefits. I suspect the most used benefits will be reduced fees at EAA meetings and free on-line access to Acta Acustica united with Acustica.

For those who want to get in contact, I now have a new presidential email address: president@ioa.org.uk.

For the most up to date information on what I'm doing, you can follow me on the presidential Twitter account: http://twitter.com/ioa_president.

For those who started harumphing or laughing at this concept, don't worry, it won't affect my background noise level because my sound level meter is set to L_{10}.

Trevor Cox

PRESIDENT

36th Annual Report

of the Council for the year ended 31 December 2009

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 Euronoise 2009 conference - organised by the IOA - was a tremendous success, the 'best ever' in terms of attendance, venue, and speakers, according to Luigi Maffei, President of the European Acoustics Association.
- The Institute's new web site went live in the summer of 2009, having been under development for the preceding two and a half years.
- Two new team members joined the staff at Head Office during the year - Debbie White and Ele Sutton are excellent additions to the team.
- The formation of a senior members' group was under consideration during the year and a new regional branch was formed - the Welsh branch.
- During the year, the Institute signed a new lease in order that it may remain in its current location for another ten years, if required. The offices were redecorated and recarpeted, for the first time in 11 years.
- An ambitious programme of well-attended conferences and technical meetings was undertaken at international, national and regional level, which included the 25th Reproduced Sound conference, held in Brighton for the second time.
- Seven formal applications (five standard route and two non-standard) for Chartered Engineer registration were submitted in 2009. These candidates presented themselves for professional review interview and six candidates were successful.
- By September, a total of 143 (including 23 resits) had been registered for the Diploma including a high number (48) for the distance learning scheme.
- Conference collaborations with neighbouring acoustical societies in Europe continued to be developed, including the *Noise in the built environment* conference to be held in Ghent, Belgium in 2010 (with ABAV), and a conference with the SFA the following year in Nantes, France.

The 2009 Spring Conference was held at Dunchurch Hall, Warwickshire

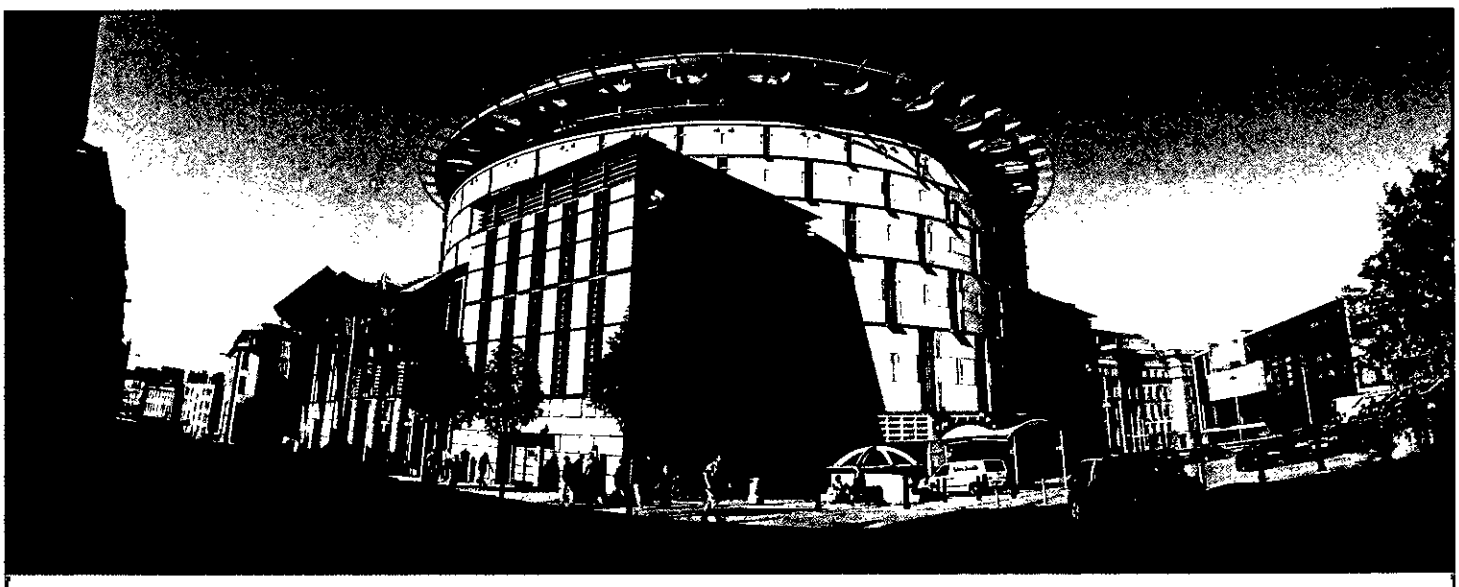
- ICBEN 2011 will take place on 24-28 July 2011 at Imperial College, London, with the conference being held in the UK for the first time in ICBEN's history.

Standing Committees

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

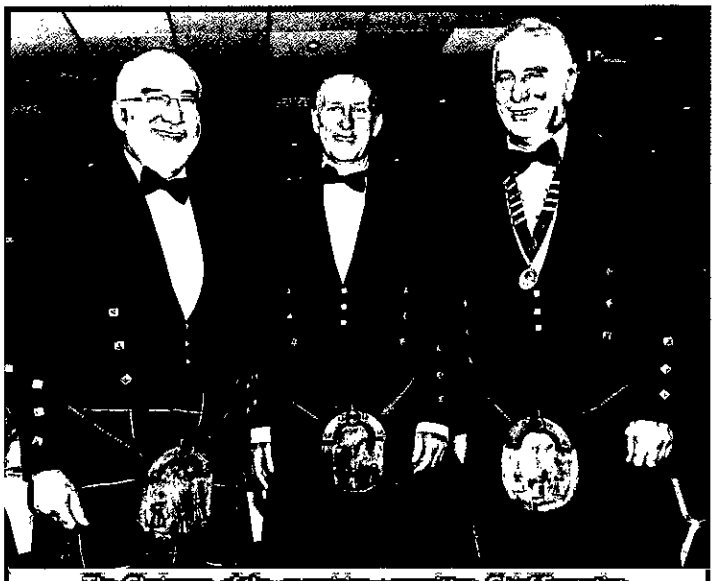
Education committee

The Diploma and Certificate courses have continued to recruit successfully and to provide education and training both for members and non-members of the IOA. The education programmes and courses introduce many



The highly successful Euronoise 2009 conference at the EICC

Euronoise 2009 was the 'best ever'



The Chairman of the organising committee, Chief Executive, and President at Euronoise 2009

The 24th annual Reproduced Sound conference at Brighton

New staff members Debbie White and Ele Sutton were welcomed to St Albans

working in acoustics and associated professions to the Institute and help in the recruitment of new members.

In September 2008 the 'new' Diploma in Acoustics and Noise Control (with only four optional specialist modules, a separate laboratory module, new examination structure and an enhanced project) recruited 144 new candidates of which 50 chose to study by the distance learning scheme. On the *General principles of acoustics* (GPA) module, the overall conflated mean mark and the percentage gaining merits are the highest ever, perhaps helped by the high coursework (CW) scores and the higher weighting of 40% on CW. On the other hand, the 50% overall pass threshold and the new section 'A' 50% pass threshold have doubled the percentage of GPA fails compared with previous years. The academic year 2008/9 was the final year in which 'old' Diploma module resits were offered. There were a total of 31 resits of 'old' Diploma modules; there were five fail grades among the 'old' module resits. As a result of grades obtained in 2008/9, the Diploma has been awarded to 117 students.

In September 2009, a total of 143 (including 23 resits) had been registered for the Diploma including a high number (48) for the distance learning scheme.

To date the distance learning notes for the new *General principles of acoustics* (units 1-10) and *Environmental noise: Prediction, measurement and control* modules have been revised, edited and distributed.

In 2008/9, the Certificate of Competence courses recruited as follows: *Management of hand-arm vibration* (CCMOEHAV) five students (five pass), *Environmental noise* (CCENM) 212 students (189 pass), and *Workplace noise and risk assessment* (CCWPNRA) 75 students (54 pass). The Certificate of Proficiency programme in *Anti-social behaviour (noise)* which is run only in Scotland, by Bel Education and Strathclyde University, recruited 54 students (47 pass). There is an ongoing debate about between centre differences in the presentation of the ASBA course. Both centres will have re-accreditation visits in 2010.

Using the Diploma qualification

Three universities (currently Derby, South Bank and Surrey (NESCOT)) accept the IOA Diploma as giving partial exemption from the requirements of their acoustically-related MSc degree courses. However, it should be noted that the IOA Diploma does not, on its own, qualify a holder to use post-nominals. Following relevant general education to degree standard, the Diploma provides sufficient specialist academic training to satisfy the educational requirements for membership of the Institute of Acoustics.

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Successful Diploma candidates are given the opportunity to apply immediately for Associate Membership of the Institute. Usually such application is accepted automatically at the Membership committee following the year of Diploma graduation and, thereby, gives the right to use the post-nominals AMIOA. Normally, a minimum of a (further) three years' professional experience are needed to enable application for Corporate Membership of the Institute (MIOA).

During the year the committee accredited/re-accredited three Diploma centres: Salford, Trinity College, Dublin (distance learning) and Liverpool University (distance learning laboratories) and the CCENM centres at Birmingham and Moloney Associates (Ireland).

A proposed Certificate of Competence in building acoustics measurement is being considered, following a potential demand in Ireland and elsewhere. Following a request from Electro-acoustics group, we are also considering the provision of short courses in specialist subjects, possibly associated with conferences and meetings.

The committee is seeking to expand the schools activities, and to roll out the Acoustic Ambassador scheme, following successful co-operation with Setpoint in Hertfordshire, to other areas.

The Education committee continues to be indebted to the support of its members, the work of the Education Manager, and for the assistance provided by members of office staff.

Engineering Division committee

The committee met three times during the year. One internal audit was carried out, with no non-compliances identified. The number of initial enquiries for registration from Institute members remained strong (at 67) and the increase in numbers of candidates wishing to present themselves for interview continued.

Presentations on Engineering Council registration were given at a conference, to two consultancies, at two branch meetings and to students at ISVR.

We took part in the ETB 'Big Bang' event at the Queen Elizabeth Conference Centre, London, at the start of the annual Science and Engineering week in March. With Arup Acoustics, we ran a show for sixth-formers, demonstrating auralisation and acoustical design for spaces as diverse as concert halls, music clubs and railway stations.

Seven formal applications for Chartered Engineer registration were submitted in 2009. These candidates presented themselves for professional review interview – five were 'standard route' candidates, holding accredited degrees, and two were 'non-standard route' candidates with diverse backgrounds. Six candidates were successful. One candidate was asked to submit further evidence for a second interview, to be held in early 2010.

John Hansen, who replaced Howard Malleson as our Engineering Council-nominated liaison officer, has been an active member of our committee and has observed most of the interviews, providing valuable insight into the assessment process, drawn from his experience in the profession. Two new members have joined the committee and they are training to become interviewers.

The Engineering Council visited the Institute in November for our five-year licence review. They commended the work of the committee and the quality of our new registrants and they encouraged us to increase the numbers of members seeking registration. They also supported our plans to promote EngTech registration among IOA Technician Members and to seek a licence for degree accreditation.

Medals and awards committee

The RWB Stephens Medal 2009 was awarded to Prof Tim Leighton for his outstanding contribution in the field of acoustical engineering. The presentation took place at the Fifth International Conference on Bio-Acoustics held in spring 2009.

The IOA's Spring Conference 2009 provided the opportunity to award Prof Mark Tatham with an Honorary Fellowship of the IOA and Tony Clayton with the ANC prize for the best IOA Diploma project 2008.

The A B Wood Medal 2009 was awarded to Dr Karim Sabra from the USA for his work on using ocean ambient noise for passive acoustic imaging. The presentation was made at the Third Underwater Acoustic Measurements Conference held in Greece in June 2009.

Graduation day at the Institute of Sound and Vibration Research (ISVR) was the event chosen at which to present Gemma Court with the Prof D W Robinson Prize as the author of the best ISVR MSc dissertation in 2009.

During the Euronoise 2009 conference dinner the Rayleigh Medal 2009 was awarded to Prof Colin Hanson from Australia for his pioneering work in the areas of active and passive noise and vibration control. The IOA Award for Promoting Acoustics to the Public 2009 was presented to Prof Trevor Cox. An Honorary Fellowship of the IOA was awarded to Prof Brigitta Berglund from Sweden and Awards for Distinguished Services to the IOA were presented to Paul Freeborn and Bernard Berry.

Finally, the Reproduced Sound 25 Conference, held in November 2009, provided the opportunity to present the Peter Barnett Memorial Award 2009 to Dr Neville Thiele from Australia for his outstanding work on loudspeaker design and the Peter Barnett Memorial Student Award to Emma Greenland. Peter Mapp and Tony Garton were both presented with Awards for Distinguished Services to the IOA.

Meetings committee

The Meetings committee met four times in 2009. The year saw some change in the active members of the committee, as maternity leave resulted in the temporary withdrawal of Hilary Notley as Secretary. The committee now consists of a chair, secretary (on leave) and two other members - Ken Dibble and new recruit Paul Lepper. The search continues for a young members' representative.

The committee presided over the organisation of 11 meetings covering a wide variety of topics. The number is slightly down on the target owing to the Institute's organisation of Euronoise 2009 - by all accounts a very successful major conference. The feedback from the meetings questionnaires continues to be very favourable. Given the global recession, the financial performance of meetings has been under some scrutiny and we continue to review performances and learn from our experiences so that deficits may be minimised in the future and meetings continue to generate a moderate surplus.

Membership committee

Four meetings were held throughout the year to review 303 applications of which 265 were successful. Four Fellows and six new sponsor members were elected. The predominant entry was to the Corporate Member grade. Although 137 members retired or did not renew their membership during the year there was a net gain over the year leaving the Institute with a total of 3005 members at the end of 2009.

One new committee member joined during 2009 and one is due to join in 2010 bringing the committee up to its full quota of 12. There was a good attendance throughout the year and a full house in November, to review the applications. The issue of which academic qualifications qualify for membership, especially at Associate grade, has been discussed at length with the object of maintaining consistency within the Institute. There have been an increased number of applications from people with diverse first degree subjects, not helped by universities offering basic technology courses wrapped up in a broad range of new titles. However, the IOA Diploma remains the benchmark for progress to corporate membership.

CPD remained a hotly debated topic in committee, driven by a request from Council to produce a firm proposal for a CPD plan by the middle of 2010. The need for professional development was acknowledged but the question of whether this should be mandatory, and in what form, has been delegated to an action team meeting outside the main committee to look at the many implications and consider the long term benefit to members of the Institute.

The membership committee also forms the disciplinary panel. Five new code of conduct cases were received this year. Much of the work relating

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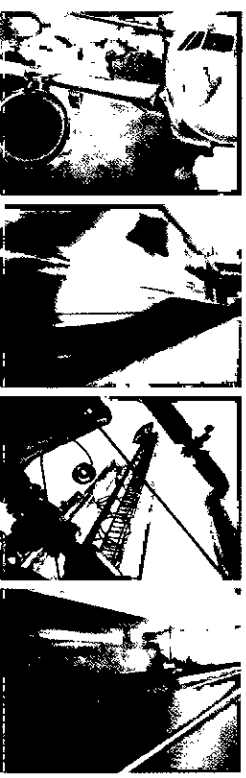

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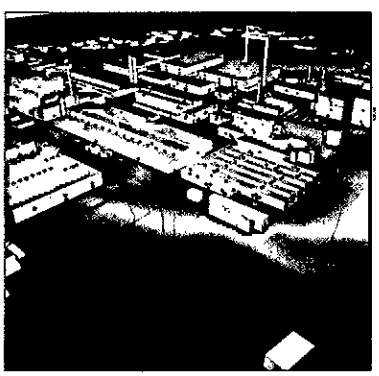
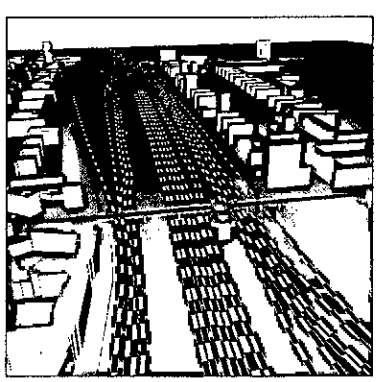


Prediction and detailed analysis of noise at industrial facilities



Optimization of building layout near roads and railway lines

Calculation of noise maps for cities of any size

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to these complaints is done by members of the committee outside the meeting, with numerous reports to be read. Most cases were resolved by the Institute acting as mediator between respective sides but one case resulted in disciplinary action against an IOA Member.

The use of the IOA logo was challenged. A number of consultancy web sites displayed the IOA logo and the companies were asked to remove them. After some debate and discussion at Council it was confirmed that, as in the past, only sponsor members were eligible to display the IOA logo. Also related to web sites, companies or members cannot advertise that they are 'registered with the IOA'. There have been misleading sites which claimed they had IOA 'Members' in the company without stating whether they were full Corporate Members or Associates. Requests were made to a number of companies to rectify this.

The committee contributed to the membership information on the new web site which went live during the year. Application forms can now be filled in on line. From January 2010 members applying for Corporate grades will be asked for evidence of CPD as part of their application.

A proposal to set up a senior or retired members' group has made progress during the year, steered by two members of the committee. An inaugural meeting will be held in the spring of next year.

The work of our membership officer in supporting and promoting the activities for members has been much appreciated. Similarly the considerable time and effort given by the committee outside the meetings to membership business over the year is acknowledged.

Membership applications by grade are tabulated below.

2009	FIOA	MIOA	AMIOA	Tech	Affil	Student	Sponsor
Applicants	4	122	91	18	7	36	7
Elected	4	103	74	19	13	36	6
New members	1	36	60	17	13	36	6
Resigned	8	48	52	5	8	3	9
Deceased	1	2	1				

Publications committee

The focus of the committee at the start of 2009 was overseeing the final stages of the Institute's new web site which was launched in the summer. In parallel, work was progressing on the Buyers' Guide which was launched in the autumn, having previously been available in printed copy in 2003. Some problems with the web site meant that the Members' Register had to be delayed till early 2010. During 2009, the overall income from advertising in the *Bulletin* and on the website dropped, although advertising for products and services remained stable.

Acoustics Bulletin has retained the themed issues, and these have continued to receive a good response. The *Bulletin* continues to produce to a high standard, containing reports of the Institute's meetings and affairs, and a broad selection of technical contributions.

The e-newsletter has also continued to be published, receiving a good response, and is in the hands of Debbie White the IOA's new publicity officer.

In addition, the committee has been considering discussion forums, the on-line publication of conference papers and the on-line availability of the IOA library catalogue, for consideration in 2010. The IOA groups on the social networking sites Facebook and LinkedIn continue to attract a steady stream of interested people, and some interesting on-line discussions have taken place there.

There have been several changes in committee membership over the year. Thanks go to all members of the committee, who have put in sterling work throughout the year.

Research co-ordination committee

During 2009 the Research coordination committee (RCC) has had two meetings. Continuing activities include liaison with EPSRC and with government departments sponsoring acoustically-related research.

Dr Louise Tillman has replaced Prabhat Sakya as the EPSRC representative on the committee. New members during 2009 were Dr Neil Ferguson (ISVR) and Duncan Williams (DSTL).

The liaison with DEFRA continues to be important and Richard Perkins has continued as their representative on the committee. DEFRA hosted both of the meetings in 2009.

New efforts are being made to secure contacts in NERC and MRC.

RCC continues to monitor and assist with joint research conferences. The most recent in this respect is the joint IOA/SFA conference to take place in Nantes in April 2012.

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.

Building Acoustics group

The Building Acoustics group had another busy year offering its members forums to discuss such hot topics as healthcare and schools, which both remain in the spotlight. The group organised and held two main one-day meetings this year, and contributed to sessions on Euronoise in Edinburgh, as listed below:

- BB93 review meeting, Birmingham, 24 February 2009
- Healthcare meeting, Manchester, 16 June 2009
- EURONOISE sessions, Edinburgh, 26-28 October 2009

The committee met three times, touring the country in the process to Edinburgh, London and Liverpool. The AGM was held on 16 June 2009 in Manchester at which Bob Craik formally stepped down as chairman, after many years' good counsel. Peter Rogers was elected chairman. The rest of the committee was re-elected and Andrew Parkin became a full committee member. Also in an effort to make sure that BAG continues to represent a cross-section of the membership, two young members were co-opted for the period of a year (James Healey and Alex Krasnic).

In addition to the meetings, BAG also has formulated consultation responses on behalf of the IOA in relation to the Part F and L review in England, and Sections 1 and 6 of the Scottish Building Regulations, and BB93 revision, with particular efforts going into assisting DCSF and PfS in technically addressing the need for good acoustics in schools. A number of technical articles and updates have also been created by members of the committee to keep members and the wider industry updated on important issues.

The year 2010 presents ongoing challenges to better connect with membership and to collaborate proactively with organisations like CIBSE and RIBA to ensure that building acoustics is a part of the holistic design approach needed to meet the challenges ahead. BAG will also be working hard to put together an autumn conference that members can look forward to. There is much to do, and should anyone be interested in getting involved then please approach a member of the committee.

Electro-acoustics group

During 2009, the Electro-acoustics group committee organised and put on the annual conference Reproduced Sound 25, the annual residential 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 both by regulars and new faces. Feedback (questionnaire forms) was sought from the attendees and this will be scrutinised to inform future events, especially from the new influx of student attendees. It was announced at RS25 that Reproduced Sound 2010 would be held at the Wales Millennium Centre in Cardiff on 18-19 November. Themes will include sound for performing arts and multi-disciplinary working. At the EAG AGM held at RS25 a new committee was agreed, including a new chairman. Paul Malpas as the incoming chairman thanked Sam Wise for his tireless efforts in the position over the previous two years.

Environmental Noise group

The Environmental Noise group held a highly successful Spring Conference in Rugby in April, which was attended by 112 delegates. The Dunchurch Park Hotel was a new venue chosen carefully by the IOA HQ and ENG committee.

It was a busy year for public consultation in the environmental noise field with some important noise policy proposals requiring our attention. ENG considered seven government consultations, and submitted formal IOA responses to four. These included the Defra consultation on Noise Action Plans for Agglomerations, Major Roads and Major Railways and Draft Noise Action Plans for 13 Airports. The consultation responses to Defra, DfT and the airports were drafted by the ENG committee from members' views sought through branch meetings, attendance at several Defra events around the country, an all-IOA member email, and a workshop held at the Royal Society, London on 28 September.

Measurement and Instrumentation group

For 2009, the group's committee has been responsible for organising a single one-day meeting *Did you hear that? – concepts of audibility and inaudibility*. Originally planned for March 2009, it had to be postponed, as the date proved difficult to get all the proposed speakers in attendance, and was eventually held at the Royal Society in London on 23 June. Eight papers from a variety of sources attempted to quantify sounds ranging from 'clearly audible warnings' to 'not clearly audible sound' and many points in between, and 67 delegates enjoyed the challenge.

With Euronoise occurring in the UK in October 2009, it was decided not to organise any further one-day meetings this year, but for 2010 the group is preparing to organise at least two one-day meetings, the first on motorsport noise being set for 18 March 2010, so it will continue to be busy.

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.

Noise and Vibration Engineering group

Five main committee meetings were held during the year, alternating between teleconferencing and meetings in St Albans. As always, the main focus of committee meetings was developing plans for events of interest to the NVEG membership.

The only event that actually had a call for papers sent out was for a meeting on *Noise from sources of sustainable energy*. Surprisingly, this topical subject drew very few offers of papers, and the meeting had to be cancelled. A second event, a workshop on measurement of sound power, reached the advanced planning stage, but had to be postponed to late spring/early summer 2010 as it required outdoor measurements.

Besides the sound power workshop, planning for a meeting on NVH issues in September 2010 is fairly well advanced. Two NVEG newsletters were produced during the year, with the latest issue finally being sent electronically rather than by post.

The committee lost two members, Rik Lewis and Jo Webb, whose contributions were much appreciated. As a result new committee members would be most welcome.

Joint IOA/IOP Physical Acoustics group

It was an unusual year in 2009, in the sense that since the annual Anglo-French Physical Acoustics Conference (AFPAC '09) was actually held at the end of 2008 there was no AFPAC meeting in 2009! This helped to avoid a clash with major conferences in January 2009.

A very successful AGM and tutorial day on physical acoustics were held at the Institute of Physics in London on 10 September 2009. This took the form of three extended lectures given by distinguished invited speakers on the general theme of 'imaging'. These covered imaging in non-destructive evaluation, medical ultrasound and underwater acoustics. The extended format enabled the presenters to provide comprehensive reviews of their topics.

The AGM saw Dr Nader Saffari step down as secretary of the group after many years of dedicated work. The committee is busy helping organise

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AFPAC 2010 (the tenth in the series) which will be a joint meeting with French group GAPSUS, and in addition this time, will also be held jointly with the French Group de Recherche (GDR) 2501 (*Research of ultrasound propagation for NDT*). The full meeting will be a week long in January 2010 at the Castle Green Hotel, Kendal.

Speech and Hearing group

The Speech and Hearing group's first meeting of 2009 was a talk entitled *Towards natural voice synthesis'* given by Professor David Howard of the University of York. This was held on 23 January 2009 and attended by some 32 people. It was followed by the group's AGM, attended by 28 members of the Institute and group.

The group also organised an evening meeting - a talk by Peter Mapp on *Standardising speech intelligibility* held in London on 30 September and attended by 27 members.

There were three full committee meetings (in April, June and November), plus an additional 'planning meeting' in September, during Euronoise 2009. Planning for a one-day tutorial workshop on *Quantitative measurement techniques for speech and hearing sciences*, to be held (in the first instance) in London in late April 2010, is well advanced.

Underwater Acoustics group

The principal event in 2009 was the (by now traditional) bio-acoustics meeting at Loughborough University, although the developments in this field are far from mundane.

The stunning performance of active sonars implemented by creatures such as dolphins can be usefully compared with that of bats, in their different medium. This meeting was therefore not confined to underwater systems as many of the principles are common across a wide field.

Anthropogenic noise is now widely recognised as significant, and the impact of pile driving for offshore wind farms, for example, is both important and inadequately understood. Keynote speakers gave presentations on crickets, bats and cetaceans (such as whales).

The AGM was held after one of the afternoon sessions. The passing of J Dunn was mourned but the renewed effort available from Hugh Griffiths welcomed.

Young Members' representatives group

Although in its infancy, the young members' group has been active over the last 12 months and has met regularly.

In 2009 the group was involved in the Big Bang science and engineering fair in London and made a series of presentations at the regional branch evening meetings on issues faced by young acousticians.

The Young Members' group continues to generate ideas such as attending careers fairs, organising a one-day meeting and networking events. We hope to evolve these ideas further in 2010. We now have a representative on most of the specialist groups and regional branches.

Regional Branches

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

Central branch

The Central branch held four evening meetings during 2009 with an average attendance of around 20. The meetings included the thought-provoking *What dose, whose response?* presentation by David Trevor-Jones, Steve Tearle explaining the changing design of sound level meters, a workshop on the Defra consultation on Noise Action Plans and innovations in sound absorption described by Chas Edgington and Anthony Thomas. Thanks are extended to all the speakers and the venues for hosting for the meetings.

The Annual General Meeting was held on 2 December 2009 and determined that the committee will be unchanged for 2010.

Eastern branch

Colin Batchelor was surprised and honoured to be elected as chairman of the Eastern branch, and takes the helm of a large and active branch. Thanks go to Mike Alston for his work as the previous chairman in keeping the branch driving forward.

Over the past 12 months we have organised six technical meetings and had four committee meetings, all skilfully co-ordinated by the endeavours of the new secretary, Clive Pink, to whom we all owe our gratitude. As always the committee has worked hard to identify subject areas, possible speakers and organise a range of locations and venues to meet the wide range of interests which are represented in our profession. We are always seeking new inspiration for subject areas or possible speakers so any suggestions from members would be most welcome.

For the first time, this year we held an August meeting which was surprisingly well attended. The committee has given up trying to determine whether it is location, time, subject area, presenter, or what's on TV (!) which most influences attendance.

In addition to the technical meeting we also arranged an afternoon social visit to the country sports centre at Darsham. Although rather poorly attended those that did come along enjoyed an afternoon of intense rivalry on the clay pigeon ground. The exciting competition was neck-and-neck with the lead changing hands regularly until a winner emerged! There followed a tour of the ground to enjoy the woods and inspect the shooting shelters and noise control measures before venturing to the clubhouse for a meal.

As an organisation the IOA is increasing in size, and this is reflected in the Eastern region. It is hoped that members will assist the process by encouraging colleagues to become members, but more importantly to come and enjoy the presentations at the regular meetings.

Thanks to those for participating in the branch this year. We look forward to welcoming you all back throughout the coming year.

Irish branch

This year has seen just one event organised by the Irish branch of the Institute of Acoustics, although responses were made to consultation documents for the *Northern Ireland Noise Action Plan and the Kilkenny County Council Draft Noise Action Plan.*

In December we held the fourth annual Gerry McCullagh Memorial Lecture. An in-depth presentation entitled *Noise Policy in Europe - Emerging issues and the role of the European Environment Agency* was given by Colin Nugent, Project Manager, Noise at the European Environment Agency, Copenhagen. He was formerly with the Department of the Environment, Northern Ireland. As in previous years, it was a pleasure that Gerry's mother (Jean) attended the lecture, although his wife (Rita) was unable to be present on this occasion. As well as having an invited guest giving a presentation on their chosen topic, the branch also presented a certificate for the best performing IOA Diploma student resident in Ireland (both north and south). This year the certificate was presented to Matthew Cassidy, now of Renewable Energy Systems (Larne office).

London branch

Last year the London branch committee announced the need to move to a new office for its meetings due to the increase in the number of people attending. We have once again surpassed ourselves with numbers steadily increasing which has meant we have moved to our new home at WSP which now caters for our growth in numbers. Attendances at London evening meetings have swelled to over 70 on occasions with typical numbers in the region of 50.

We have had probably our busiest year to date which has included thirteen events consisting of ten evening meetings, two half-day visits and our annual dinner.

As usual, the topics for the evening meetings have been varied in nature covering topics from vibration to acoustic cameras to the use of the WHO

guidelines. The meetings started with an enlightening talk from David Trevor-Jones who discussed among other things WHO guidelines and how they could be incorrectly interpreted - a housing development and gardens with ambient levels of 57dB L_{Aeq} enjoying breathtaking views of the sea is apparently a serious annoyance! Alan Oldfield gave the February talk from his position on the committee as the young persons' representative. The talk gave some useful insight to the aims and objectives of the young persons' committee. In March, Gill van Buuren provided an educational talk on room acoustics which was followed in April by Nigel Jones who presented a technical review on modelling and noise mapping. In May, David Leversedge gave our second paper touching on WHO guidelines but in relation to night-time music events. The WHO theme was followed in June by Dani Fiumicelli who reviewed the use of the guidelines with some interesting examples.

Our normal summer break for evening meetings is July and August, but our busy year meant that we had another talk in August by Neil Gross on directional noise monitoring. In September, Emma Greenland provided an interesting talk on school acoustics and the developments that are taking place and this was followed in October by Phil Abbott who discussed the links between the Noise Insulation Regulations, Design Manual for Roads and Bridges and the Calculation of Road Traffic Noise. The final speaker of the year was John Shelton who described the use of the acoustic camera. His presentation included a demonstration of its applications.

The half day visit to the O2 Arena in Greenwich was a sell-out. In fact it was so popular that we ran two visits in March and April. The visit started by a tour of the bowl from first floor and then up to the fourth floor. The acoustic treatment to the various elements of the arena was described from the seats to the balcony fronts to the rear bass enclosures. The visit then continued on the catwalk which gave spectacular views of the arena as well as close-up inspections of the sound system delay speakers and the sound system equipment racks. The acoustic treatment within the roof space was also clearly visible from this position. The visit then continued to the sound control room where we were shown the control equipment and the use of the system in concert mode. Finally we had an enjoyable lunch which was followed by an interesting talk from Mark Murphy who described some of the acoustic design and commissioning aspects of the project. A total of 80 members came on the tours and there is a call for another visit which is being considered for the New Year.

The annual dinner was held in November in the Bleeding Heart Restaurant, which is renowned for its excellent French cuisine and friendly ambiance. We have successfully had several other dinners at this venue and it has always proved popular. This year's after-dinner speaker was Mike Bullen who gave an insight into his career starting as a professional musician leading up to his current position with Cirrus Research. Mike gave some wonderful stories of his early days as a guitarist and although he did not get his guitar out for a few numbers, a sound level meter was at least on display.

Exciting and interesting talks are already planned for 2010 and thanks go to all the members of the London branch committee and of course Kevin and Linda at HQ for all their invaluable support throughout 2009. Thanks also go to 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 organised a varied selection of meetings for 2009.

28 January: Evening meeting entitled *Are my dB's too loud or not loud enough?* by Peter Mapp at Scott-Wilson, Nottingham.

13 May: Half-day meeting and tour at the Building Research Centre organised by Alex Ahern, with presentations from Paul Goring and Nick Conlan at British Gypsum in East Leake.

22 July: Late afternoon tour of the Rolls-Royce Heritage Trust Museum by Max Alderton at Rolls-Royce in Derby.

19 August: Evening meeting entitled *Real time directional noise monitoring* by Neil Gross of Sound Science, at Scott-Wilson in Nottingham.

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29 September: Evening meeting entitled *Presentation by best IOA diploma projects of 2008/2009 on the subjects of Uncertainties in sound insulation testing* by Tom Lucas of HRS in Sheffield; *Noise from outdoor concerts* by Janine Dickinson, working for Birmingham City Council; and *Noise associated with golf* by Ben Ellis, Daventry Council. The meeting was hosted by John Pritchard at the University of Derby.

14 October: Evening meeting entitled *Ensuring acceptable vibration in buildings* by Thomas Jaquet, at Scott-Wilson in Nottingham.

26 November: Evening meeting on the subject of *Noise maps - right or wrong?* by Nick Tinsdeall of Birmingham City Council, at the Arup Campus in Solihull. This meeting also included our AGM.

Thanks go to all members of the committee for the active roles they take in all aspects of the group's activities, and to Paul Shields for organising the lion's share of our meetings. Thanks also go to Scott-Wilson, British Gypsum, Rolls-Royce, University of Derby and Arup for their vital support of providing venues for our meetings. Special thanks go to John Grant and Rik Lewis, who both stepped down this year, for their past support on the committee.

North-west branch

In March, the North-west branch held an interesting evening meeting at Arup with a presentation by Bob Hargreaves of RCM Marine on *Nautical problem sorting - an investigation into noise complaints on board a luxury yacht.* Complaints of noise from those who chartered a luxury yacht resulted in Bob having to spend time investigating the problem whilst in an exotic location and providing a solution based on experiences gained in the Second World War.

John Shelton of AcSoft Ltd provided a very knowledgeable demonstration of the use of an acoustic beam-forming device to locate noise sources quickly and easily, at an evening meeting at BDP in April. His talk *Seeing is hearing - a view through the acoustic camera* not only showed us how the device was used, but also its limitations.

In support of Noise Action Week, the North-west branch hosted a one-day meeting in May on *Latest developments in transportation noise and action planning.* The meeting provided an update on the recent developments in transportation noise, including the latest guidance on noise provided in the Design Manual for Roads and Bridges, and an update on railway noise and aviation noise, together with noise action planning arising from the Environmental Noise Directive and as well as providing updates on plans for roads, rail and airports, particularly in Birmingham, including the international airport. The meeting was held at Salford University and primarily organised by Paul Freeborn of Bureau Veritas.

Finally, in November, our President-elect, Prof Trevor Cox, provided a presentation on *Aural architecture* as a supporting act to our efficiently-held AGM at BDP. Trevor gave a typically well-presented media-aware talk on how our aural experience can be transformed given that research has shown that a poor aural experience can have a considerable negative effect on how we feel and behave, even at a subconscious level.

During the latter part of the year we have also been supporting the regional branch of the joint Institutes at events organised to introduce students to the various types of engineering available as careers. Mike Barrett of Bureau Veritas and Jamie Hladky of Arup Acoustics have been providing the acoustical guidance.

As every year, we are grateful to all those who provided venues for hosting the meetings and, of course, assisted with the organisation of the meetings and to Bureau Veritas, where Paul Freeborn arranges a venue and refreshments for committee meetings. As identified in our AGM, although the committee has been joined by some younger members, we need more assistance, if only to help those who have been involved with the North-west branch for a long time. Bring your new ideas to our next committee meeting, Paul can be contacted on 0161-446 4793 regarding the location and the date.

As always, a special thanks to Paul Michel who provides the secretarial support with fictitious minutes.

Scottish branch

A joint meeting of the Scottish branch and Building Acoustics group was held on 8 September to consider the proposals for amending the Building (Scotland) Regulations and associated guidance in relation to Section 1: Structure, Section 6: Energy and Section 3: Environment. Thanks go to Bernadette McKell and Alistair Somerville for co-ordinating the event and the consultation response.

Scottish branch members were offered the opportunity to attend the Euronoise Conference at Edinburgh Conference Centre on 26 October for a half-day session. The event was exceptionally well attended and members had the choice of attending a variety of plenary sessions listening to presentations from noise mapping to antisocial behaviour noise. Afterwards members retired to Guiliano's Restaurant on Leith Walk to sample some fantastic Italian cuisine. Thanks to Sean Smith for kindly organising the evening meal which finished off the evening in true Scottish branch style. This was a very memorable evening and we were particularly pleased that our President John Hinton, Chief Executive Kevin Macan-Lind and Duncan McNab of the Scottish Government noise and air quality team could join us.

The year finished off with our usual Christmas social event on 21 December at the Khukuri Nepalese Restaurant in the west end of Edinburgh and our AGM, held a little later than planned, on 22 January 2010 at Kelvinside Hillhead parish church in Glasgow. The AGM was preceded by a wide ranging and interesting debate on Planning Advice Note 56 – Planning and noise, which is currently under review. Scottish branch members exchanged views on what required to be revised, added, removed and left alone. Thanks go to Fiona and Andy Watson for allowing us to use their beautiful church as a venue once again for our AGM.

The secretary and treasurer of the Scottish branch remain unchanged. Many thanks to Andy Watson for continuing to look after Scottish branch financial matters, to Lilianne Lauder for her continued commitment as secretary, and to committee members for their ideas, hard work and support during 2009.

Southern branch

The Southern branch enjoyed a range of well-attended evening meetings over the year from Rupert Taylor's presentation on the role of an expert witness at Public Inquiries to an excellent in depth review of sound insulation (particularly at low frequencies) by Prof Carl Hopkins.

Other talks in the year included a review of current issues when assessing noise from wind turbines by Andy McKenzie. James Healey presented an excellent talk on issues affecting younger acousticians where Peter Wheeler and Sue Bird highlighted the benefits of becoming a Chartered Engineer. A timely talk from Rob Pierce at the beginning of the festival season regarding noise from outdoor events and festivals was also well attended.

A series of evening meetings is planned for 2010.

South-west branch

There was only one meeting of the South-west branch during 2009.

This was held in May at the Octagon, Exeter entitled *Unattended environmental noise measurements - a cost-effective method or a can of worms?* presented by Michael Wright of Atkins Acoustics and John Campbell of Campbell Associates. This was attended by 23 delegates who also had the pleasure of the company of the Institute's President, John Hinton OBE, who gave a short opening address.

Thanks go to Stan Simpson, who is standing down as secretary after many years in that role, for his support and help over the years. The branch also passes on its best wishes to our young persons' representative, Lisa O'Driscoll, who is moving to a new job in London in February 2010. It is obviously a time for ringing the changes as the chairman will also be standing down soon.

Welsh branch

The year 2009 saw the start of the work on the creation of the Welsh branch. Born out of the desire to provide a professional focus for members in Wales and to provide the IOA with a role in shaping the development of Welsh noise policy, which is becoming increasingly divergent from the policy

TABLE 1: MEMBERSHIP

Grade	2008	2009
Hon Fellow	31	32
Fellow	187	185
Member	1577	1637
Associate Member	879	844
Affiliate	98	96
Technician Member	58	72
Student	41	70
Totals	**2871**	**2936**
Key Sponsor	3	3
Sponsor	37	49
Institutional Subscriber	29	17

TABLE 2: GROUP MEMBERSHIP

Group	2008	2009
Building Acoustics	1067	1120
Electroacoustics	266	278
Environmental Noise	1373	1426
Measurement & Instrumentation	384	402
Musical Acoustics	216	227
Noise & Vibration Engineering	883	940
Physical Acoustics	138	155
Speech & Hearing	157	170
Underwater Acoustics	139	138

TABLE 3: BRANCH MEMBERSHIP

Branch	2008	2009
Central	109	123
Eastern	263	259
Irish	143	139
London	711	730
Midlands	421	423
North-west	383	409
Overseas	312	326
Scottish	176	180
South-west	302	298
Southern	450	484
Yorkshire & North-east	217	223

of England, the Welsh branch is seen as a necessary addition to the structure of the IOA.

In starting up the Welsh branch it was recognised that there was a need for a 'launch' of sorts. As a result, it has been decided to hold the first committee meeting of the Welsh branch early next year in Cardiff, immediately after the wind turbine noise conference.

Yorkshire and North-east branch

In the year 2009 the Yorkshire and North-east branch of the Institute of Acoustics held two branch meetings, one in January at the University of Bradford and one in April at Arup Acoustics offices in Leeds. At January's meeting Mr Andrew Parkin of RPS Gregory talked about the past, present and future of the BB93. He discussed a number of issues raised by the steering group. This group had been originally convened by the Department for Children, Schools and Families and headed by Les Fothergill. There was a good debate on the experience of the industry and possible means to bring BB93 up to date. At April's meeting Mr Steve Devonshire of Bang and Olufsen (UK) talked to members of the branch about the company history and unique sound reproduction technologies developed over a number of years. He gave a very impressive demonstration of BeoLab loudspeakers built on an active loudspeaker platform. He explained how physical and perceptual testing could be used to evaluate the quality of Bang and Olufsen products. The audience had an excellent opportunity to enjoy jazz, vocal and classical music reproduced at a quality expected usually only in concert halls and special acoustic venues.

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TABLE 4: DETAILS OF EMPLOYMENT

Employment Category	2008	2009
Architectural Practice	32	31
Consultancy	1294	1347
Education	216	216
Industry & Commerce	351	353
Public Authority	474	468
Research & Development	191	180
Retired	112	120
Other	83	84

TABLE 5: MEETINGS ATTENDANCE IN 2009

Topic, Date & Venue	Attendance
Wind turbine noise: 16 January, Bristol	79
BB93 review forum: 24 February, Birmingham	109
Bio-acoustics conference: 31 March–2 April, Loughborough	68
Spring Conference 2009: 28–29 April, Rugby	112
Transportation noise and action plans: 21 May, Salford	38
Acoustics in healthcare: 16 June, Manchester	48
Did you hear that?: 23 June, London	67
ENV ConDoc workshop: 28 September, London	30
Euronoise 2009: 26-28 October, Edinburgh	700
Reproduced Sound 25: 19-20 November, Brighton	115
The art of being a consultant: 9 December, Manchester	61

TABLE 6: INSTITUTE PERSONNEL AT 31 DECEMBER 2009

COUNCIL

	Officers	Ordinary Members
President	Mr J F Hinton OBE FIOA	Ms L D Beamish MIOA
President Elect	Prof T J Cox MIOA	Mr K Dibble FIOA
Immediate Past President	Mr C E English FIOA	Prof J Kang FIOA
Honorary Secretary	Prof V F Humphrey FIOA	Mr D N Lewis MIOA
Honorary Treasurer	Dr M R Lester FIOA	Mr P R Malpas MIOA
Vice President: Engineering	Dr B McKell MIOA	Mr P J Rogers MIOA
Vice President: Groups & Branches	Mr S W Turner FIOA	Prof P D Thorne FIOA
Vice President: International	Prof B M Shield HonFIOA	Mr R G Tyler FIOA
		Ms L J Webb FIOA

COMMITTEES AND SUB-COMMITTEES

	Chairman
Education	Mr S W Kahn MIOA
- *Diploma in Acoustics and Noise Control, Board of Examiners*	Mr J G Walker HonFIOA
- *Certificate of Competence in Environmental Noise Measurement*	Mr D Trevor-Jones 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 J Stirling
- *Certificate in the Management of Occupational Exposure to Hand Arm Vibration*	Mr T M South MIOA
Engineering Division	Dr B McKell MIOA
Medals & Awards	Mr J F Hinton OBE FIOA
Meetings	Mr J P Newton MIOA
Membership	Dr B J Tunbridge MIOA
Publications	Mr A Lawrence MIOA
Research Co-ordination	Prof K Attenborough FIOA

SPECIALIST GROUPS

	Chairman	Secretary
Building Acoustics	Mr P J Rogers 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	Dr P F Dobbins FIOA	vacant
Noise and Vibration Engineering	Dr M G Smith MIOA	Mr M D Hewett MIOA
Physical Acoustics *(Joint with the Institute of Physics)*	Dr A Temple	Dr M Lowe
Speech & Hearing	Mrs E E Greenland MIOA	Dr G J Hunter MIOA
Underwater Acoustics	Dr P F Dobbins FIOA	Dr R A Hazelwood MIOA
Young Members' Representatives	Ms L D Beamish MIOA	Ms E Keon MIOA

REGIONAL BRANCHES

	Chairman	Secretary
Central	Mr D L Watts FIOA	Ms R H Canham 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	Ms N Stedman MIOA
Midlands	Mr P J Shields MIOA	Mr M Swanwick FIOA
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	Mr T Clarke MIOA	Mr S Simpson MIOA
Welsh	Mr G O Mapp MIOA	Mr J M Keen AMIOA
Yorkshire & North-east	Mr D Daniels	Prof K V Horoshenkov FIOA

CHIEF EXECUTIVE Mr K M Macan-Lind

Conference report

Bridget Shield. Noise in the built environment

The joint meeting between the IOA and ABAV, the Belgian Acoustical Association, took place at the University of Ghent on 29 and 30 April 2010. The meeting, which had the theme *Noise in the built environment* was held in 'Het Pand', a very beautiful former monastery dating from the 13th century, which is now used as a conference centre by the University.

The meeting was attended by 125 delegates from 15 countries; approximately one third were from the UK and one third from Belgium, the remainder coming from France, the Netherlands, and nine other European countries.

Seventy-seven papers were presented during three parallel sessions throughout the two days. In addition there were four very enjoyable plenary lectures on various aspects of the conference theme. **Jian Kang** from the UK gave a very interesting review of current soundscape research, while **Massimo Garai** of Italy discussed recent advances in standardisation and testing of noise barriers. **Keith Attenborough** of the UK gave an entertaining presentation on periodic structures in the urban environment, and advances in sound quality were presented by **Patrick van de Ponseele** of Belgium.

Two awards were made during the conference. The Tyndall Medal, which is awarded to a young acoustician for achievement and services in the field of acoustics, was presented by John Hinton to **Olga Umnova** of Salford University. Olga's medal lecture was on her research into effective medium models for granular materials and composites. During the conference dinner John also presented Mary Stevens of Environmental Protection UK with the IOA Award for Promoting Acoustics to the Public in recognition of all her work over the past 20 years in raising awareness of noise as an environmental health problem.

Over the two days delegates presented papers on the following topics: noise barriers, soundscapes, effects of noise on health, modelling of road traffic noise, road surfaces, acoustic modelling of interior spaces, industrial and entertainment noise, urban sound propagation, railway noise, classroom acoustics, noise policy, building acoustics and noise measurement.

The conference dinner was held in Gravensteen, the old castle in the centre of Ghent. This was a very enjoyable occasion, especially as there was ample time to look around the castle before sitting down for dinner in the castle keep.

The enjoyment of the conference was enhanced by the warm, sunny weather. The city of Ghent looked beautiful, and it was a very enjoyable bonus to be able to sit in the sun in the gardens of Het Pand during lunch and coffee breaks. Some delegates also very much enjoyed sitting by the river partaking of a variety of Belgian beers in the evenings.

The Institute would like to thank the ABAV, in particular Dick Botteldooren, for hosting the conference in Ghent and making all the local arrangements; the session organisers and chairs for ensuring such a full, varied and stimulating programme; and all presenters and delegates for coming to Ghent and making the conference such a success. And, as ever, many thanks to Linda Canty for all her hard work in the organisation of the conference, and to her and Kevin and Linda Macan-Lind for ensuring that things ran smoothly over the two days. The IOA and ABAV would also like to thank the European Acoustics Association for their support of the conference as an EAA symposium.

Irish branch - Consultation

Draft Northern Ireland Clean Neighbourhoods and Environment Bill

Dear Mr Allison

Consultation on the draft Northern Ireland Clean Neighbourhoods and Environment Bill

In response to the publication of the above document by the Clean Neighbourhoods team, the Irish branch of the Institute of Acoustics (IOA) has invited input from its branch members whose areas of expertise include acoustic consultancy, environmental health, and education.

The Irish branch of the Institute of Acoustics

Formed in 1974, the Institute of Acoustics has some 3,000 members in the UK and Ireland, with some 120 of these being members of the Irish branch which was established in 1997. The Irish branch is the only institution specifically representing those professionals involved in the acoustic industry in Ireland. Our members are involved in a wide range of acoustical disciplines including environmental noise, occupational noise, architectural acoustics, building acoustics, electroacoustics, noise and vibration control, hearing, speech and underwater acoustics. Our members are currently employed by government agencies, local authorities, industries, consultancies, universities and other educational establishments.

The IOA is the professional institute for those involved in any aspect of noise and has a long history of helping develop standards, guidance and UK government documents on the measurement, assessment and control of many types of noise issues. The IOA also runs and accredits various courses to provide an educational basis for our members. These courses are run both in the UK and Ireland, and include certificate of competency courses (currently being run at Dublin Institute of Technology, National University of Ireland, Galway and Shore Control Safety Ltd) and a post-graduate diploma course (currently running in Dublin at Trinity College Dublin under a distance learning programme).

Coordination of response

In response to the consultation paper, the members of the Irish branch have had the opportunity to review the document and this response is a combination of the member's responses. It is considered that this therefore contains the views of a cross-section of recognised professionals with daily involvement with all types of noise issues in Ireland.

Comments

We have reviewed the Draft Northern Ireland Clean Neighbourhoods and Environment Bill. The following comments have been provided by members of the Irish branch of the Institute of Acoustics.

The Draft Northern Ireland Clean Neighbourhoods and Environment Bill is a consolidation of a number of existing individual acts that Environmental Health professionals use in dealing with noise nuisance including barking dogs, audible alarms and that which occurs in the street. The Bill will also include an amendment to extend the Noise Act to licensed premises.

This general principle of the Bill appears to be welcomed by our Environmental Health members, although it is not proposed to go into detail here as each local authority has its specific opinion and it is understood that these will be being sent to you by each Council.

With regard to our members who are involved within the acoustic consultancy business, there is little to comment on as there are no criteria contained within the Bill, and there is therefore nothing to agree or disagree with on a technical level. Should there be the opportunity to comment on the applicability of any criterion that may be set in respect of neighbourhood noise nuisance; we would welcome the opportunity to provide input to the discussion.

Whilst we do not have any significant comment or input to make in respect of this consultation, we do welcome the opportunity to comment and would request that we be included in any further consultations in which you or your department may be involved.

Yours sincerely

Dr Martin Lester FIOA CEng [Chairman, Irish branch]

Attention all Associate Members!

Institute professional development scheme

The Associate Member grade is the first step towards becoming a full corporate Member, to which we hope you will aspire in due course with the appropriate experience.

As an Associate Member, you have agreed to abide by the Institute's By-laws, Code of Conduct and Rules of Conduct. This includes the requirement to:

- update your professional knowledge and skill; and
- maintain adequate awareness of technological developments, procedures, standards, laws and statutory regulations which are relevant to your field either by involvement in the Institute's professional development scheme or by any other appropriate means.

The IOA professional development scheme is not based on collecting 'hours' or 'points' but instead requires members to develop their own action plan. You may already be recording your professional development as part of the requirements of membership for another institute or for a company scheme. The IOA does not expect you to maintain two sets of records: any goal-based professional development scheme could be appropriate provided that the records can easily be understood by a third party.

Note that applications for corporate membership (MIOA, FIOA) will require comprehensive evidence of your work experience, technical challenges faced and your position and responsibility within your company or organisation.

From **May 2011** the IOA will also require evidence of your professional development to be included with the application form for MIOA. This may relate to internal training, conferences and meetings attended so it is worth getting into the habit now of keeping records of your objectives and achievements.

The professional development section of the IOA website (within the membership section) includes an overview of the scheme with some tips on how to get started. There are also blank forms for your own use and examples of some completed forms. Please contact the IOA office if you need further help on professional development.

Do not forget that it is a requirement of IOA membership in any grade for members to maintain and develop their professional knowledge and skill. With the information available on the IOA website there is no excuse not to get started!

IOA Membership committee, April 2010

Citation for Tyndall Medal

Dr Olga Umnova

Olga Umnova has contributed scientific work in acoustics of consistently high quality. Her main contributions have been in the field of modelling of the acoustical properties of porous media and, more recently, of sonic crystals.

She graduated with an MSc in Physics from Moscow Institute of Physics and Technology in 1989. Her PhD, obtained from the Russian Academy of Science, Moscow in 1994, and subsequent work as a research scientist at the Wave Phenomena Department of the Russian Academy of Sciences, concerned generation of sound in viscous fluids, including non-linear effects. During this period she published frequently in highly-rated Russian journals such as Soviet Physics Acoustics.

In 1998 Dr Umnova moved to the UK and started work with Prof Keith Attenborough, first at the Open University and then Hull University. She moved to her current post at the Acoustics Research Centre at the University of Salford in 2004.

In 2000 she published a development of theoretical models for dynamic viscous effects in packed spheres. This was followed by a complete model for granular porous materials including dynamic thermal effects published in Acta Acustica. As a result of her strong theoretical background she was able to tackle the challenging problem of predicting the non-linear response to high intensity sound in porous media and develop and improve models developed by others. She has published several papers in JASA including theoretical modelling and comparison with measurements making original contributions to the field. Among these is the first prediction and subsequent experimental validation of the properties of porous layers for which the reflection coefficient magnitude decreases with increasing incident sound intensity, a very useful phenomenon.

A more recent line of work is in the field of sonic crystals again in collaboration with Keith Attenborough. Sonic crystals are arrays of cylinders which attenuate sound over particular frequency ranges called bandgaps. Analysis requires a detailed knowledge of acoustic scattering theory. Among her original contributions on this topic has been the investigation of cylinders with finite surface impedance leading to a frequently-cited publication in JASA. In performing this work she showed herself to be a versatile and rounded scientist capable of making measurements as well as theoretical modelling.

Since moving to Salford she has quickly established a team of two PhD students and a post-doctoral research fellow. It is a high quality team. She is acknowledged as an outstanding supervisor capable of academic and research leadership and has successfully secured two coveted EPSRC grants in the fields of porous media and sonic crystals.

Olga Umnova's work is characterised by a strong interest in the fundamental underlying physical phenomena behind acoustical performances and designs. While she is often diffident about her own work, her ability to express a concise and authoritative academic opinion is highly valued by colleagues. She has been a respected referee for several internationally rated journals including the Journal of the Acoustical Society of America, Applied Acoustics, Acta Acustica and Proceedings of the Royal Society since 1998.

In summary, Dr Umnova is a high quality scientist of international standing and deserving recipient of the Institute of Acoustics' Tyndall Medal for 2010.

Meeting report

Kevin Howell. Midlands branch

The branch's April meeting returned to Atkins in Birmingham where Robin Hall presented results from research that examined methods for measuring sound insulation in buildings.

Pre-completion tests in dwellings, to ISO 140-4 and ISO 140-7, are conducted to demonstrate compliance with Building Regulations or to justify credits under the BREEAM and Code for Sustainable Homes schemes. There have been concerns expressed about the guidance in these standards which is open to different interpretations and hence methodologies.

More than 50 consultancies which are involved in pre-completion testing and are UKAS accredited or ANC registered took part in the project. It was carried out in a test facility at the Building Research Establishment. In each case three different airborne and one impact test were carried out. The consultancies were asked to follow their usual procedures, which encompassed a range of approaches A number of noticeable procedural differences were identified and the results of the tests were analysed to determine if these produced different results.

The main conclusion from the study was that there was no evidence of significant systematic differences in measured values of field sound insulation produced by different approaches to complying with ISO140-4 and ISO140-7. It is therefore reasonable to adopt measurement methods that minimise time on site and investment in equipment, as long as the relevant measurement standards and safety standards are maintained. Some calculation errors were observed and this demonstrated the need for robust data handling and organisational procedures, and the benefit of regular audits and third party accreditation.

Many thanks are owed to Robin for his comprehensive presentation, and to Atkins for hosting the meeting.

Meeting report

Kevin Howell. Midlands branch

The branch's March meeting was held at Loughborough University where Prof Abigail Bristow presented a discussion of research carried out to find a 'monetary value' for noise annoyance.

She began by identifying the historical context, a 1970 paper by Foster and Mackie, who considered how policy should develop to address annoyance from noise. They considered that *"If even the cheapest method of reducing noise costs more than the amount at which people affected value the noise reduction, it is not worth taking that step to reduce noise"*.

Abigail reviewed the progress made in valuing annoyance from noise, in the 40 years since that paper. She discussed the most common methods utilised namely 'revealed preference', including Hedonic pricing, and 'stated preference', including contingent valuation and stated choice approaches. With many detailed examples of results of her own research and that of others Abigail compared the various outcomes, technical issues and design challenges of the different methods.

Amongst her conclusions were that revealed preference and stated preference methods are both useful and have different strengths and weaknesses. Work on income elasticity suggests that quiet is not considered as a luxury but as a need. Further work is needed, in the form of robust comparative experiments, on the way noise is represented to respondents and how they interpret it, and also on the effect of embedding noise questions amongst other quality of life issues rather than making them transparent. Embedding seems to result in a lower valuation than transparency does. Gaps in current knowledge include changes in valuation over time, valuation of noise nuisance experienced outside the home and the valuation of health effects.

Many thanks to the speaker for her thought-provoking presentation, and to Loughborough University for hosting the meeting.

Senior Members Group

Ralph Weston. up and running...

The Senior Members Group (SMG) is now up and running thanks to the hard work of Nezi Yusuf and others who have made contributions. I would also like to thank our President and Vice-president, groups and branches for their support.

An email letter has been circulated to all members with a link to the questionnaire, which by the time you read this I hope that that you have answered. If, for any reason, you have yet not received the invitation to complete the on-line survey, please contact the IOA membership@ioa.org.uk and we can send you a paper version.

I have already received a number of suggestions, among them offers to arrange for golf in Essex and a venue for a half-day meeting and also interest in Archeoacoustics.

Geoff Kerry is keen to chart the early days of the Institute.

However, the first object is to get SM's to meet under the auspices of their branches so that they can have a chat and reminisce over past times when noise monitoring required big heavy pen recorders! It is stories of yesteryear that I would like to publish regularly in Acoustics Bulletin. If you have not had a meeting at branch level yet, please try and meet in September so that we can have group meeting in October. All branch chairmen have been approached to encourage them to get us SMs to meet.

This brings me to my recent visit to the Oberammergau Passion play. Considering that the stage is open and that the 2000-seat auditorium is covered by a curved roof the acoustics are, subjectively, very good. Whether the spoken word was enhanced electronically was not easy to spot. The clarity of speech was excellent even though it was in German. If they were using microphones then it was well done. It started with the 48-strong choir, all dressed in identical white robes and white hats gliding in from both sides to form a long line at the front of the stage with the narrator in the centre.

Even the animals behaved themselves and we had donkeys, horses, camels, sheep and goats at different times. The experience was very enjoyable.

(l to r) Brian Tunbridge, Stephen Turner, Nezi Yusuf, Ian Campbell, Ralph Weston, Martin Armstrong, Michael Forrest

The World's Biggest Noise Map.

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

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

SoundPLAN Version 7.0

Incredibly Fast

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

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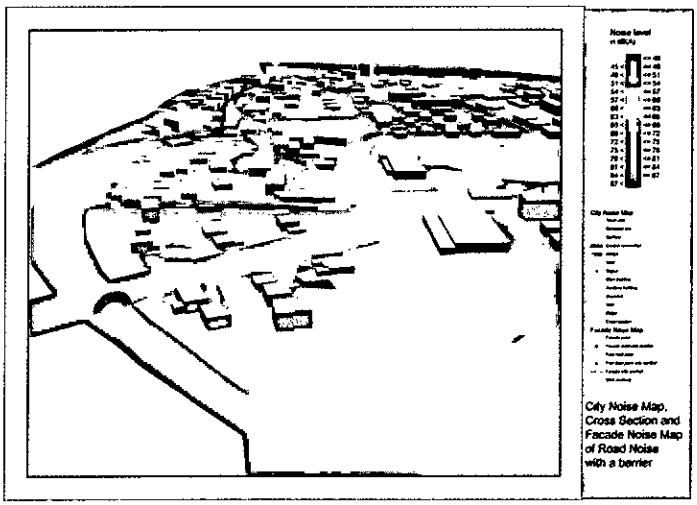
Mesh maps, hot spots, dynamic search and extensive testing for utmost accuracy according to 50+ standards.

Incredibly Useful

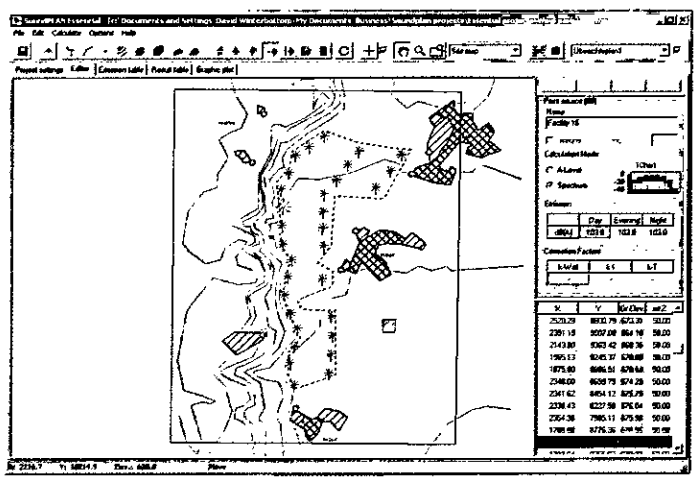
Stunning Graphics are easy to use. Spreadsheet for multiple results and automation of analysis such as DMRB. Documentation with advanced formatting. User definable templates and much, much more.

Incredibly Popular

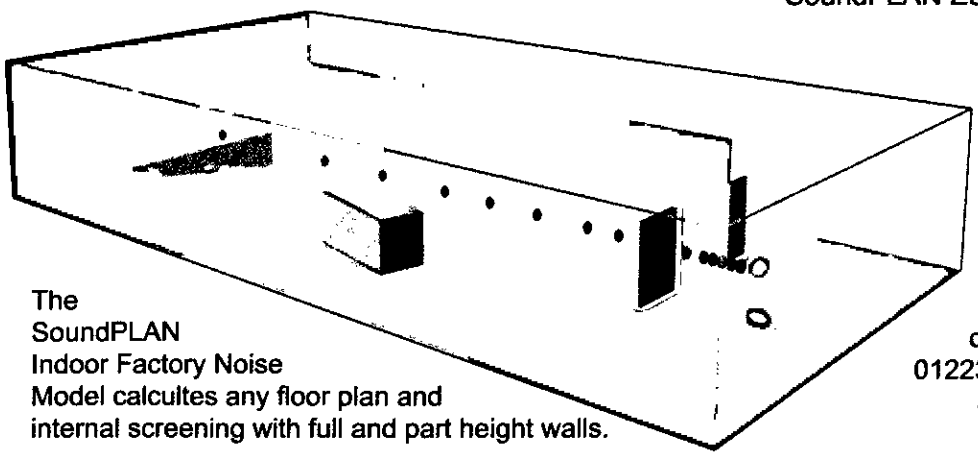
Nearly 5000 users in 50+ countries. Used by governments, consultants and researchers. Available in European, Asian and soon Arabic languages.



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



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



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Meeting report

One-day workshop on speech recording and analysis

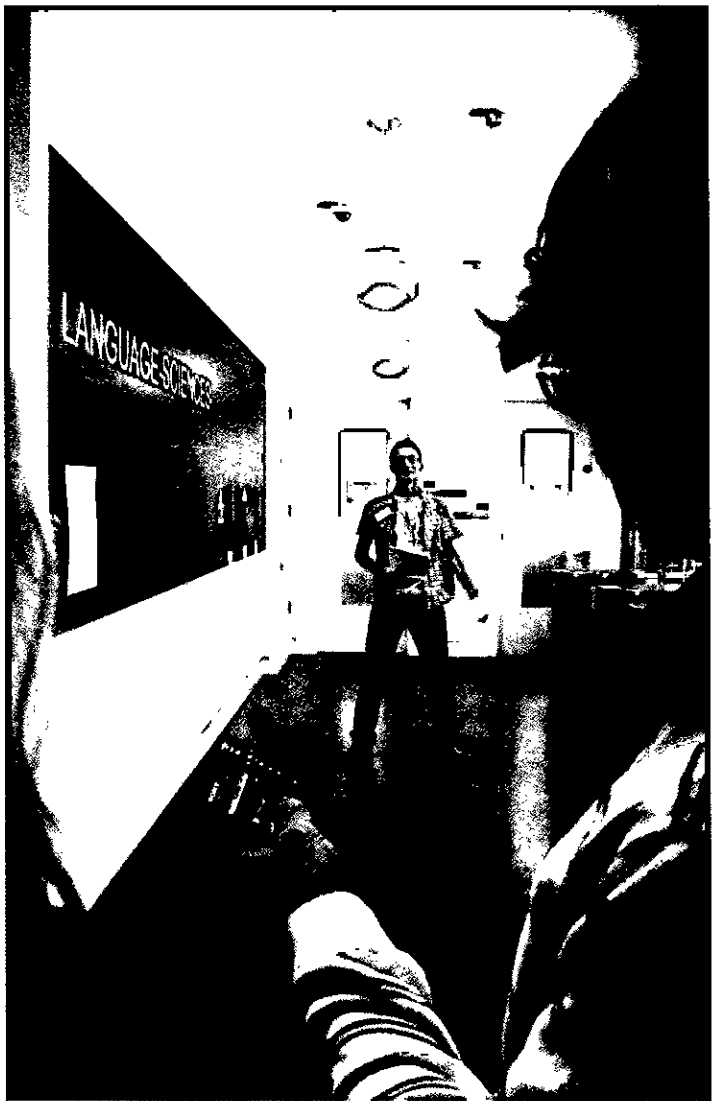
On Thursday 22 April the Speech and Hearing group ran a one-day workshop for IOA members and professionals involved in speech and hearing. It was jointly organised with the Centre for Human Communication and was held at the Department of Speech, Hearing and Phonetic Sciences at University College London.

After coffee and conversation, welcome speeches were given by Gordon Hunter, secretary of the IOA Speech and Hearing Group and by Prof Stuart Rosen, co-director of the Centre for Human Communication at UCL, to the 27 delegates from a wide range of backgrounds. Dr Patrick Naylor from the communications and signal processing group at Imperial College gave the morning plenary lecture describing why it is important to make good recordings of speech for analysis, and indeed how to make them. A practical session followed where groups of two or three participants were given one type of recording device (from a variety of different recorders) and sent to locations both inside and outside the building to make both good quality and bad quality speech recordings. Delegates were encouraged to make recordings affected by reverberation, background noise, muffling and 'presence'. Before lunch, the recordings were transferred to laboratory computers and analysed subjectively.

The afternoon session was presented by Dr Mark Huckvale from the Department of Speech Hearing and Phonetic Sciences. It began with a plenary lecture on the acoustical analysis of speech data, introducing various computer-based techniques for investigating pitch, energy, duration and timing, and the quality of speech. The following practical session involved groups of between one and three delegates making recordings of various prescribed spoken sounds and phrases in the laboratory. These recordings were analysed using standard methods to obtain measures of mean pitch, jitter, shimmer, harmonics-to-noise ratio, formant frequencies and voice onset time. The results of each group were collated, analysed statistically and explained in terms of the behaviour of the voice.

The IOA would like to thank Patrick and Mark for giving up their time and the CHC at UCL for allowing the use of their facilities for what was an interesting, enjoyable and very worthwhile event. Thanks also to Ed Weston (Bureau Veritas), Phil Harrison (J P French Associates) and Rob Connetta (London South Bank University) for assisting in the practical sessions, and to Emma Greenland (WSP Group) for much of the pre-meeting planning.

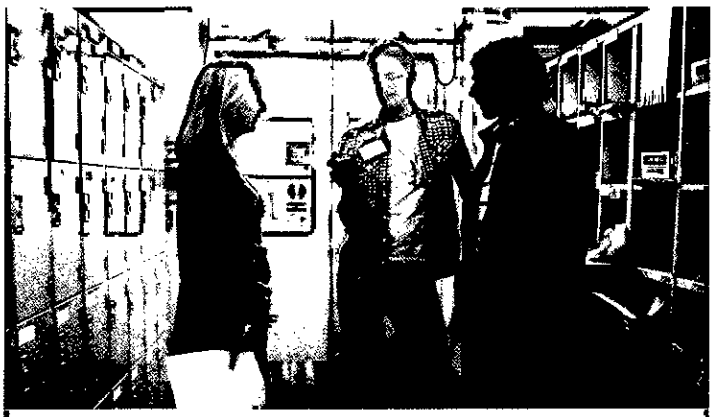
Ed Weston (Bureau Veritas) and **Gordon Hunter** (Kingston University)



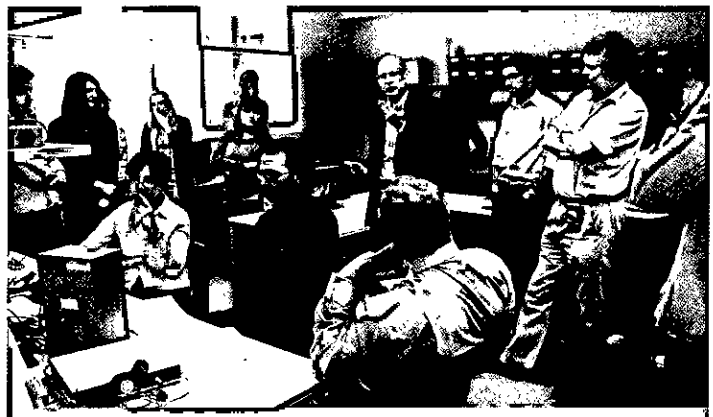
Delegates were encouraged to make recordings...

...inside and outside the building...

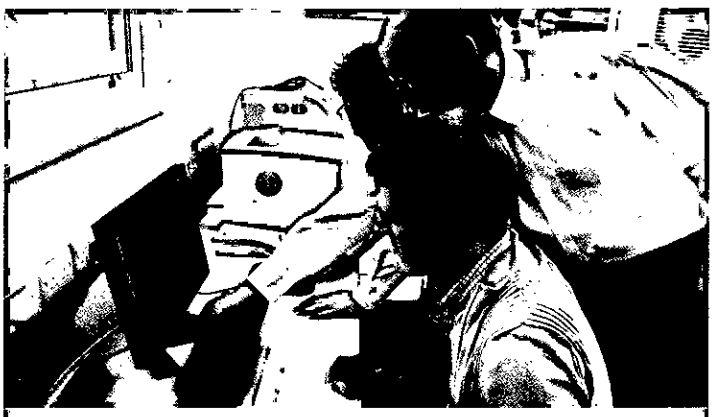
...affected by background noise



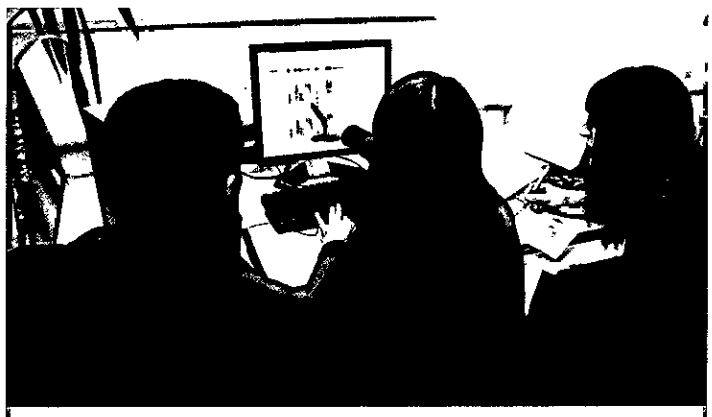
groups were given a recording device



subjective analysis

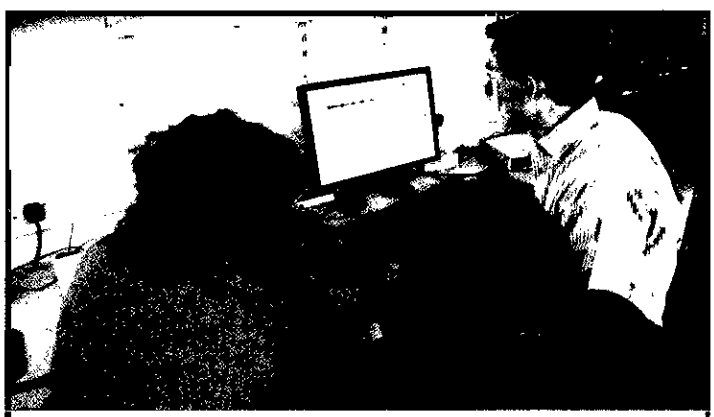


introducing various computer-based techniques



investigating the quality of speech

making recordings of spoken sounds



the recordings were analysed using standard methods

Instrumentation corner

William Egan. Mixing and matching instrument components

Sound level meters and noise analysers all have three main components: a microphone, a measuring system including display, and a sound level calibrator. Modern noise measuring instruments are usually designed to meet an International Standard [BS EN 61672 Part 1 (2003)] defining their performance so that measurements from different instruments are comparable.

Most noise measurement standards stipulate the grade of sound level meter required to carry out the measurements. For example, BS ISO 20906:2009 'Acoustics – Unattended monitoring of aircraft sound in the vicinity of airports' specifies that each measurement channel shall conform to class 1 of BS EN 61672-1.

Although the instruments from different manufacturers are designed to carry out a similar range of noise measurements, the user should be aware of the dangers of swapping components from different manufacturers. In addition mistakes can be made in assuming that a particular instrument conforms to the standard when used for outdoor noise measurements.

Sound level meter Standards

The older standards for sound level meters originate in the 1970s and 1980s but because of the longevity of instruments many are still in regular use. These standards referred to Type 1 or Type 2 instruments for field use but there were also Type 0 (laboratory use) and Type 3 instruments.

These older standards were replaced in 2003 with the current BS EN 61672 Part 1 (specifications) and Part 2 (pattern evaluation) and then Part 3 (periodic tests) followed in 2006. This standard replaced the original four grades of instrument with just two — Class 1 and Class 2. It is noticeable that some updated versions of older standards still mistakenly refer to the older Type classification — see for example BS5228 Part 1 2009!

Part 1 of the Standard for sound level meters is a very detailed document on the specifications for a Class 1 or Class 2 instrument and is mainly of interest to the manufacturer of such a product. However the operator of such an instrument should note a few points.

(a) 'The instruction manual shall state the models of microphones with which the complete sound level meter conforms to the specifications…' (Section 5.1.6).

It is not uncommon for the unwary user to assume that they can use any (similar) microphone on their sound level meter. In all cases known to the author, there is just one microphone specified for use with any particular model because the implications of costly 'pattern evaluation' (see below: Part 2 of the Standard) means that is impractical to provide a range of suitable models of microphone. The BS EN 61672 Standard (Part 1: specifications) specifies the performance of the sound level meter as a complete instrument including its microphone.

Therefore if you wish to ensure your measurement results comply with the Class 1 or Class 2 standards, please ensure your instrument is fitted with the correct microphone, either the one originally supplied by the manufacturer or a replacement of exactly the same type.

(b) 'At least one model of sound calibrator shall be stated in the instruction manual for checking and maintaining the correct indication on the display of the sound level meter' (Section 5.2.1).

It is very likely that a manufacturer will specify one of their own range of calibrators for use with the instrument, for obvious reasons! Do not use a different sound level calibrator from the stated one in the handbook by the manufacturer as there are many pitfalls trying to use a different one.

Richard Tyler's article *Coupling an acoustic calibrator to a sound level meter in Acoustics Bulletin* of March/April 2009 details the problems and his advice should be followed: 'The mix-and-match of manufacturer A's calibrator with manufacturer B's adaptor for calibrating manufacturer C's microphone/sound level meter is a recipe for error on a grand scale and should **never** be employed!'.

(c) Windscreens: 'The instruction manual shall contain…a description of the average effects…of enclosing the microphone with a recommended windscreen, rain protection device or other accessory provided or recommended. A statement of the performance class to which the sound level meter conforms when such accessories are installed…' (Section 9.2.6 (a)).

It is important that the correct type and size of windscreen is used for the sound level meter.

Part 2 of the Standard describes 'pattern evaluation tests' to verify conformance that the all the specifications given in Part 1 have been met. These tests are carried out by an independent acoustical test laboratory (often PTB in Germany) and at least three sound level meters must be submitted for testing.

This procedure means that the buyer of any instrument can be sure that it fully complies with all the many requirements laid down in Part 1 (specifications). The alternative is for the user to assume that the manufacturer's claims are true, but this is not always the case, as shown in Liz Brueck's (HSE) paper in *Acoustics Bulletin* March/April 2010, where she says that 'responses can be more than 15dB outside standard tolerances even after a field calibration'!

Although most of the main manufacturers of sound level meters submit their new or modified instruments for pattern evaluation it is worth checking that the complete measurement system you intend to use has been approved. This particularly applies for outdoor noise measurements using a weather-protected microphone system linked to the sound level meter.

The meter and its normal-use windscreen may well have gone through the pattern-evaluation process to confirm specifications, but often the configuration including a weather protection system for the microphone has not undergone such approval. You can check on this with the manufacturer or find many of the certificates on the PTB website. http://www.ptb.de/de/org/1/16/163/schallpegelmesser.pdf

Physikalisch-Technische Bundesanstalt PTB
Braunschweig und Berlin

Innerstaatliche Bauartzulassung vom 02.11.2005 21.21 / 05.02
Type-approval certificate under German law, dated 02.11.2005

2. Neufassung der Anlage
Revision 2 of the Annex

Seite 1 von 11 Seiten
Page 1 of 11 pages

Zulassungsinhaber: Brüel & Kjaer GmbH
Issued to
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28359 Bremen

Bauart: Integrierender Schallpegelmesser Brüel & Kjaer 2250
In respect of:

Zertifikatsgeschichte

Zertifikats-Ausgabe	Datum	Änderungen
21.21 / 05.02, 2.Neufassung	25.02.2009	Prüfung mit Außenmikrofon 4952
21.21 / 05.02, 1.Neufassung	07.05.2007	Prüfung nach DIN EN 61672
21.21 / 05.02	02.11.2005	Erstbescheinigung

Die 2. Neufassung ersetzt die 1. Neufassung der Anlage vom 07.05.2007, Geschäftszeichen PTB-1.72-4027414 zum oben genannten Zulassungsschein sowie die für diese Fassung erteilten Nachträge:
- Nr.1 vom 26.06.2007 Geschäftszeichen PTB-1.72-4030327
- Nr.2 vom 01.10.2007 Geschäftszeichen PTB-1.72-4032119
- Nr.3 vom 29.09.2008 Geschäftszeichen PTB-1.72-4030491

Für die Messgeräte der zugelassenen Bauart gelten:

Pattern evaluation certificate for a sound level meter and its outdoor microphone system to ensure it is a Class 1 instrument (both sound level meter and its outdoor microphone) and provides appropriate results in that configuration.

In summary, if you want to ensure that your measurement results fully meet the relevant standards and can therefore not be challenged later, make sure the full instrumentation you use including outdoor microphone protection complies with the latest standards (Class 1 or Class 2) and that the full system has been pattern evaluated to confirm its compliance.

Meeting report

Richard Tyler and Daren Wallis. Motorsport noise

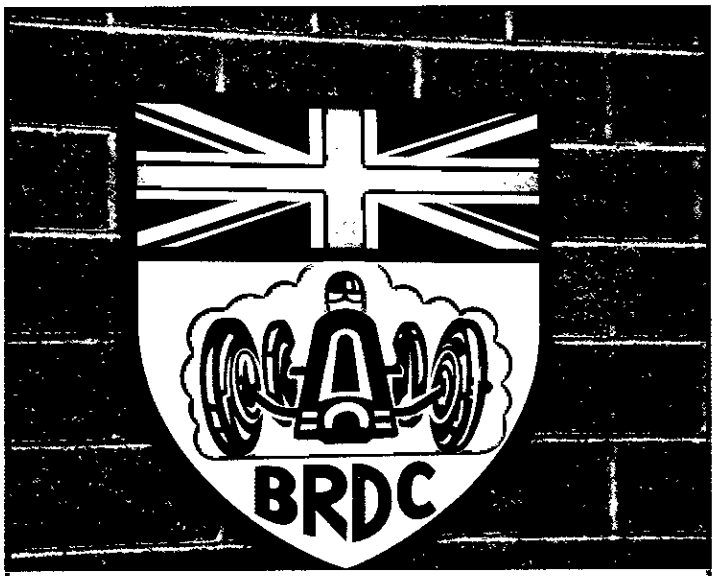
The one-day meeting on motorsport noise on 18 March 2010 opened with a short presentation from the Technical Director of the Motor Sport Association UK, **John Symes**, entitled *Motorsport and noise issues*. He gave a short review of noise control, stating that since 1960 more control has gradually been introduced, but that the current levels have been in existence for about 10 years. He also commented that some normal highway vehicles are actually permitted to make more noise than these prescribed levels. The Motor Sports Association (MSA) sets levels of static tests and trains staff to monitor and enforce them. A new noise working group is trying to find a consistent approach for the FIA worldwide, probably linked to live monitoring of events. As many of the working group members were present at the event a short meeting was held during the afternoon coffee break.

This was followed by **Andy Watson** of Acoustic Consultancy Services with a presentation of *The importance of noise control to venues and how the governing bodies approach the issue*. He stated that motorsport venues usually needed maximum use and therefore noise control was essential, but that static tests did not usually measure community impact. LAeq he considered most suitable for determination of this, with a time period of either 30 minutes or one hour, and the MSA was looking to produce new action plans to correlate trackside noise with community noise. He reminded us that although the noise may be audible, wind can easily affect levels and motorsport may not always be the dominant noise effect.

Alan Bissett, an MSA event scrutineer, followed with his presentation *Practical interpretation of the MSA Blue Book*. He concentrated mostly on smaller events where there was no permanent motorsport venue, but where noise testing of vehicles was often difficult to fit in around the timetabled events, especially as these were not permitted to start before 09:00h (12:30h on Sundays). He noted that different local levels were being set at tracks around the country for different categories of cars. It was often confusing into which category a certain vehicle fitted, and where and how the noise was measured. He noted that the MSA and FIA currently had different regulations, and that course officials had the authority to overrule failed noise test results if they chose to do so. In questions following the presentation it was observed that there were very few opportunities for car owners to have noise tests performed before they arrive at a race, and that at present, there is no code of practice governing noise from truck racing events.

After a coffee break in which a Renault Formula 1 car was both heard and seen using the main track outside the conference suite, **Dr Mike Fillery** of Fillery Acoustics gave a presentation entitled *Ten things you ought to know about motorsport noise*. He was not convinced that there was correlation between static and on-track noise levels, and considered that L_{Amax} gave a better correlation with complaints of community noise from motorsport than L_{Aeq}. He quoted the results of an MSc project that showed cars were not particularly noisier the faster they went, and that low-noise tarmac surfaces could reduce levels by about 3dB. He also commented that there was little funding for any research into the noise generated and its effects.

A presentation on *Noise nuisance at a former airfield* was then given by **Mike Southcombe**, Environment Protection manager for City of York Council, co-authored with Mike Stigwood of MAS Environmental. A disused airfield had changed ownership and trials of F1 and other cars started, as had the noise complaints. Despite serving notices to reduce the noise in 2005, the problem was still ongoing and the assessment



The British Racing Drivers Club is headquartered at Silverstone


Mike Fillery


Andy Watson

A Renault F1 was heard

a tour of the circuit's noise monitoring system

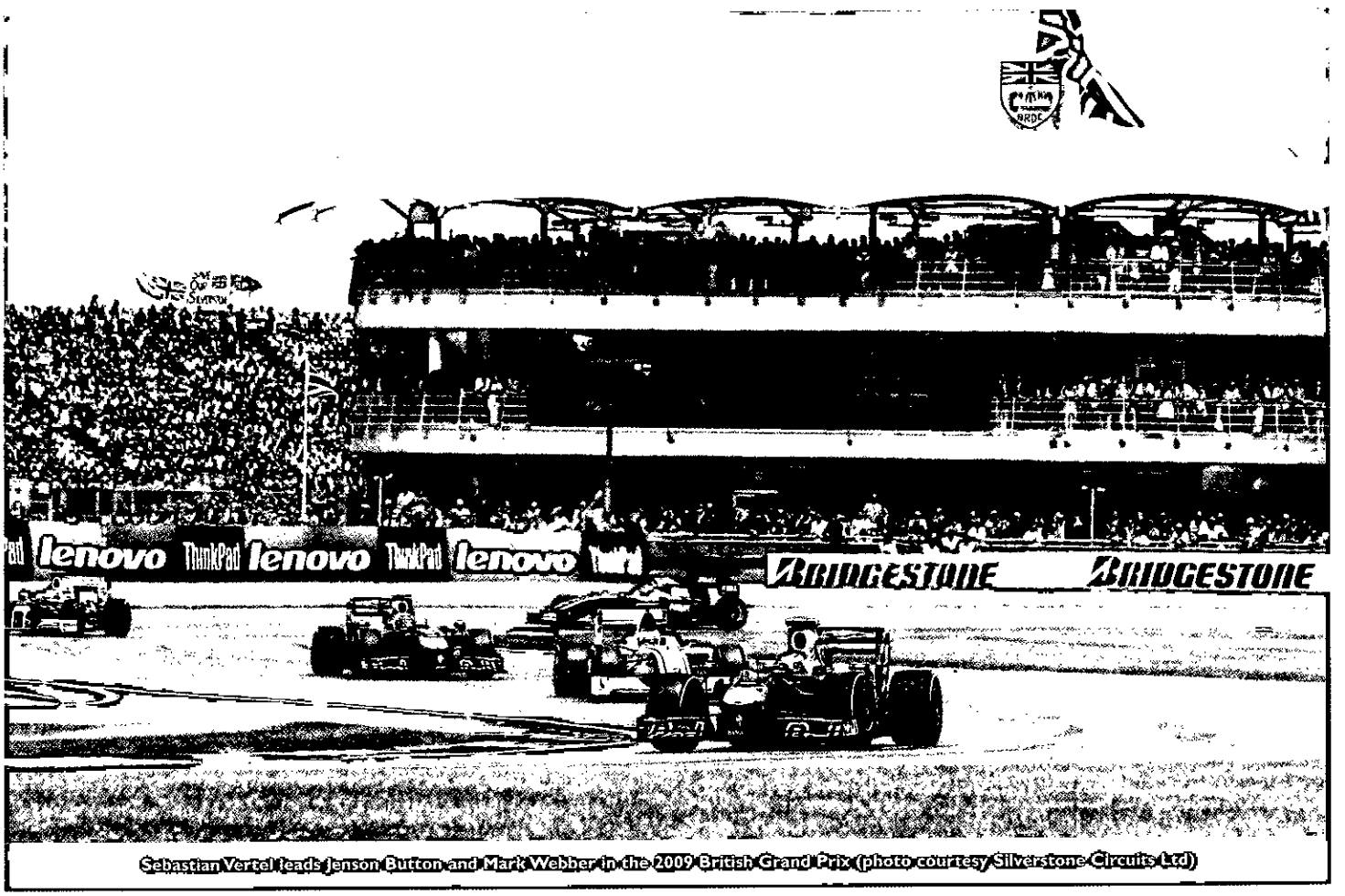
had proved problematic. Recently, the court had put more weight on the effects of psychoacoustic factors on people than on the actual noise levels. Factors such as people being unable to hold a telephone conversation in their home when the noise was present was deemed more important than actual measured noise levels, for instance. The World Health Organisation (WHO) guidelines were deemed applicable for more continuous noise rather than the sudden short bursts encountered on this site.

After lunch **Chris Beale** of CBA Ltd described and gave a conducted tour of the noise monitoring facilities at Silverstone with the kind permission of Leslie Cox, environmental manager at the racetrack.

After the brief tour of the Silverstone noise monitoring system, **David Trew** of Bickerdike Allen Partners gave a presentation on *Managing noise from motorsport*. David examined a range of existing national and international environmental noise legislation to determine whether any of these guidelines could actually be effective as a means for assessing the impact of motorsport venue noise. He then suggested the adoption of best practice to minimise noise which would include an ongoing noise management plan. Using examples from a number of UK and overseas venues David went on to illustrate how the noise impact is currently managed and highlighted examples of good practice. He finally called for robust research to establish guidelines. Communication with the public and local authority is essential.

The final paper of the afternoon was presented by **Ed Clarke** of Alan Saunders Associates on *Lessons learned from F1 engine test cell design*. Ed explained the huge engineering task undertaken in developing and commissioning a test cell for F1 engines, with a very demanding specification including an attenuation of 80dB into the control room

continued on page 28



Sebastian Vettel leads Jenson Button and Mark Webber in the 2009 British Grand Prix (photo courtesy Silverstone Circuits Ltd)

Meeting report - Motorsport noise - *continued from page 27*

but with clear sight of the test engine, good ventilation, no noise overspill from the rest of the factory and the ability still hear the engine without affecting the hearing of employees. This was all conducted without the ability to test the system on a real engine, which was quite a challenge. Clearly F1 is a competitive business and much technical detail had to be omitted from the presentation, however it still remained a very interesting run through the challenges and solutions which involved variable sound insulation.

Each paper sparked a number of questions and discussions, many of which continued throughout the breaks.

A small exhibition was also part of proceedings with instrumentation on display from Cirrus Environmental, Brüel and Kjær and Campbell Associates.

The event was well attended with just under 80 delegates from various backgrounds and, rather encouragingly, a large proportion were not Institute members. Clearly the message from the event was that motorsport has such a diverse mix of disciplines and issues that one single noise regulation may not suffice. The issues are highly emotive!

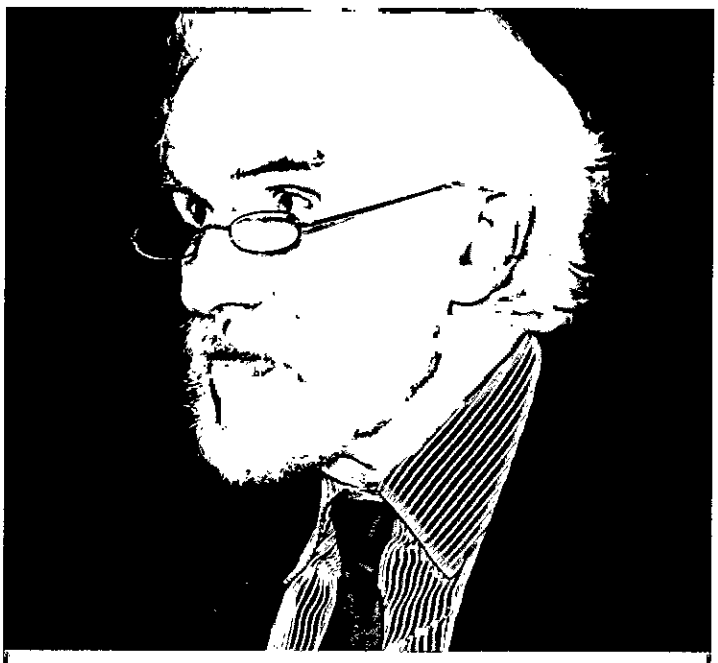
part of the Silverstone noise monitoring system

INCE Distinguished International Members elected

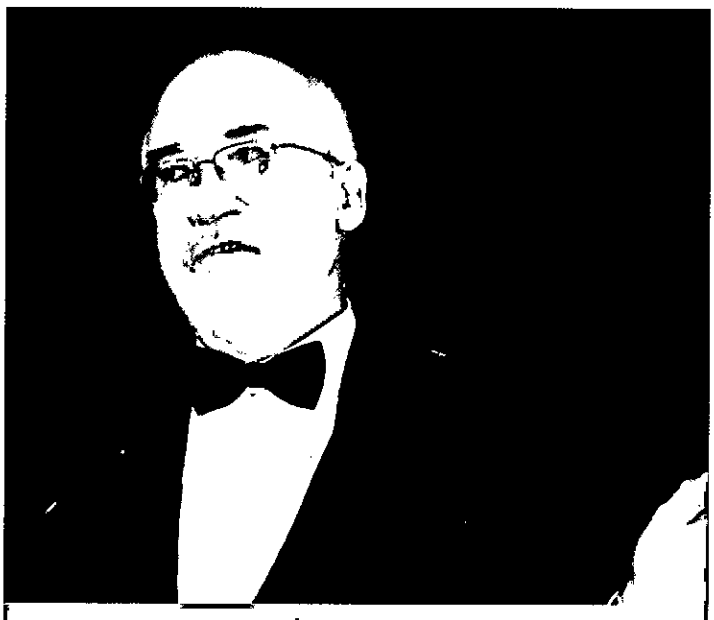
International honours for Frank Fahy and Bernard Berry

The Institute of Acoustics recently nominated two prominent British figures as Distinguished International Members of INCE, the Institute of Noise Control Engineering in the USA. Both were duly elected by the INCE/USA Board of Directors at their meeting on 18 April 2010. Congratulations are offered to Bernard Berry HonFIOA and Frank Fahy HonFIOA.

The status of INCE Distinguished International Member is conferred by the INCE Board upon eminent acousticians who reside outside the USA. This distinguished, honorary status is conferred on individuals who have personally made extraordinary significant contributions to the theory and/or practice of noise control engineering. Nominations are submitted by a committee of peers who are active in noise control engineering in the country of the proposed nominee. An important criterion is incontrovertible evidence of superior professional stature in their own country, and factors which are considered to contribute significantly to this attribute are recognition by technical peers through awards and honours, and contributions to engineering activities related to noise control in academe, industry or government.



Frank Fahy



Bernard Berry

Apology

IOA Education wises to apologise for an omission from the article in Acoustics Bulletin, volume 35 no.3, which failed to report the following names of Diploma candidates who received special commendations for gaining five merits in the 2008/9 IOA Diploma.

Louise King (distance learning, Edinburgh)

Jan Leask (distance learning, Salford)

Rachael Meadows (distance learning, St Albans)

Andrew Oldridge (distance learning, St Albans)

Investigation of flanking sound transmission in lightweight building structures using a scanning laser vibrometer

Stefan Schoenwald, Berndt Zeitler and Trevor R T Nightingale.

Introduction

In some cases the overall sound transmission between adjacent dwellings is governed by flanking transmission and hence testing of the flanking performance of building structures is an important issue. Usually, the well-established indirect measurement method of ISO 10848 is applied for testing junctions of lightweight building elements like wood joist floors and gypsum board walls. Here a full-scale junction is built in a special test facility, some surfaces of the test specimen are shielded, and the sound pressure level difference between the source and receive rooms is measured. An estimate of the flanking sound reduction index of one particular path is obtained by considering the power injection, propagation attenuation of structural waves in the two coupled elements, junction attenuation, and radiation into the receiving room. In this article a scanning laser vibrometer is used to get a better understanding of flanking transmission in lightweight building structures and of the above-mentioned mechanisms. The spatial distribution of the velocity on the surface of the structure is measured and structural power flow is investigated.

Background

The sound insulation between two adjacent dwellings that is experienced by occupants is the apparent sound insulation, which is the sum of the direct path through the separating partition and a number of flanking paths involving building elements that are coupled to the partition. Along each flanking path the airborne sound field in the source room, or alternatively a structure-borne source such as people walking, excites one building element; structure-borne sound is transmitted at the junction to the coupled building element that finally radiates airborne sound into the receiving room. In prediction methods for flanking transmission, eg in EN 12354, only bending waves are considered because this wave type has an 'out-of-plane' displacement normal to the surface of the building element, typically the dominant motion for acceptance and radiation of sound by a surface. Further building elements are usually weakly coupled at the junction and only the resonant wave component, due to free bending waves, is transmitted structurally from one element to the other. In the case of monolithic homogeneous structures that are weakly damped, like concrete or masonry, the elements are usually line-connected along one edge. Structure-borne sound is distributed uniformly in both the source and receive element and an estimate of the flexural energy (due to bending waves) and the power flow across the junction can be simply obtained from the mean spatial surface velocity of the elements.

Lightweight assembled building elements, like framed gypsum board walls or joist ceilings, are also used in construction for various reasons. Since they consist of multiple structural members - usually thin leaves and a framing member to provide the necessary strength - the element is no longer homogeneous and prediction models must simulate the element as multiple subsystems. The leaves of the flanking elements that are actually excited on the source side, and radiate sound on the receiving side, usually are not continuous across the junction nor directly attached to each other. Hence, structureborne sound is transmitted between the leaves via the framing members at the junction. Owing to this inhomogeneity in the coupled surface and the material properties, energy is not distributed uniformly - the velocity has a strong spatial gradient especially on the leaf of the receiving wall - and the velocity fields cannot be considered to be diffuse. This is discussed in[1].

In this article the normal surface velocity was measured with a scanning laser vibrometer on the gypsum board leaf of a wood stud wall that is part of a full-scale building junction located in the NRC-IRC Flanking Facility. The specimen was excited in one room with airborne sound and the velocity was measured in an adjacent room on a flanking wall. Since the velocity on the receive leaf is due to free bending waves, the flexural intensity in the leaf could be estimated. From the power flow in the leaf valuable information was obtained on the power transmission across the junction, and further different junction regimes are identified.

Measurement of structural intensity

The normal surface velocity is measured in a closed-meshed measurement grid on the gypsum board leaf of the flanking wall with a scanning laser vibrometer system. The velocity is proportional to the flexural energy of the leaf and hence areas of high and low energy can be identified. However, from the velocity plots no information can be gained about the power flow in the leaf - either about sources where power is injected, or about sinks where power is dissipated or transmitted to other structural members of the gypsum board wall. Hence the structural intensity is calculated from the velocity distribution as briefly outlined in the following.

Structural intensity due to bending wave propagation

The structural intensity [W/m] due to bending wave propagation in x-direction in a thin, homogeneous isotropic plate is the sum of three independent components that are product combinations of the shear force Q_{SF}, the bending moment M_x, the twisting moment M_{xy} and the corresponding normal velocity $\dot{\xi}$ or angular velocity $\dot{\theta}$.

$$I_x = \langle Q_{SF}\dot{\xi}\rangle_t + \langle M_x\dot{\theta}_x\rangle_t + \langle M_{xy}\dot{\theta}_y\rangle_t \qquad [1]$$

Subscripts x and y indicate the direction on the plate in Cartesian coordinates, and angle brackets the time averaging.

Further all factors - the shear force, the moments and the velocities - can be expressed in terms of the time or spatial derivatives of the normal plate displacement ξ. The intensity component due to shear forces (the first term on the right hand side of Equation 1) is then given by Equation 2.

$$I_{x,SF} = -B\cdot\left\langle\frac{\partial}{\partial x}\left(\frac{\partial^2\xi}{\partial x^2}+\frac{\partial^2\xi}{\partial y^2}\right)\cdot\dot{\xi}\right\rangle_t \qquad [2]$$

The sum of the second and third terms of Equation 1 is the so-called moment component of flexural intensity where the one due to bending moments is given by Equation 3 and the one due to twisting moments by Equation 4.

$$I_{x,BM} = B\cdot\left\langle\left(\frac{\partial^2\xi}{\partial x^2}+\mu\frac{\partial^2\xi}{\partial y^2}\right)\cdot\frac{\partial\dot{\xi}}{\partial x}\right\rangle_t \qquad [3]$$

$$I_{x,TM} = B\cdot(1-\mu)\left\langle\frac{\partial^2\xi}{\partial x\partial y}\cdot\frac{\partial\dot{\xi}}{\partial y}\right\rangle_t \qquad [4]$$

All intensity components depend on the bending stiffness B, which for a thin, homogeneous, isotropic Kirchhoff plate is function of Young's modulus E, the plate thickness h and Poisson's ratio μ, and is given by Equation 5.

$$B = \frac{E\cdot h^3}{12\,(1-\mu^2)} \qquad [5]$$

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In plates, energy is transported by all three components and the relative magnitude of the shear force component and the moment component depend on the presence or absence of discontinuities *eg* plate edges, joints, point connections, stiffeners *etc.* However, in the far field more than a quarter-wavelength away from discontinuities, force and moment components are equal.

Measurement of structural intensity with the simple 2-point method

The simple formulation for the measurement of the bending wave intensity derived by Noiseux uses the equality of the force component and the moment component in the far field and a finite difference approximation. An estimate of the active component of intensity I_x in, for example, the *x*-direction is obtained from the velocity signals of only two points using Equation 6. The active component of intensity describes the power flow in the structure, whereas the so-called reactive component of structural intensity (which is not considered here) is a measure of energy stored by bending modes.

$$I_x = -\frac{2\sqrt{Bm''}}{\Delta} \cdot \mathrm{Im}\{G_{12}\} \qquad [6]$$

G_{12} is the cross spectrum between the velocity signals measured at two points indicated by the subscript, Im{} denotes the imaginary part, Δ is the point spacing, and m'' is the surface density of the plate.

When the velocity signal is measured at four points as shown in Figure 1 the bending wave intensity can be estimated in both the *x*- and *y*-directions, and the resultant vector of these two orthogonal components is a measure of the magnitude and direction of the flexural power flow in the centre of the four point array. The intensity component I_y in the *y*-direction is simply given by Equation 7 by interchanging the subscripts of the measurement points in Equation 6.

$$I_y = -\frac{2\sqrt{Bm''}}{\Delta} \cdot \mathrm{Im}\{G_{14}\} \qquad [7]$$

For the cross-spectrum the phase relationship between the two velocity signals has to be known and thus either they have to be measured simultaneously or, as in this work, the so-called frequency response technique can be applied to linear structures[3]. The transfer functions between the velocity signals and a reference signal are measured. The cross spectrum eg G_{12} is found from the product of the transfer functions H_{rvi} and auto spectrum G_{rr} using Equation 8 where subscript *r* denotes the reference signal, v_i the velocity signal at point *i*, and * indicates the complex conjugate.

$$G_{12} = H^*_{rv_1} \cdot H_{rv_2} \cdot G_{rr} \quad with \quad H_{rv_i} = \frac{G_{rv_i}}{G_{rr}} \qquad [8]$$

Measurement setup

The measurements are carried out in the two-storey NRC-IRC flanking facility in Ottawa. In this facility a full-scale building junction has been built that consists of wood joist floors and wood frame walls. The wall and floor specimen separates the space inside the facility into eight rooms with four rooms on each floor. Just as in real buildings, sound is transmitted between adjacent rooms of the facility through the separating partition and further by a number of flanking paths as it is described in more detail elsewhere[4]. All measurements in this paper were carried out on the ground floor and only the wall-to-wall flanking path between the room SW (south-west) and room SE (south-east) is considered since measures are taken to suppress all other transmission paths sufficiently between the two rooms - also paths through the outer shell or the floor of the facility. The orientation of the four rooms on the ground floor and their designations are given in Figure 2.

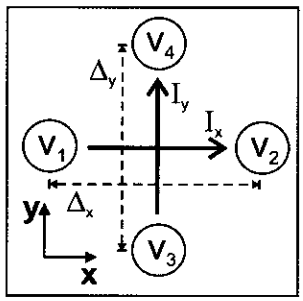

Figure 1

Four point array for the measurement of the bending wave intensity on a plate with the simple 2-point method according to Noiseux [2].

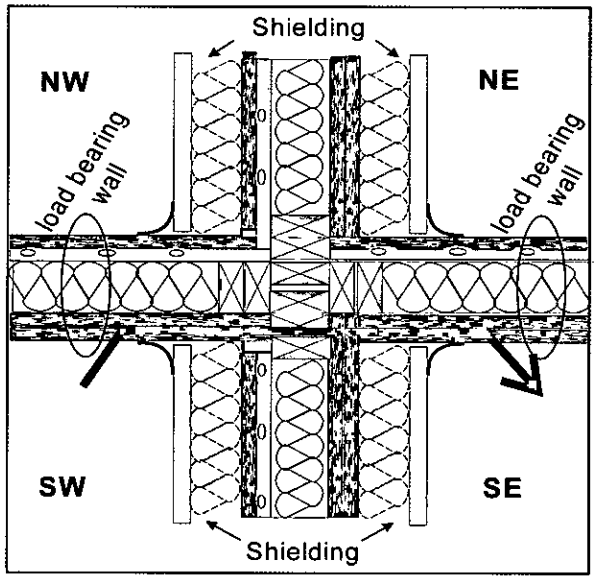

Figure 2

Junction, orientation of rooms in this paper: south-east (SE), south-west (SW), north-west (NW); north-east (NE) and transmission path and leaves considered.

Test specimen

Flanking transmission through the load bearing walls separating the north and south rooms of Figure 2 is considered. All walls are single wood stud walls having studs (38 ×89 mm) spaced at 406mm centres. On one side of the frame, two layers of 16mm gypsum board are directly attached to the studs. On the other side, one layer of 16mm gypsum board is attached via resilient metal channels to the studs. The resilient metal channels are installed perpendicular to the studs with a spacing of 610mm. The cavity is filled with 90mm of mineral wool. A load of 4500 pounds is further applied with a hydraulic loading system to the top of both load-bearing walls to simulate conditions that are comparable to junctions on the lower floors of multi-storey houses.

To isolate the wall-to-wall path, the direct transmission path must be suppressed. Thus, the non-load bearing walls separating rooms on the east and west sides of the facility are shielded on both sides with 16mm gypsum board on a layer of 90mm encapsulated mineral wool. The shielding is not attached mechanically to the walls and joints between the boards are taped with aluminium tape. The ceilings of the rooms consisted of two layers of 16mm gypsum board attached to resilient channels and thus sound transmission involving these surfaces is also suppressed sufficiently.

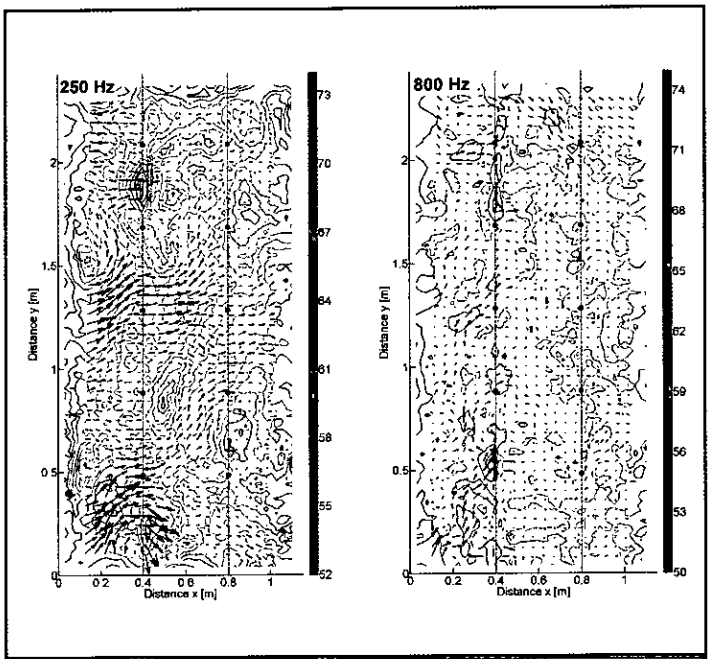

Figure 3

Structural intensity close to the junction in the gypsum board leaf of the load bearing wall in room SE at 250Hz (regime 1) and at 800Hz (regime 2). The colour map shows the magnitude of the intensity in dB [re 10^{-12} W/m], the left edge of the plots is the building junction, dashed lines indicate stud positions, and blue dots fastener positions.

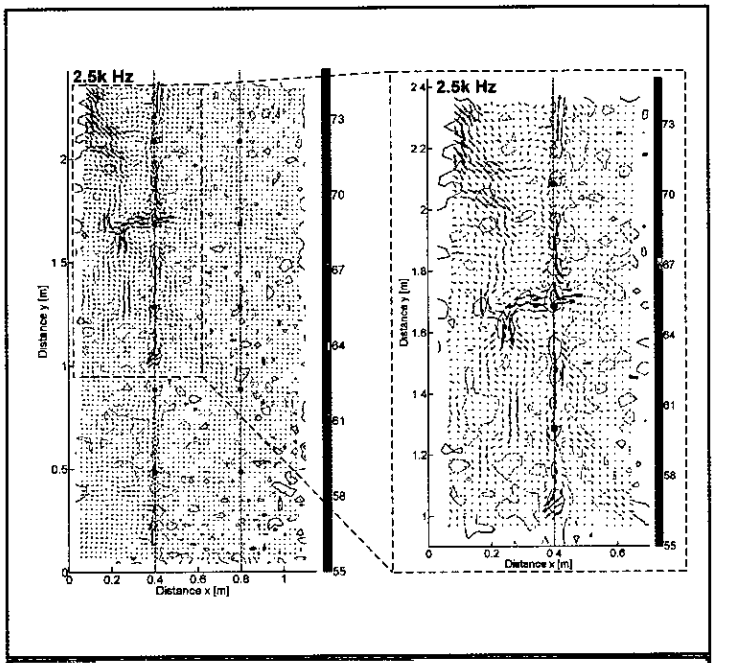

Figure 4

Structural intensity close to the junction in the gypsum board leaf of the load bearing wall in room SE at 2500Hz (regime 3) (left: whole area; right: blow-up of upper left edge). The colour map shows the magnitude of the intensity in dB [re 10 12 W/m], the left edge of the plots is the building junction, dashed lines indicate stud positions, and blue dots fastener positions.

Surface velocity measurements and structural intensity

In this article the velocity is measured on the gypsum board leaf of the load bearing wall in room SE using a scanning laser vibrometer system (Polytec, PSV-300) when the specimen in room SW is excited with a sound system with four loudspeakers. A velocity scan of the complete wall for this type of excitation is shown in[1], however with a rather greater measurement point spacing (300mm) than was used for the intensity measurement. Furthermore the load bearing wall is not loaded in the companion work. The results of that show a high velocity with a great gradient in the three bays that are closest to the junction, so the present article focuses on the structural intensity measured in the area less than 1.2m away from the junction. The spacing between the points in the measurement grid for the intensity is only 23mm and moreover two grids that are shifted by a half point spacing are used. Hence in total the velocity signal is measured at 8656points and simultaneously at a reference point that is located in the upper area between the second and third stud at an approximate distance of 1.1m away from the junction.

A FFT is performed on both the velocity and the reference signal and FFT spectra with 3200 equally spaced frequency lines in the range 2Hz to 3200Hz are obtained. Time averaging as well as the calculation of the transfer function and the auto spectra of both signals is done in the frequency domain. However, owing to the great junction attenuation in the high frequency range and the limited dynamic range of the measurement system sensible data can be measured only in the third octave bands below 2500Hz.

From the measurement data the components of structural intensity in the *x*- and *y*- directions are calculated according Equation 6 and Equation 7 and band filtered afterwards to reduce the amount of data to third-octave bands and octave bands respectively. For the calculation of the structural intensity, the gypsum board leaf is assumed to be point-connected to studs so the bending stiffness is given by that of the plain gypsum board ($E_x \approx E_y = 2.4 \times 10^9$ N/m^2, $m'' = 13.9$ kg/m^2, $\mu = 0.3$) for the sake of simplicity, although it is shown later that the assumption certainly does not hold in the low frequency range. Further it is shown in earlier work eg[5] that the error of the two-point method minimises when a point spacing of a quarter bending wavelength (0.25-λ_B) is used. Hence the point spacing is adjusted during calculation by skipping points with decreasing frequency. Point spacings between 0.2-λ_B and 0.3-λ_B are achieved in all bands of the frequency range considered.

Measurement results

Structural intensity in the leaves

The structural intensity is investigated on the part of the leaf that is close to junction. A detailed examination exhibited that in the third-octave bands below 100Hz the power flow shown by the vector plots obtained is not physical since the vectors are all of equal magnitude, the direction of vectors is varying strongly and the vector fields do not show a systematic power flow. This is probably due to the dominance of a few vibration modes in the leaf in the low frequency range in each third-octave band and thus the vibration energy of the wall is rather reactive. This behaviour is also

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observed in the 125Hz band as pointed out again later. Moreover the wood studs stiffen the gypsum board leaf in the very low frequency range along the vertical axis making the wall orthotropic which is not taken into account here.

However in Figure 3 and Figure 4 intensity vector plots are presented for three different third-octave bands that are representative of three different power flow regimes in the frequency range under consideration. The y-axis represents the position along height axis of the wall and the x-axis the distance to the junction that is located at the left edge of all vector plots. The direction of power flow is indicated by the direction of the intensity vectors and their length represents their magnitude in W/m. Since the length of the vectors is scaled differently in each plot to enhance intelligibility the colour map in the background also shows the magnitude of intensity in dB re 10^{-12} W/m; red areas are of high and blue areas of low structural power flow. The dashed blue lines and blue dots indicate the stud positions and the positions of the screws that attach the gypsum board to the frame.

In Figure 3 at the left the measured intensity field is shown for the 250Hz and at the right for the 800Hz third-octave band. Both have a reduced resolution of intensity vectors in both graphs to enhance intelligibility.

At 250Hz the vector plot clearly shows that in the low frequency range most of the energy is injected into the gypsum board leaf at the left edge, where the junction is located. The intensity vectors in the left-most columns are all almost perpendicular to the junction and also their magnitude is greatest in this area. Further the vectors in the top and in the bottom rows have a comparably small *y*-component (direction parallel to the studs), and with exception of the left bottom corner all are either horizontal or point towards the upper or lower boundary of the leaf. In the remaining measured area, the vector field indicates that most power flows away from the junction towards the centre of the leaf. However, in some areas the resultant intensity is very low (eg at x = 0.5m, y = 0.8m) and the vectors in the centre of these areas have random direction whereas away from these areas there is significant power flow. This is typical of the presence of modal patterns. Of particular order in the plot is a small area of high intensity at the upper part of the first stud where vectors to the left and right of the stud point towards the stud. Usually, this indicates a power sink, but remember the applied intensity method is not suitable for measurements in near fields. Thus, measurement error due to the proximity of the stud cannot be fully excluded since in this frequency range the bending wavelength is much greater than the spacing of the measurement points. However further developments are necessary to exclude near field errors which is certainly beyond the scope of this article. Generally the vector field indicates that in the frequency range considered, power is injected into the gypsum board leaf over the whole junction length. On the other hand at the top and bottom edge power is lost or transmitted to other structural members of the junction specimen.

At 800Hz in the plot at the right the vectors depict a completely different power flow. The vectors in the columns close to the junction are rather undirected and certainly do not point straight away from the junction as they do at 250Hz. Instead, the vectors in the top and bottom rows point towards the centre of the leaf. Here power is injected into the leaf and the magnitude of the intensity is greatest, but only less than 10dB greater than in the rest of the measurement area. However the magnitude is rather uniform - its gradient is much smaller than at 250Hz - but power flow is again undirected. This suggests that in this frequency range a rather diffuse structure-borne sound field exists on the leaf. Bending waves propagating in different directions and therefore the measured net power flow is small and undirected. However the vector field shows that in this middle frequency range the continuous head and sole plates of the framing transmit structure-borne sound at the junction and inject it at the top and bottom into the gypsum board leaf.

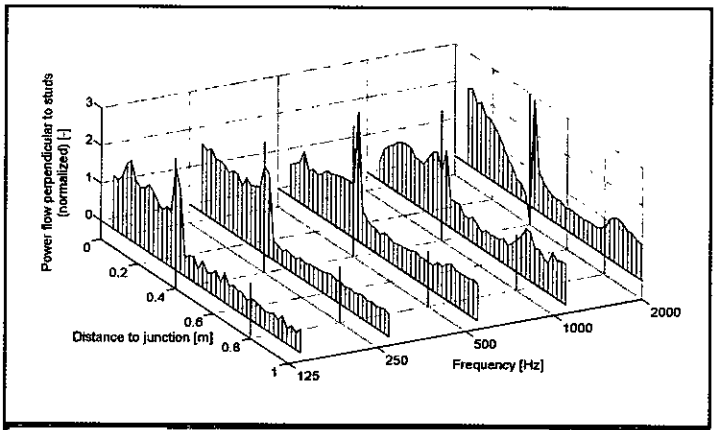

Figure 5

Change of net power flow perpendicular to the studs (intensity in the x-direction integrated over the height of the leaf) normalised by the mean power flow in this direction. The red and green lines show the stud positions.

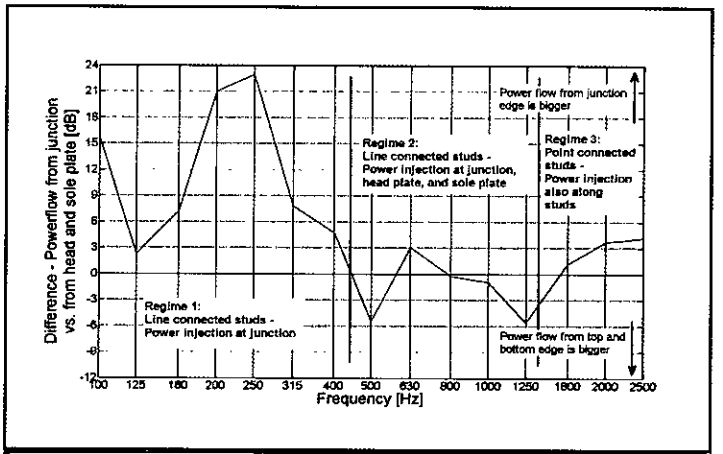

Figure 6

Net power flow along the boundaries of the gypsum board leaf: level difference of net power flow from the junction and from the top and bottom edge towards the leaf.

In Figure 4 the measured intensity is presented for the 2500Hz third-octave band. At the left the vector field of the whole measurement area is shown. In this frequency range the vector field does not indicate a distinct net power flow - the structure-borne sound field is rather diffuse - and the magnitude of intensity is uniform with exception of some spatially restricted areas of high power flow in the upper left corner of the leaf and along the first stud. Since the power flow in these areas cannot be shown properly in a plot with reduced resolution (as in Figure 3) the full measured data set is presented in Figure 4 at the left and additionally on the right the upper left corner of the first plot is enlarged. The enlarged plot clearly shows a great power flow only from two areas, the upper part of the junction, and the leftmost part of top boundary into the gypsum board, whereas at the remaining boundaries almost no energy is injected. Further power seems to flow in the *y*-direction along the first stud, but also a series of point sources and sinks can be identified that partly match the location of the screws that are used to mount the top layer of gypsum board. At some points in between the marked fastening points the vectors indicate further point sources, for example, the lowest in the plot on the right at approximately 1m height - which probably match with the fasteners of base gypsum board layer that are staggered (not shown in the graph). The plots show the same trend as earlier measurements conducted on a Plexiglas plate with a point connected rib that is excited structurally[5]. Hence the plot suggests that in the high frequency range power is injected into the gypsum board at its boundaries, only at the upper left edge and additionally

farther away from actual junction at the fastening points along the studs.

Net power flow across the studs and from the boundaries of the leaf

In this section the measured structural intensity is integrated along various lines to demonstrate further applications of the intensity method and to confirm the results that are indicated by the vector fields. Analogously to the sound intensity method the net structural power flow across a boundary or an arbitrary line of a plate respectively can be obtained if the components of measured intensity vectors that are normal to the integration boundary are integrated.

In the current case, first the *x*-components of the intensity vectors are integrated along the columns to obtain the change of the net power flow in direction perpendicular to the studs with distance to the junction. The net power flow perpendicular to the studs is presented in octave bands in Figure 5. The net power flow is normalised to the mean net power flow, averaged for all distances, in the frequency band. In Figure 5 the red lines at a 0.4m distance indicate the position of the first stud and the green lines at 0.8m the position of the second stud. Positive values indicate more power flow away from the junction and negative values *vice-versa*. At first glance it is obvious that the change of net power flow with distance from the junction is quite different depending on the frequency range.

In the 125Hz and the 250Hz octave band the presented net power flow is positive at all distances and so most power propagates away from the junction. In the bay close to the junction the net power flow perpendicular to the studs is greatest and drops significantly at the first stud position. In front of and behind this stud the net power flow is rather uniform and there is no significant gradient with distance to the junction. This confirms again that in the low frequency range most power is injected into the gypsum board along the junction. The drop at the first stud suggests that the studs and the gypsum board can be considered as line-connected. Bending waves that are only captured with the applied method are either reflected at line-connect stud or converted into other wave types, like longitudinal or transversal waves, that do not cause an out-of-plane displacement of the gypsum board. The latter assumption is more likely since there is no change of net power flow due to bending waves at the second stud, which is consistent with an earlier study[6].

In the 500Hz and 1kHz octave bands again the studs can be considered as line-connected since the net power flow drops significantly at the first stud. However, between the junction and this stud the net power flow increases perpendicular to the junction increases with distance slightly in the 500Hz and more pronounced in the 1kHz octave band. Thus in this frequency range power is

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injected farther away from the junction by the head and sole plate into the gypsum board as already shown by the vector fields.

In the 2kHz octave band the change of net power flow with distance differs completely and the studs and gypsum board are point connected. In the bay that is closest to the junction the net power flow decreases strongly with distance from the junction and even has negative values - more power propagates towards the junction - just in front of the first stud. Right behind the first stud the net power flow has great positive values that again decrease rapidly. A second increase of power flow that is also already present in the 1kHz band occurs at the second stud position. Thus energy is injected at the junction edge into the leaf but also farther along the studs which causes the decrease, even with negative values, of net power flow on the junction side and great positive values on the other side of the studs.

In a second step the *x*-components of the intensity vectors are summed along the junction edge of the leaf as in Figure 5 to obtain the net power flow from the junction into the plate. This is also done with *y*-components of the intensity vectors along the top and bottom rows of the measurement area to obtain the net power flow from the head and sole plate into the leaf. In Figure 6 the level difference of the net power flow from the junction and the sum from the top and bottom edge is presented. The three regimes, identified already earlier, are also indicated. In the first regime (line-connected, and with the junction the dominant source of power injection) below 400Hz the power flow from the junction is much greater than from the top and bottom edge. The small values in Figure 6 at 125Hz are due to a strong reactive bending wave field on the leaf and hence it was not possible to obtain a good estimate of the active structural intensity. In the second regime (line-connected, and power injected at junction, head plate and sole plate) between 500Hz and 1.25kHz the level difference in Figure 6 is about zero, hence power flow is equal and the same amount of power is injected into the leaf at the junction and at the other two considered boundaries. In the last regime (point-connected, and power injected also along the studs) again the power injected by the junction is greater. However in Figure 6 the power that is injected at the point connections between the studs and the gypsum board is not captured.

Summary and conclusions

The simple two-point method is applied to estimate the structural intensity due to bending wave propagation from the surface velocity that is measured in a closed meshed grid on the gypsum board leaf of a wood framed wall. The wall is part of a junction specimen that is used to investigate flanking transmission and during the measurement the leaf is the part of a wall-to-wall flanking path that radiates sound into a receiving room.

The work presented here is actually a feasibility study to investigate the application of structural intensity methods to lightweight framed building systems since some of the assumptions that are made in the derivation of the simple intensity method, ie bending wave far field on thin, isotropic homogeneous plate, are not fulfilled at all points of the plate in the whole frequency range considered. However, the results obtained are promising and consistent with findings of earlier work, thus the major part of this paper actually discusses the power injection at the junction and power flow in the gypsum board leaf of a wood framed flanking wall. An extension of the applied methods to naturally orthotropic plates such as timber, or even technically orthotropic plates such as the gypsum board walls considered, is highly desirable and certainly the goal of future research to improve the structural intensity technique further.

The intensity vector fields presented, and graphs of the net power flow in the leaf that are obtained by integration of the intensity vectors along lines, show clearly that transmission of structure-borne sound across a junction of framed lightweight building elements is not as simple as for homogeneous, line connected plates. Two regimes, line-connected and point-connected, are identified for the coupling of the studs and the gypsum board and there are three regimes that describe the power injection at the junction. In the current case the leaf and the studs are line-connected in the low and middle frequency and in this connection regime power is mainly injected into the leaf over the whole length of the actual junction below about 400Hz. In the frequency range between 500Hz and 1.25kHz the same or even more power is injected along the head and sole plate of the wall frame than directly by the nominal junction. The head and sole plates of this wall specimen are continuous at the junction and hence transmit most of the structure-borne sound. Finally above 1.6kHz the leaf is point-connected to the frame and in this regime power is injected only by a small area at the junction edge and at the head plate, but additional point sources are identified in the intensity vector plots at the fastening points of the leaf along the first stud that even lead to resultant net power flow towards the junction.

Further research and measurements at different specimens are necessary for generalisation of the results presented here. However, the results indicate that a treatment of junctions of lightweight, framed building elements as simple line connections in the whole frequency range, as suggested by EN 12354 and ISO 10848 is neither reasonable nor valid. An alternative simple solution that covers also the power injection by the head and sole plate and at the first studs might be a definition of a connection area for each element. Since it is shown that power is actually injected in the radiating leaf far away from the actual connection of the elements the question has to be raised when considering flanking transmission between framed elements: '*Where is the building junction?*'

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Evaluation of traffic noise effects on sleep

Mathias Basner, Uwe Müller, Barbara Griefahn and Kenneth Hume.

Introduction

Environmental noise disturbs sleep and may impair well-being, performance and health. The European Union Directive 2002/49/EC (the European Noise Directive, END) requires member states to generate noise maps and action plans to mitigate traffic noise effects on the population. However, practical guidance for the generation of action plans, *ie* for assessing the effects of traffic noise on sleep, is missing. Based on the current literature, this article provides guidance on hazard identification, exposure assessment, exposure-response relationships and risk estimation. There is currently no adequate consensus on either exposure or outcome variables that describe traffic noise effects on sleep.

Sleep disturbance is one of the most common complaints raised by noise-exposed populations, and it can have a major impact on health and quality of life. Studies have shown that noise affects sleep in terms of immediate effects (eg arousal responses, sleep stage changes, awakenings, total wake time, autonomic responses) and after-effects (eg self-reported sleep disturbance, daytime performance, and cognitive function deterioration).

Definition of outcomes

Sleep disturbances can be measured electrophysiologically, using so-called polysomnography (PSG), or epidemiologically, using survey questionnaires.

PSG, which is the simultaneous recording of the electroencephalogram (EEG), the electrooculogram (EOG), the electromyogram (EMG), and other physiological variables remains the 'gold standard' for measuring and evaluating sleep. According to specific conventions[1,2], the night is usually divided into 30s epochs. Depending on EEG frequency and amplitude, specific patterns in the EEG, muscle tone in the EMG, and the occurrence of slow or rapid eye movements in the EOG, different stages of sleep are defined and the appropriate stage is assigned to each epoch. Wake, superficial sleep stages S1 and S2, deep sleep stages S3 and S4, and REM-sleep (*rapid eye movement* sleep) are differentiated. Current knowledge assumes that sleep stages differ in their function and in their relevance for sleep recuperation, where continuous periods of deep sleep and REM sleep seem to be especially important for sleep recuperation[3]. Shorter activations in the EEG and EMG, so-called arousals, can also be detected with polysomnography[2,4]. These *arousals* are usually accompanied by activations of the autonomic nervous system (*eg* increases in heart rate and blood pressure) and they may contribute to sleep fragmentation[5,6].

$L_{night,outside}$ range	Health effects
< 30dB	Although individual sensitivities and circumstances differ, it appears that up to this level no substantial biological effects are observed. less than 3 [0; 11] additional EEG awakenings per year
30 - 40 dB	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. 3 [0; 11] to 14 [1; 31] additional EEG awakenings per year
40 - 55 dB	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected. 14 [1; 31] to 275 [160; 381] additional EEG awakenings per year
> 55dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep disturbed. There is evidence that the risk of cardiovascular disease increases. more than 275 [160; 381] additional EEG awakenings per year

Table 0

Night Noise Guideline for Europe (NNGL)[35] ranges for the relation between nocturnal noise exposure and health effects in the population. For each dB category, the number of additional aircraft noise induced EEG awakenings per year is given as median [2.5 percentile; 97.5 percentile] according to Figure 1A. The NNGL assumes an average attenuation of 21dB between inside and outside noise levels (A-weighted decibels)

Summary of evidence linking noise and disturbed sleep

Undisturbed sleep of sufficient length is necessary to maintain performance during the day as well as for general good health[7]. The human organism recognises, evaluates and reacts to environmental sounds even while asleep[8]. These reactions are part of an integral activation process of the organism and express themselves as changes in sleep structure or increases in heart rate. Environmental noise may decrease the restorative power of sleep by means of repeatedly occurring activations (so-called sleep fragmentation). Acute and chronic sleep restriction or fragmentation have been shown to affect, among others, waking psychomotor performance[9], memory consolidation[3], creativity[10], risk-taking behaviour[11], signal detection performance[12], and accident risks[13,14].

Probability and magnitude of noise induced activations of the central nervous system are predominantly influenced by the type and sound pressure level of the noise event, beside many other moderating factors[15]. Depending on their frequency, acute noise effects on sleep (arousals, awakenings) cause a general elevation of the organism's arousal level that consequently leads to a redistribution of time spent in the different sleep stages with an increase of the amounts of wake and stage S1 and a decrease of slow wave sleep (SWS) and REM-sleep[16-19]. Although these global alterations are not specific for traffic noise, there is an ample number of laboratory and field studies that provide sufficient evidence to conclude that traffic noise causally and relevantly disturbs sleep and, depending on noise levels, may impair behaviour and well-being during the subsequent period awake[19-31]. Although clinical sleep disorders (*eg* obstructive sleep apnoea) have been shown to be associated with increased risks for cardiovascular disease, little is known about long-term effects of noise disturbed sleep on health. However, recent epidemiological studies do suggest that nocturnal traffic noise exposure increases the risk for cardiovascular disease[32-34].

Exposure-response relationships

Noise-induced sleep disturbances may impair recuperation and lead to short-term and long-term consequences for performance, well-being and health. It is therefore important to assess the impact of noise exposure on sleep on the population level. Strategic noise maps according to the END suggest L_{night} as the primary exposure variable for assessing noise induced sleep disturbances. In the WHO Night Noise Guidelines, several L_{night} exposure categories are linked to health and sleep disturbance outcomes, and can accordingly be used to assess the degree of sleep disturbance (see Table 1). Additionally, it is possible to use exposure-response relationships between L_{night} and sleep disturbance indicators (like additionally induced awakenings) to directly assess the expected degree of sleep fragmentation. However, nocturnal sleep disturbance primarily depends on the number and acoustical properties of single noise events, and it may therefore be advantageous to directly use these predictors instead. The END explicitly states that it may be advantageous to use maximum sound pressure level L_{Amax} or sound exposure level (SEL) as supplementary noise indicators for night period protection.

In contrast to daytime traffic, where high traffic densities may lead to more or less constant and continuous noise levels, low traffic densities during the night often go along with intermittent exposure to single noise events. Hence, traffic noise induced alterations in sleep structure depend crucially on the number of noise events, the acoustical properties (such as the maximum sound pressure levels) of single noise events, the placement of

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Evaluation of traffic noise effects on sleep - *continued from page 35*

noise events within the night, and on noise-free intervals between noise events[21,23,36]. The causal relation between distinct acoustical stimuli and acute alterations is evident. Clear exposure-response relationships have been demonstrated between single stimuli and arousals, awakenings or body movements. Several moderators (time of night, sleep depth etc) have been identified and quantified[20,23,24].

The END proposes L_{night} as the night-time noise indicator for sleep disturbances. L_{night} is defined as the A-weighted long-term average sound level as defined in ISO 1996 2: 1987, determined over all night periods of a year. Noise events in the period between 23:00h and 07:00h contribute to the calculation of L_{night}. L_{night} is an equivalent continuous sound pressure level summarising complex traffic scenarios into a single value. This necessarily leads to information loss, as noise scenarios which differ in number, acoustical properties, and placement of noise events may calculate to the same L_{night}, but differ substantially in their effects on sleep. Hence, the END states that it may be advantageous to use maximum sound pressure level L_{Amax} or sound exposure level (SEL) as supplementary noise indicators for night period protection.

However, by default, strategic noise maps specify L_{night} as the only sleep disturbance indicator, which then necessarily has to be used to assess traffic noise impacts on sleep disturbance. In this case, the fact that the best predictors of sleep disturbance (number and loudness of noise events) are positively correlated with L_{night} can be used to assess the degree of sleep disturbance or sleep fragmentation[37] (see below).

As stated above, experimental studies have shown clear exposure-response relationships between single noise events and arousals, awakenings or body movements[20,23,24,30,37,38]. Exposure-response relationships between L_{night} or similar integrated measures and sleep disturbances are rare[39,40], which may in part be attributed to the fact that L_{night} as a whole night indicator can only be related to whole night sleep parameters. However, exposure-response relationships on the single event level can be used to predict the expected degree of sleep fragmentation depending on L_{night}. The relationship between L_{night} and the number of awakenings additionally induced by noise is shown using aircraft noise as an example, in Figure 1A.

According to Figure 1A, the degree of sleep fragmentation increases in a non-linear fashion with L_{night}. Clearly, the variance of the number of noise induced awakenings, and therefore the imprecision of the prediction, increases with increasing L_{night}, as many different exposure patterns can lead to the same L_{night} in the higher exposure categories. However, nocturnal sleep disturbance primarily depends on the number and acoustical properties of single noise events, and it may therefore be advantageous to directly use these predictors instead. The relevance of the number of noise events for sleep disturbance is shown in Figure 1B, demonstrating that, at the same L_{night}, the degree of sleep fragmentation may differ substantially depending on the number of noise events contributing to this L_{night}. At L_{night} 55dB, the number of additional EEG awakenings induced by aircraft noise per year increases from 106 (N=20 noise events), to 192 (N=40), to 262 (N=60), to 323 (N=80), and to 375 (N=100).

Figure 1A shows the average number of awakenings additionally induced by aircraft noise per year depending on $L_{night,outside}$. Altogether, 10 million 8-hour nights with 1 to 200 (1, 2, 3,..., 200) noise events randomly drawn from the DLR field study[20] were simulated. The lines represent (from below to above) 2.5, 25, 50, 75, and 97.5 percentiles. Figure 1B shows the average number of awakenings additionally induced by aircraft noise per year depending on $L_{night,outside}$ and on the number of aircraft noise events. Altogether, 600,000 8-hour nights with 5, 10, 20, 40, 60, 80, 100, 120, 140, 160, 180, and 200 noise events randomly drawn from the DLR field study[20] were simulated. Black lines represent median number of additional awakenings. Numbers next to the black line indicate the number of noise events per night. The red line connects mid-points of each 'number of events' category. In both Figures 1A and 1B, for each category of number of noise events per night 50,000 simulations were run, and for each simulation L_{night} was calculated (based on outside sound pressure levels measured 2m in front of the window, with 69.3% tilted windows, 18% closed windows, and 12.6% open windows) as well as the number of additional aircraft noise induced awakenings (based on inside sound pressure levels measured near pillow position) according to equation [2] in Basner et al.[20]. There were 8,170 eligible noise events from 135 nights at 32 measuring locations. The grey shaded areas represent Night Noise

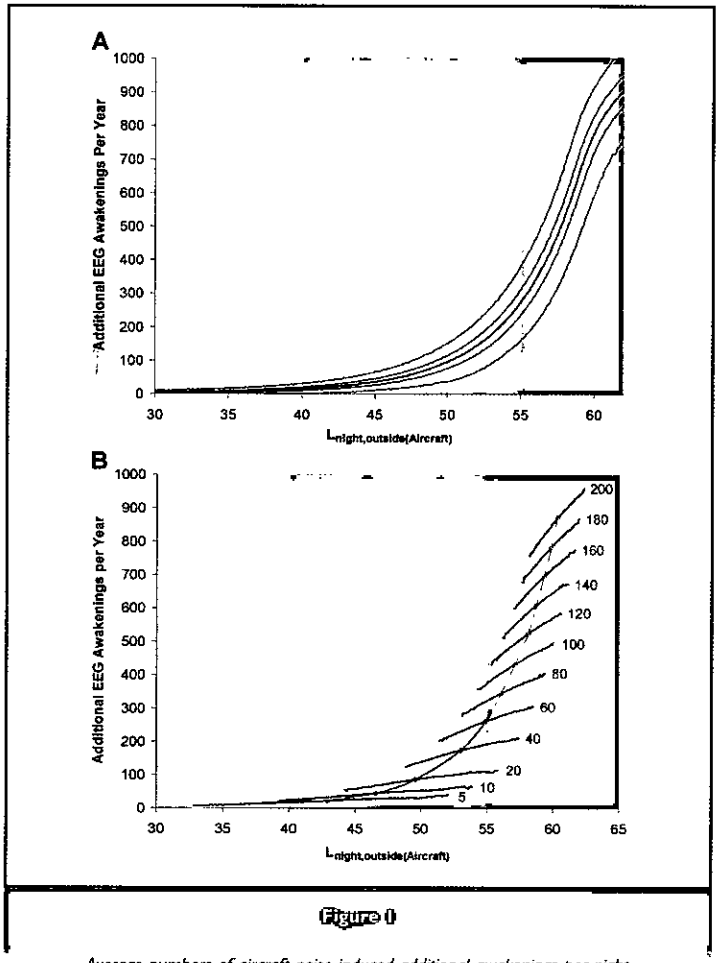

Figure 1

Average numbers of aircraft noise induced additional awakenings per night in relation to $L_{night,outside}$.

Guideline (NNGL) L_{night} ranges 30 – 40 dB, 40 – 55 dB, and >55dB. In an eight-hour undisturbed night for a healthy sleeper, on average 24 spontaneous EEG awakenings (as defined by Rechtschaffen and Kales[1]) can be observed (equalling 8,760 spontaneous awakenings per year).

Recent research suggests that EEG awakenings constitute one of the most appropriate indicators for noise induced sleep disturbances[18,22,31]. However, other indicators exist, and there is no consensus on what exposure-response relationships should be used, although first attempts have been made[41]. Therefore, decision makers may choose exposure-response relationships with different endpoints or indicators. The occurrence of sleep disturbance indicators (awakenings, body movements *etc*) is not pathological *per se*, as these reactions are also a physiological part of otherwise undisturbed sleep. They only reach pathological significance once a certain physiological frequency is exceeded, *ie* once sleep fragmentation reaches a relevant degree. However, inter-individual variability in the sensitivity to noise exposure is high, and it is not clear to what extent these experimentally derived dose-response relationships can be extrapolated to the population at large.

Conclusions

Noise induced sleep disturbances may impair recuperation and lead to short-term and long-term consequences for performance, well-being and health. It is therefore important to assess the impact of noise exposure on sleep on the population level. Strategic noise maps according to END recommend L_{night} as the primary exposure variable for assessing noise induced sleep disturbances. In WHO's NNGL, several L_{night} exposure categories are linked to sleep disturbance and health outcomes, and can accordingly be used to assess the degree of sleep disturbance. Additionally, it is possible to use exposure-response relationships between L_{night} and sleep disturbance indicators such as additionally induced awakenings to assess directly the expected degree of sleep fragmentation.

The END explicitly states that it may be advantageous to use L_{Amax} or SEL as supplementary noise indicators for night period protection. However, it

Figure 2

aircraft noise, a typical 'single event' causing disturbance

may be more practical to gather information on the average number of noise events contributing to L_{night} rather than to collect information on L_{Amax} or SEL of single noise events. It was seen in Figure 1B that additional information on the number of noise events contributing to L_{night} dramatically increases the precision of the sleep disturbance degree prediction.

L_{night} is calculated for the eight-hour period 23:00h to 07:00h by default, but parts of the (especially non-adult) population go to bed before or get up after this period where traffic is usually very busy. Based on the amount of traffic during shoulder hours, it should therefore be decided whether it is sufficient to assess the expected degree of sleep disturbance for the usual period, or whether it should be extended. END explicitly states that Member States can choose their own start times for day, evening, and night periods.

Exposure-response relationships usually refer to exposure to one type of traffic mode. However, parts of the population may be exposed to two or more traffic modes at the same time, as tends to be the case near airports. The cumulative effects of simultaneous exposure to noise from different traffic modes should be taken into account, although the knowledge on the effects of simultaneous exposure to different noise sources is limited[42]. A pragmatic way would be to calculate a single L_{night} value for all traffic modes and base the risk assessment on this combined exposure measure, at least until more is known about the combined effects of air, road, and rail traffic noise on sleep.

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doi:10.1016/j.apacoust.2010.01.002. Reprinted with permission from Elsevier. The work was also presented at the WHO workshop *Practical guidelines for risk assessment of environmental noise*, 15 and 16 May 2008, Bonn, Germany, at Internoise 2009, and at Euronoise 2009. Simulation data were sampled within the HGF/DLR-funded project *Quiet air traffic*.

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Direct sound insulation of lightweight solid walls

Andreas Ruff and Heinz Martin Fischer.

Introduction

In many multi-storey-buildings in Germany, the separating walls between rooms in the same occupant unit are constructed from lightweight solid masonry. In most cases these walls are of non-load-bearing construction, so there are no static requirements for the walls. The acoustical requirements for the direct sound insulation are lower than those for separating walls between different occupant units. It is therefore possible to use lightweight material, for example calcium silicate, porous concrete, brick or gypsum blocks, to construct these separating walls. Typically the mass per unit area of such lightweight solid walls is about 100kg/m².

Some of these lightweight internal walls are not connected rigidly to the adjacent building elements: they are decoupled by using an elastic interlayer. Lightweight walls made of gypsum blocks are a typical example for such decoupled constructions. Usually, the gypsum walls are decoupled on all edges by the elastic interlayer made of cork, polyethylene foam or bitumen. The primary reason for the decoupling is to avoid crack formation between the different building elements. In addition, the decoupling has a significant influence on the direct and the flanking[1] insulation of the gypsum walls. Figure 1 shows the construction of such gypsum walls in buildings.

Within a research project[2] at the Stuttgart University of Applied Sciences the acoustical behaviour of decoupled gypsum walls was investigated in detail. The aim of this research project was the implementation of the European standard EN 12354-1[3] concerning the prediction of sound insulation for constructions with gypsum blocks.

The decoupled gypsum walls have to be considered as a system consisting of gypsum blocks and elastic interlayer. To investigate the influence of the decoupling on the sound reduction index of lightweight gypsum walls was one part of the work. All results of the investigations discussed in this article relate to gypsum walls with a thickness of 100mm and a mass per unit area of 90kg/m² (with mid-density gypsum blocks) or 120kg/m² (with high-density gypsum blocks).

Laboratory measurements

In a wall test facility for direct sound transmission the sound reduction index of different gypsum walls was determined according to EN ISO 140-3[4]. In addition, the loss factor of the gypsum walls was measured according to EN ISO 10848-1[5].

Sound reduction index

For decoupled building elements a lower sound insulation is usually expected because of the reduced energy flow to adjacent structures. Owing to the elastic interlayer one would expect that less energy can flow into the adjacent building elements. This means higher radiation losses and hence a lower sound insulation of the decoupled building elements.

The most common materials for the elastic interlayer are cork, heavy polyethylene foam (density at least 120kg/m³) and bitumen. The 3 to 5 mm thick elastic interlayers are fitted to all edges of the gypsum walls. Figure 2 shows a comparison of the sound reduction index of 100mm thick gypsum walls with a mass per unit area of 90kg/m² decoupled with three different kinds of elastic interlayer, and with a rigid connection of the gypsum wall.

The measurement results show that the application of some elastic interlayers can significantly improve the sound reduction index of the gypsum walls. The highest sound reduction index is attainable using an elastic interlayer made of bitumen.

Figure 3 shows the influence of the gypsum block density on the sound reduction index of 100mm thick gypsum walls which are decoupled by cork interlayer.

With a mass per unit area of 120kg/m² for the gypsum wall the weighted sound reduction index increases by 3dB compared with a gypsum wall with a mass per unit area of 90kg/m² and the same cork interlayer. This improvement is independent of the kind of the elastic interlayer.

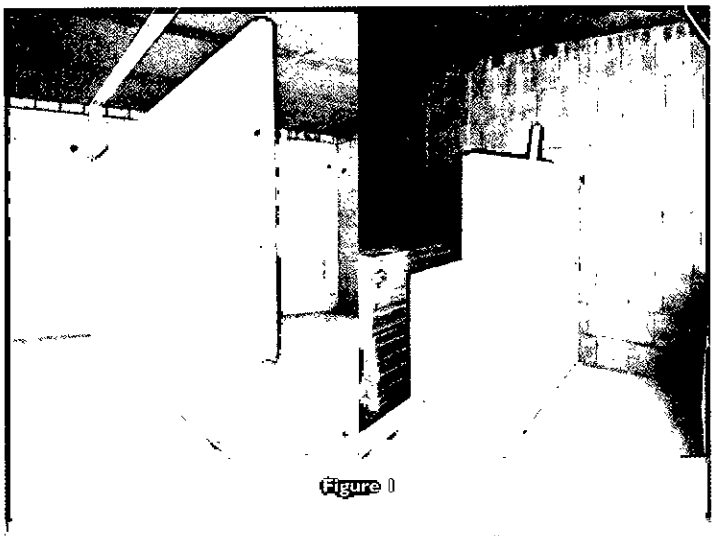

Figure 1

Construction of lightweight gypsum walls

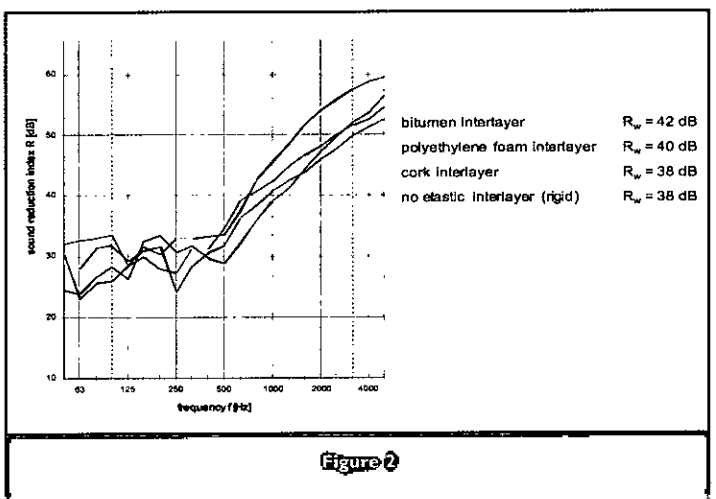

Figure 2

Sound reduction index of gypsum walls with different elastic interlayers and a rigid connection

Loss factor

The loss factor of the different decoupled gypsum walls was determined by measuring the structural reverberation time of the wall. In Figure 4 the loss factors of 100mm thick gypsum walls are shown, with a surface density of 90kg/m² decoupled by the same three kinds of elastic interlayer cork, polyethylene foam and bitumen and a rigid connection to the gypsum wall.

The behaviour of the measured loss factors is analogous to the measured sound reduction indexes. That means the highest loss factor and the highest sound reduction index is achieved by the bitumen interlayer. An interesting point is that the lowest loss factor was measured at the gypsum wall which was connected rigidly to the test facility. Normally one would expect a lower loss factor of a decoupled wall compared with a rigidly connected wall, owing to the reduced energy flow into the adjacent building elements. The measurements showed that this did not apply to the decoupled gypsum walls. Obviously the vibrations of the wall have been damped more by the elastic interlayer than by the energy flow in the adjacent building elements. The

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Direct sound insulation of lightweight solid walls - *continued from page 39*

damping therefore depends on the material characteristics of the elastic interlayer used.

Measurements in buildings

The sound reduction indices of gypsum walls were also measured in different building situations, for example between a bedroom and a living room in the same dwelling. Figure 5 shows the average sound reduction indices measured in several buildings in comparison with the results of the laboratory measurements using the cork interlayer.

The comparison between building and laboratory measurements of the sound reduction index shows similar results especially at frequencies higher than 315Hz. In principle, in buildings with decoupled gypsum walls similar sound reduction indices can be measured to those measured in the laboratory. The consequence for sound reduction index is that no in-situ correction is necessary. The measurements of the loss factor in building and laboratory situations also support this fact: the loss factors measured in the buildings were quite similar to the loss factors which were measured in the test facility.

Conclusions

The use of decoupled gypsum walls as non-structural internal walls in buildings has a number of advantages. One is the improvement of the direct sound insulation by using an elastic interlayer to decouple the wall. With bitumen especially, but also with a polyethylene foam interlayer, the sound reduction index of the gypsum walls can be improved significantly. Owing to the decoupling effect and the reduced energy conduction this would not be expected. Some of the elastic interlayers tested have damping characteristics, and this could be confirmed by measurement of the loss factor.

The results of the sound reduction index from the building and laboratory measurements were quite similar so there is no in-situ correction necessary. The findings of the investigations can be used as input data for the calculation models given in EN 12354-1. Suitable input data are proposed for the future German catalogue of building constructions in the DIN 4109 standard[6]. The sound reduction index of the gypsum wall can be taken directly from the measurement results in a laboratory which are dependent on the kind of the elastic interlayer, and an application of the in-situ correction is not necessary.

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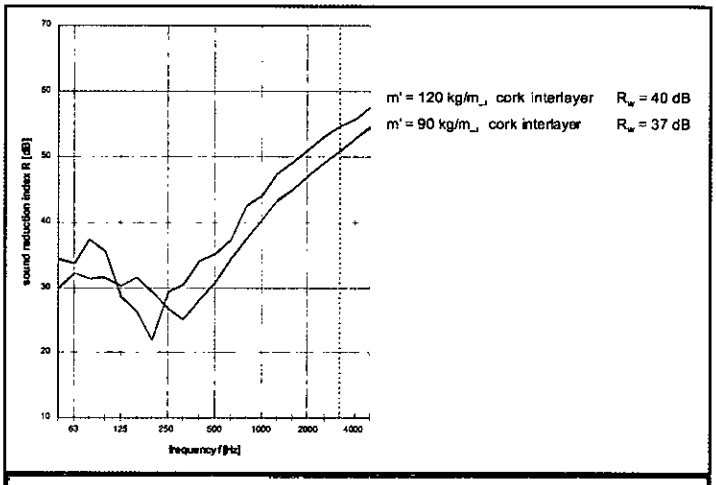

Figure 3

Sound reduction index of 100mm thick gypsum walls with m' = 90kg/m² (mid-density) and m' = 120kg/m² (high density), decoupled by cork interlayer

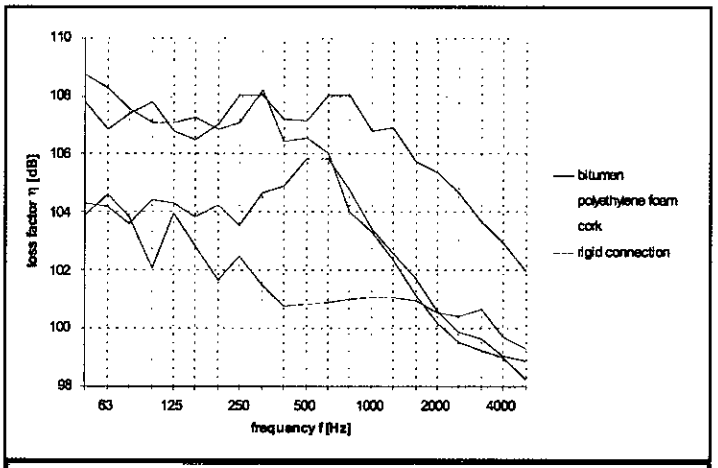

Figure 4

Loss factors of gypsum walls: different elastic interlayer and rigid connection

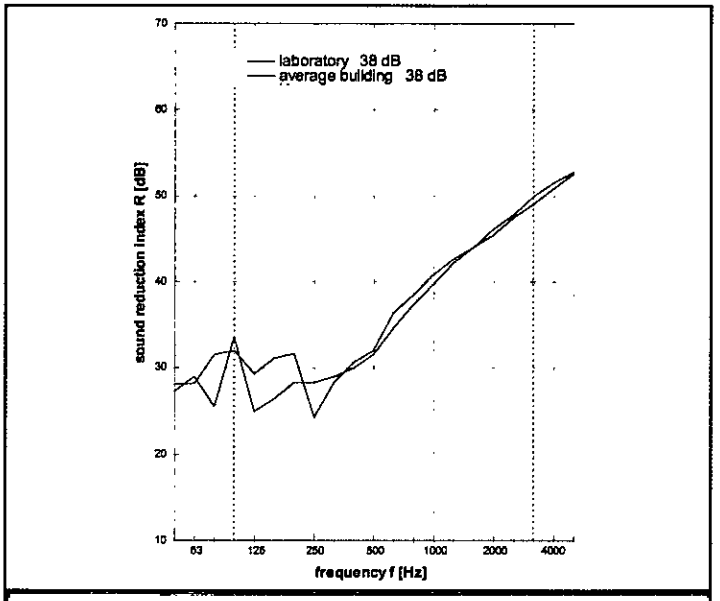

Figure 5

Comparison of sound reduction index measured in the laboratory and in the field

Urban construction sites under noise and vibration monitoring

Christine Aujard, Stéphane Bloquet and Christian Frénéat.

Introduction

Building and public works sites generate noisy activities that can be disturbing for our living environment. Depending on the type of works, requirements and sites under consideration, the quietness of the neighbourhood can be locally affected.

Directive 2000/14/EC relative to noise emissions of outdoor equipment deals with various types of building equipment and machines. Acceptable limits for sound power levels are specified for the main noise sources. Furthermore, based on the Public Health Code, the absence of appropriate precautions aiming at limiting noise and abnormally noisy behaviours can be penalised. Finally, current regulations allow defining acceptable vibration thresholds in order to prevent any damage to the structures and/or works, thus limiting the vibration troubles disturbing the residents.

In order to limit the noise and vibration impact of a building site on the environment, devices monitoring noise and vibration levels are thus often implemented.

The Oper@-NetdB metrological solution, which is based on the issue of alarms when fixed thresholds are violated, allows for a reactive management of the building site impact through the implementation of immediate corrective actions. It also allows providing objective information on the real status of the situation to the residents and to all members of the project team. Various operating examples will be presented in this paper, describing the achievement of building works within a high environmental quality and sustainable development framework.

By nature, building sites generate noise and/or vibration. There is no typical building site: depending on the nature of the works, on the requirement and on the setting, each site is specific. In order to reduce noise and vibration originating from building sites, current regulations rely on a better management of the activities and on the reduction of noise and vibration at the source and during their propagation.

This regulation deals with the sound power levels of the equipment (Directive 200/17/EC) and their environmental impact (Public Health Code). Monitoring noise and vibration levels allows for immediate action instantly limiting disturbance around the building site.

European Directive 2000/14/EC

Directive 2000/14/EC of 8 May 2000 deals with noise emissions of outdoor equipment. Its purpose is to harmonize the national laws of member states regarding noise emission limits, procedures for assessment of conformity, labelling and technical documents. It also deals with the collection of data relative to noise emissions of outdoor equipment and the update of the EC laws in this domain.

The Directive covers various type of equipment that is usually used outdoors, all mobile or movable equipment available on the market or actually being used and thus contributing to the exposure to environmental noise. This includes specific equipment for parks, road works, and also building equipment... The rated sound power level, as well as CE marking guaranteeing the product's compliance with current European standards, must be affixed on the equipment.

Furthermore, national laws penalise any noise that, due to its duration, repetitive character or intensity, may disturb the neighbourhood quietness, during both daytime and night-time.

For instance, in France, Article R1334-36 of the Public Health Code states that:

'If the noise mentioned in Article R. 1334-31 originates from a public or private works building site, or from works relative to buildings and their equipment subject to a declaration or authorisation procedure, the breach of neighbourhood quietness or human health is characterised by one of the following circumstances:

1 *Non-respect of the conditions set by the competent authorities regarding either the achievement of works, or the use or operating of equipment or machines;*

2 *Lack of appropriate precautions aiming at limiting this noise;*

3 *Abn*ormally noisy behaviour.'

This article is used as a 'basis for reflection' when selecting the criteria to set for noises emitted by the building site, but also as a guide for the approach aiming at controlling and monitoring nuisance. The suggested approach must become a 'sufficient precaution' to avoid any 'abnormally noisy behaviour'.

Finally, building sites are also subject to possible by-laws that specify their operating hours in order to prevent noise and vibration pollution, risks and disturbance.

Active and/or passive noise and vibration monitoring

Today, two types of noise and vibration monitoring are used in a complementary way: active monitoring, which leads to a set of actions in real time, and passive monitoring, which is based on the post-processing of long-term information [1].

Active monitoring is based on an approach implying a very short response time for all persons involved in the process. It aims to take into consideration, in real time, sound and vibration levels generated on a site, so as to limit noise and vibration pollution. When a pre-programmed threshold is violated, an alarm is issued and a set of actions is deployed on the site in order to restore the previous 'acceptable' situation as soon as possible. More than a noise and vibration measuring instrument, the monitoring system implemented on the site is a real-time alarm and warning system in case of excesses over sound and vibration thresholds.

The system uses all existing communication means: e-mail, phone, SMS and rotating light. Active monitoring is now widely developed in urban building sites where the works impact is monitored in real time and where the resulting nuisance is therefore very limited. It aims at a better understanding of the situation and the impact of processes on the environment on one hand, and at communicating with the residents on the other hand.

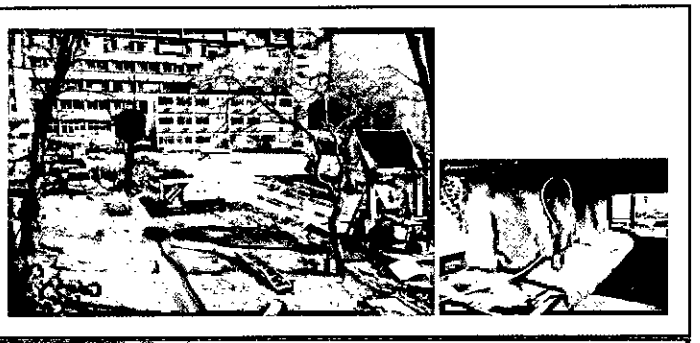

Figure 1

Active noise and vibration monitoring of an urban building site

Passive monitoring relies on an approach the aim of which is to build databases relating to measured environmental noise and vibration and their statistical analysis. It allows assessment of the evolution of the situation over time, as well as the impact of a decision on environmental noise and vibration,

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Urban construction sites under noise ... - *continued from page 41*

Oper@ - NetdB: An optimised metrological noise and vibration monitoring system

The HQE (high environmental quality) label includes an environmental section relating to the equipment and their use on a building site. The Oper@-NetdB solution by 01dB-Metravib [2] addresses fully and in an optimal way the 'noise' issue in this section: it allows the monitoring of environmental noise, warning appropriate persons as soon as noise and/or vibration overexposure is detected and publishing automatic reports on the evolution of the situation on the building site.

As a tool for the assessment and follow-up of local environmental noise and vibration [3], the Oper@-NetdB system relies on new wireless technology to transfer measured information in real time. It is thus possible to monitor the evolution of noise levels at the microphone and accelerometer locations on a computer in a remote office, through a connection to the central database.

Consisting of compact and discreet measurement stations, Oper@-NetdB [4, 5] collects and transfers acquired data to a remote computer for processing, analysis, archiving or publication.

We can now have a real-time knowledge of the environmental noise and vibration on a building site, large or small, with the following features:

- Noise and vibration metrological quality;
- Easy deployment and adaptation to each solution;
- Low cost for each measurement point;
- Operating robustness for continuous use over very long time periods (several years);
- Synchronous data transfer of measured data to a central site;
- Network upgradeability in terms of functions embedded in measurement stations;
- Interfacing with various pieces of equipment, in particular for metrological purposes;
- Remote management of the entire network from the central site;
- Integration of innovative technology, remote wireless and network connections, dynamic databases;
- Openness of decision-making based on the real situation;
- Noise and vibration monitoring contributing to sustainable development and high environmental quality.

The processing of elementary data is performed by the following dedicated application software:

- dB@dmin, for hardware management;
- dBDat@, for the visual display of measured data;
- dBTrait, for sound analysis and expertise;
- dBTrig, for triggering on sound and vibration thresholds;
- dBSurv, for the monitoring of alarms and system operations;
- dBReport, for automatic publication of reports.

A set of fixing accessories for network deployment allows rapid and simple on-site implementation of the measurement system on urban furniture (advertising billboards, lamp posts *etc*) or on building facades.

Some examples of noise and vibration monitoring

Today, building operations relating to new buildings, reconstruction or civil engineering works are carried out by public works specialists who follow good engineering practice. In urban and suburban areas, noise emissions (and vibration transmission) are the main cause of nuisance complained of by residents.

Respect of the neighbourhood's quietness can be demanded and granted by the building owner through a detailed description of the requirements in terms of means and objectives in the particular technical specifications. These requirements are often part of a voluntary approach of the implementation of HQE building sites or 'clean' building sites.

Renovation of a railway station

Active monitoring facilitates optimal reactions from all persons involved. On a station renovation site, each violation of a sound threshold (the daily number of which varied considerably depending on the type of work in progress) resulted in the sending of an email to the site manager and project manager so that operations on site could be changed accordingly (moving a source, modifying a process or a schedule *etc*). Sound thresholds used in active monitoring were calibrated based on on-site measurements carried out before the renovation start (background reference): they dealt with a set of specific acoustic indicators, such as $L_{Amax,1s}$ and $L_{A10,10min}$ sliding, representing the instantaneous sound levels, sound levels integrated over one second and the level reached or exceeded during 10% of the time, integrated over a sliding period of 10 minutes.

Passive monitoring is a mid-term or long-term technique. For the station, it consisted of the collection and monthly analysis of data for each indicator (L_{Amax}, $L_{A10,10min}$ sliding, as well as L_{Aeq} day/evening/night) so as to follow the evolution of these indicators daily, weekly or monthly, along with an expert's advice in case of a recurring problem or progressive drifts that require further analysis.

The purpose of the mixed active and passive monitoring implemented around the railway station under refurbishment was to reconcile the neighbourhood quietness and the progress of the operation on the building site. Thus, in the case of a complaint, recorded data are checked by validating (or not) the cause of action, in a manner fully transparent to the residents. This is a powerful lever limiting the number of complaints. The cost of noise monitoring installations is very low compared with the costs resulting from the shutdown of a building site after a complaint.

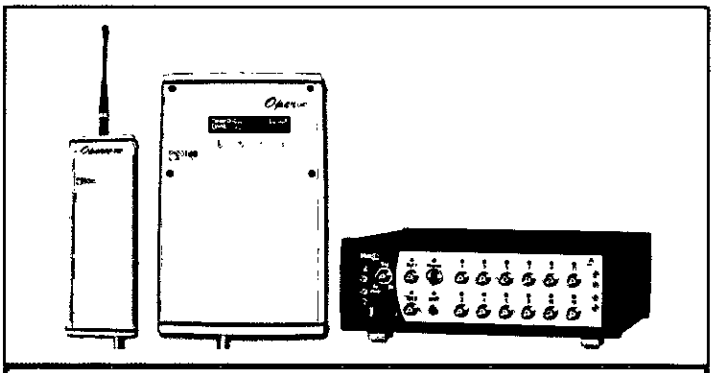

Figure 2

The Oper@-NetdB system

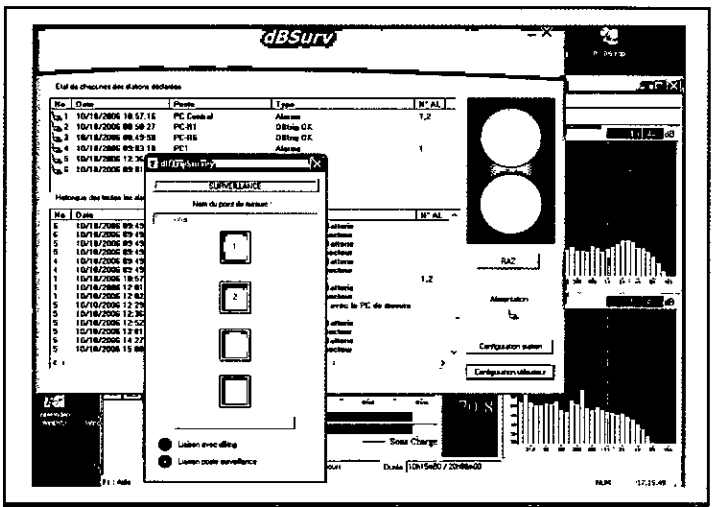

Figure 3

Detection of an overexposure, triggering the issue of an alarm to the building site manager

Refurbishment of a famous school in an urban setting

The objectives of the monitoring are to minimise the impact of the rehabilitation on the neighbourhood, on one hand, and on the classrooms and administration buildings, on the other.

The optimised monitoring system implemented on the site includes:

- a NetdB/Harmonie noise and vibration station, with 4 active measurement channels, installed next to the living house adjoining the demolition area, on a neighbour's property;
- an Oper@EX station located on the facade of the Greta pavilion;
- an Oper@RF station installed on the facade of the classrooms.

The selected follow-up indicators are two-minute sliding L_{Aeq}, vibration levels L_{vib} on the site and at the neighbours, and the daily noise dose. Thresholds that are taken into account differ from one measurement point to another.

The table below indicates the selected values.

	neighbouring building	Greta pavilion	Classroom
metrology	4-channel Harmonie/NetdB	Oper@EX	Oper@RF
orange threshold	L_{Aeq} sliding 2min > 75dB, and L_{vib} site > L_{vib} neighbour	L_{Aeq} sliding 2min > 70dB	L_{Aeq} sliding 2min > 75dB
red threshold	daily dose > 65dB(A), and L_{vib} site > L_{vib} neighbour	daily dose > 65dB(A)	daily dose > 65dB(A)

Table 1

Selected indicators and alarm thresholds

When noise and/or vibration thresholds are violated, the following actions ensue:

- Audio recording for identification of the source;
- Coding of the signal;
- Warning email sent to a distribution list (site manager, acoustician, architect, *etc*);
- Phone call to the site manager.

In order to preserve transparency for, in particular, the teachers and the neighbours, the building site manager must justify all alarms by assigning to each threshold violation the origin of the trouble, along with the identification of the noise and/or vibration source. Furthermore, the site manager acts in real time during the works in order to stop the trouble when the 'orange' threshold is reached, by adapting operating methods. When the 'red' alarm appears, a temporary shutdown of the building site is triggered.

Conclusion

Located in the hearts of cities, building works frequently take place in occupied sites, with neighbouring houses close to the works and local activities that continue during the operations. Noise and vibration pollution generated locally affects the neighbourhood quietness. Noise and vibration monitoring becomes necessary to address this issue.

Directive 2000/14/EC relating to noise emissions of outdoor equipment covers various types of building equipment and machines. Furthermore, the French Public Health Code can penalise the absence of appropriate precautions aiming at limiting noise and abnormally noisy behaviours.

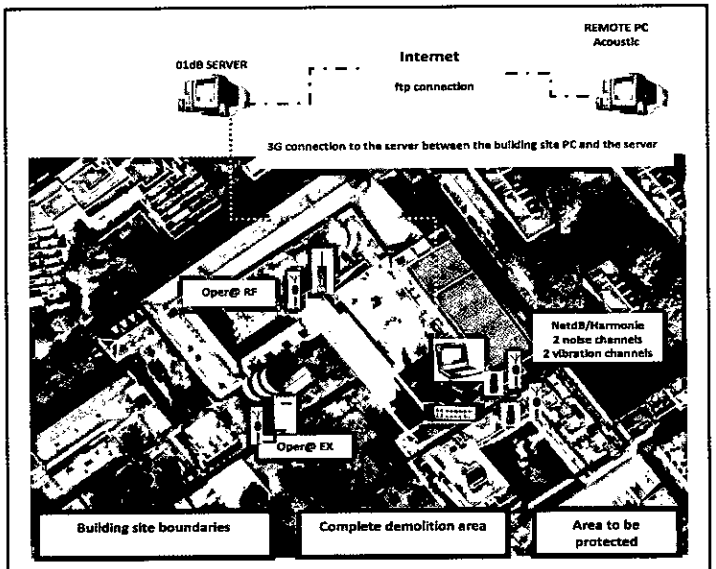

Figure 4

On-site implementation of the Oper@-NetdB monitoring system

An answer to the 'noise' issue of the High Environmental Quality label, the Oper@-NetdB system [6] allows:

- Protection of neighbouring houses, commercial activities, neighbouring computer rooms, engineering structures and buildings located next to the building works;
- The compilation of databases on equipment and machines involved;
- Facilitation of dialogue with residents or local authorities;
- Unambiguous identification of the origin of noise (separating noise attributable to the building site from other noises of external origin);
- Optimisation of organisation, equipment or process selection and making workers aware of the effects of drifts.

Measurement stations and quality control tools specific to building sites help managers and contractors to gain the optimum control of nuisance and mitigation measures.

Christine Aujard christine.aujard@01db-metravib.com, **Stéphane Bloquet** stephane.bloquet@01db-metravib.com and **Christian Frénéat** christian.freneat@01db-metravib.com are all with 01dB-Metravib, 200 Chemin des Ormeaux, 69578 Limonest, France. This article is closely based on their presentation at Euronoise 2009, Edinburgh.

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Open source software for the acoustician

Mikael Ögren.

Introduction

Open source software is rapidly growing compared with traditionally-licensed software. This article describes the basics of open source development of software, which is relevant both for commercial and free software distribution, and gives a compact demonstration of a few programs useful in the field of acoustics. These cover a few different areas such as operating systems (Linux), mathematics related tools (Octave and Maxima), audio processing (Audacity and Nyquist) and GIS (QGIS).

Open source software is essentially software where the source code is publicly available. A more elaborate definition is available from the *Open Source Initative*[1] and the *Free Software Foundation*[2]. This could be compared with making the technical drawings and specifications available for an ordinary product such as a car. It is important to note that open source software is not necessarily free of charge and that companies that work with open source are essentially no different from those working with traditional licence models: they are not adopting open source for ideological reasons or as a charity to their customers. Indeed, software vendors working with open source solutions are among the fastest growing companies[3], and open source software is used in mission-critical roles by many large companies such as Google and Amazon.

The main advantages of open source software development are that the developer can use the growing pool of other open source applications as an inspiration, or simply re-use code from them, and that anyone can make improvements to the code. The main drawback is that it is more difficult for the software developer to make money than with the traditional licences, but not impossible. The successful open source company MySQL estimates that it has approximately 1000 non-paying software users for each paying customer. Still the company thrives, and out-competes many companies that use traditional licensing.

The benefit for users of open source software is mainly the increased freedom of choice and increased competition between vendors associated with the availability of the source code. The users can more easily migrate their data and applications to other software or vendors, since all information about formats and so on can be found in the source code. In a way this is an effect similar to standardisation, since it is impossible to hide information about the inner workings of the system like data formats. Another benefit is shared development and support: since the software is free anyone can get a copy and help out with whatever the user needs. Using an expensive and closed system the user is limited to the official support channel of the vendor.

The topic of this article is open source software useful to the acoustician, and it very briefly describes the Linux open source operating system below. A few examples of software for audio analysis and sound creation and manipulation are given, and later some more general tools for mathematics and science are presented. In the final section, some tools for GIS are presented.

The Linux operating system

The operating system itself is perhaps not central for the typical acoustician, but I will discuss Linux[4] here for two reasons. The first is that Linux has an outstanding support for open source software. All software packages mentioned in this article are accessible from the main Linux distributions via their respective package management software. Installing (for example) Audacity is then as simple as typing the name to search for, selecting it, and pressing install. Any dependencies are automatically handled by the package manager. Most software described in this article is also available for Windows XP and OS X (Macintosh), but here the installation procedures differ and dependencies on other packages may require manual installation and tweaking.

The second reason is that Linux is becoming more and more accepted in the scientific community. As an example there is a Linux distribution called *Scientific Linux*[5] which is backed by many organisations such as CERN and Fermilab. It is packed with software for the scientist such as FEM solvers, CFD systems, mathematical and statistical software and so on. There is also a special initiative aimed at making the Linux kernel (the core of the operating system) better optimised for audio processing (and focusing on low latency). The best known end user system using this approach is Ubuntu Studio[6], which is easy to install and use and is full of software for audio applications.

Even if installing Linux is not a complex task and Linux lives quite happily alongside Windows on your hard drive, you may prefer to use your familiar Windows environment. Most of the software discussed below is still usable, at least if you have Windows XP, and support for Windows Vista is getting better all the time.

Audio software

Audacity[7] is an excellent software suite for creating, manipulating and analysing audio files. There are a lot of similar programs around, but what makes Audacity stand out for the acoustician is the ability to write plug-ins using the lisp variant Nyquist[8]. Nyquist is a lisp dialect for audio processing and includes functions for FFT analysis, filtering, waveform synthesis and much more. I wrote a simple plug-in that calculates the A-weighted level of the selected audio9. Other important strengths of Audacity are the many supported audio formats and the ability to work with different sampling rates and bit depths in many formats. An example of using Audacity to perform spectrum analysis is given in Figure 1.

Mathematical and scientific software

I often stumble across mathematical formulae during my research, and having a good computer algebra system at hand is a great tool. One such system that is open source is Maxima[10], which supports all the manipulations I typically use, from integration and derivation of expressions to plotting a function over a certain interval.

Another fantastic tool is Octave[11], a high-level numerical programming language centred on numerical matrix and vector analysis. The closely related cousin Matlab is perhaps more familiar. In fact, many M-files written for Matlab work perfectly well running under Octave - but not all of them. Octave is easy to use and perfect for generating high quality plots and graphics for academic publication. For audio analysis there are many functions for filtering and signal processing. The graphical capacity of Octave can be extended even further by installing Octaviz[12], which makes it easy to generate three-dimensional graphical output. Figure 2 shows a typical screen running Octave, a text editor for writing an M-file and the graphical output from Octaviz for the calculations performed.

For those of us that only vaguely remember how to design an A-weighting filter or how to process FFT data to third-octave bands, there is a set of filters for Matlab/Octave published by Christophe Couvreur[13]. Another very useful addition to octave is the spectutils toolkit[14] by Kai Lassfolk and Jaska Uimonen, which greatly simplifies spectrogram analysis.

Geographic information system software (GIS)

GIS tools are becoming increasingly important for the acoustician. Extracting data from digital maps and coupling calculation of sound levels with geographical data are two examples of common tasks. There are a great number of formats in which GIS data can be stored, but fortunately many of them are standardised or open, in the sense that the owner of the format has published specifications on how the data can be extracted or stored. But some are proprietary and closed with

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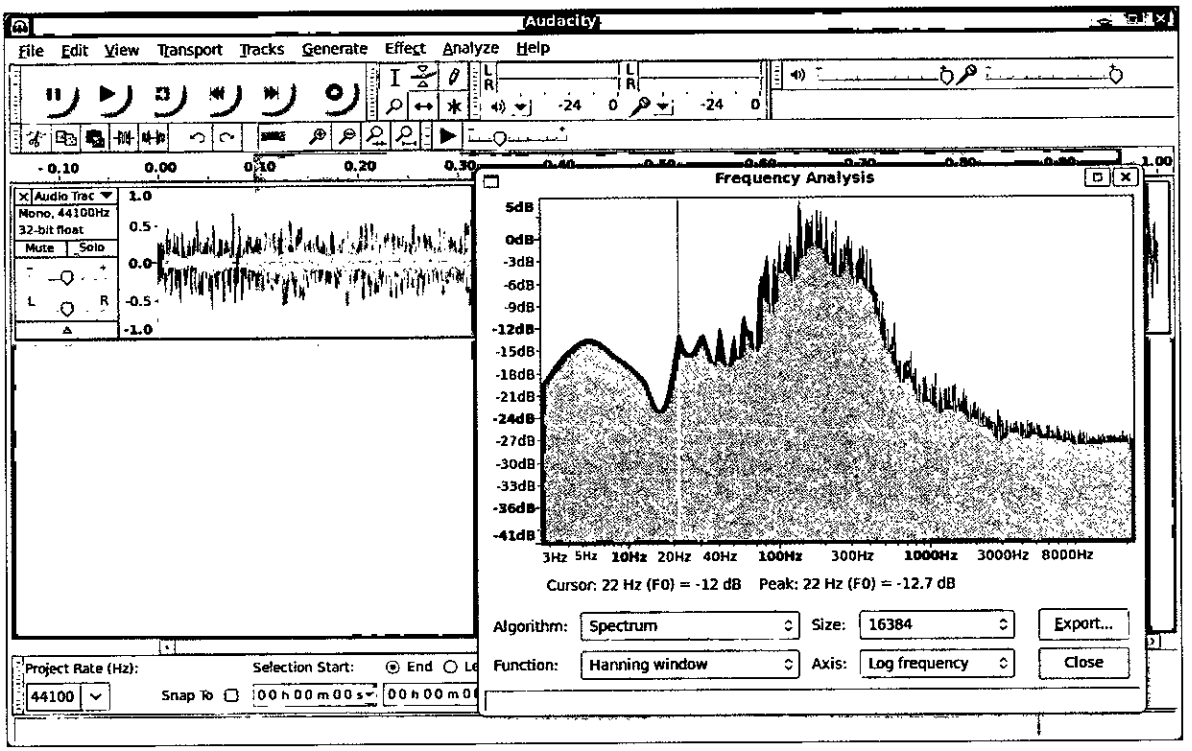

Figure 0

Using Audacity to perform spectrum analysis. Note that you can export the spectrum for use in other applications

Open source software for the acoustician - *continued from page 44*

no option except to use the software that created the data to access it.

A great resource is the *Geospatial Data Abstraction Library*[15] provided by the *Open Source Geospatial Foundation*[16]. The library is intended to be used from other programs, and one such example is the open source Quantum GIS17 (QGIS). QGIS can import many vector and raster based formats, and uses an intuitive graphical user interface for many GIS operations. It can also be extended with small programs called plug-ins. This is excellent for research purposes where essentially any kind of analysis is possible if the user is familiar with one of the many supported programming languages such as C++, Python, *etc.* Figure 3 shows QGIS in action working with noise maps.

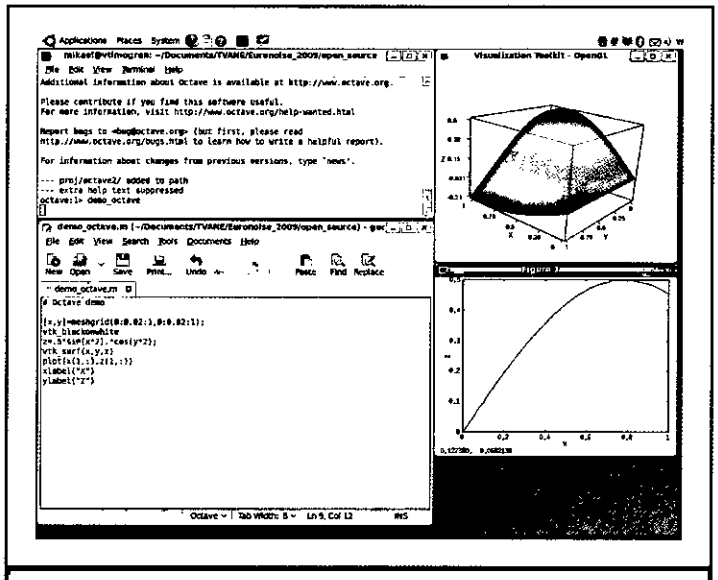

Figure 2

Numerical analysis using Octave and Octaviz

Acknowledgments

Thanks are owed to James B Rawlings, John G Ekerdt and John W Eaton for writing and maintaining Octave, and releasing it using an open source licence. Most of my research from 1998 and onwards has been based on this powerful and versatile numerical software.

Mikael Ögren is with VTI, the Swedish Road and Transport Research Institute, Gothenburg, Sweden: email mikael.ogren@vti.se. This article is an updated version of a paper presented by the author at Euronoise 2009, Edinburgh.

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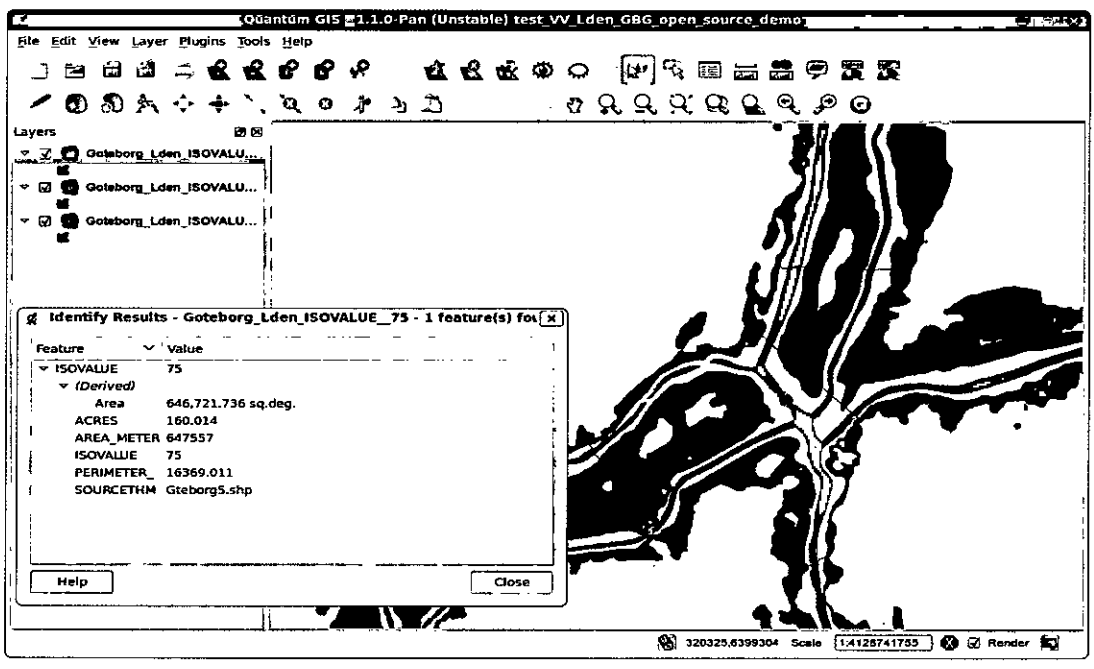


Figure 3

Using QGIS to access noise maps

Brüel & Kjær

Barajas airport noise monitoring

Local residents around the Barajas airport in Madrid can now raise direct alerts about aircraft noise disturbance, as Spanish Airport operator AENA has launched an interactive WebTrak service.

WebTrak is a software tool that displays live flight and noise data from 27 noise monitoring terminals located around Madrid-Barajas airport. It is freely available for public use via the airport's website and allows them to lodge complaints about individual flights. By utilising the same data that the airport has on its noise and flight tracking system, SIRMA, WebTrak helps the airport to engage with local communities over aircraft noise.

As it is also part of the AENA's environmental action plan to reduce CO_2 emissions and noise generated by operations at its airports throughout Spain, the organisattion expects to roll out similar services to other Spanish airports in the future.

Director of Environment for AENA, José Manuel Hesse Martin, said that they were very proud to launch WebTrak; the positive response from the community was demonstrating that they were working in the right way to minimise noise effects and CO_2 reduction. WebTrak was seen as a key part of how aircraft noise from airports was to be managed in the future'.

Madrid is the 46th airport to launch WebTrak and the first to implement Brüel and Kjær's 7804 noise and flight tracking system. This flight tracking software enables the airport's noise monitoring system to correlate aircraft movements with noise events, all recorded via the noise motoring terminals, and track any violations by aircraft or airlines.

The 7804 software also allows the user to analyse the recorded noise data in various ways, such as making a comparative study between two different airlines using similar aircraft at the same airport.

one of the 27 noise monitoring terminals

For more information about WebTrak, contact Brüel & Kjær UK Ltd on
01763 255 780
web **www.bksv.co.uk**
email **heather.wilkins@bksv.com**

Letter: Misrepresentation of acoustical performance

As do most consultants, I spend a small amount of time each week on various manufacturers' web sites looking for various products that might suit a particular problem. I'm sure that I am not the only person to have spotted spurious acoustical performance figures or claims about various products.

Whilst we have the expertise to be able to question, doubt or at least be wary of these claims, the general public does not have this luxury and will often take such information at face value. I have lost count of how many times a customer has said something like 'I've seen this acoustic floor on a web site that provides 50dB of noise reduction'.

Some considerable amount of time is then spent, explaining that there are two sorts of 'noise' referred to when dealing with acoustic floors, and that the figures displayed will refer to the overall performance of the floor structure, not just the final acoustic flooring product. Indeed, the way the figures are displayed will often be a blatant attempt to mislead the customer in thinking that a particular product will meet their needs.

Another trick is used when manufacturers refer to a product being compliant with Approved Document E, without any mention to the fact that it is the **whole** floor construction that may be compliant, or that the product achieved 43dB $D_{nT,w} + C_{tr}$, without mentioning that this is the absolute minimum requirement of Approved Document E and the figure may not be achieved by a similar installation by A N Other.

It seems to me that as a trusted organisation, the IOA has a responsibility to try and educate and persuade manufacturers to be more responsible with the publication of performance figures, so that at least they mention how the figures were achieved or in what context they should be taken.

I wonder if there may be something the Institute could do in relation to this problem, maybe an award scheme of points or stars showing that the company's information is correctly displayed? This could then get the IOA more publicity, in turn helping to promote itself.

Yours sincerely

Mark Page AMIOA
Sound Solution Consultants Ltd

Letter: How up to date are your calibrations?

Many thanks for Glynne Parry for his interesting article in the May/June 2010 issue of Acoustics Bulletin. Perhaps I could add some comments in respect of the of sound level meter standards.

The earlier version of the sound level meter standards did in fact have documents controlling their pattern evaluation. These were issued by the International Organisation for Legal Metrology (OIML) based in Paris, as R58 and R88 respectively. These documents were used by the National Laboratories controlling the approval of instruments, and as part of the process of approving each new design of meter they would normally write the periodic verification schedule for their local calibration laboratories. In the UK we did not take up the pattern evaluation phase of this work but did document our periodic verification requirements as a British Standard. So the situation has, as Glynne says, not changed that much.

I am not sure I agree with the comment that it is 'just possible' to make a sound level meter comply with both the old and new standards. It is actually just a matter of publishing the correct information. Measurements are made for a purpose and they are controlled by a wide range of laws, Government recommendations, Standards, Codes of Practice, *etc* and many of these specify the accuracy of the meters to be used by reference to the standard: and yes, many still refer to the numbers of old Standards. It could be some time before all of these are updated to the new Standard numbers, and bearing in mind that instruments are designed and manufactured for a world market we could be living with dual-numbered instruments for some time yet.

As the new Standard was an amalgamation of two older Standards it was reasonable that it had to have a new number, but that should not of itself blind us to common practicalities of the life of being an acoustical consultant. After all, the sound calibrator standard was substantially revised and only needed its date changed. In respect of conformance testing we manage to live with the differentiation between the 1998 and 2003 versions so I am sure the profession will be able to make decisions with respect to BS.7580 and BS.61672 Part 3 for dual-numbered instruments.

I trusting these observations are helpful.

Yours faithfully

Ian Campbell HonFIOA

Obituary

Andrew Middleton CEng FIOA

Andy Middelton was a former Rolls-Royce engineer, senior consultant and manager of ISVR consultancy services group and director of Anthony Best Dynamics.

He qualified from Southampton University with a BSc in Mechanical Engineering in 1958 and started his professional career at the Rolls-Royce car division at Crewe, working on the development of car suspension and steering.

One of the projects that he worked on was to turn the Austin Princess of the day into a Rolls-Royce. With the help of Andrew's input, the team managed to make a very promising prototype car. But the accountants got involved and managed to unpick all the good work that the team had built into it. Andrew was never a very emotional man but he was very disappointed when the car was eventually released for sale.

Other projects into which he had considerable input were prototype vehicles, one called Burma, which was intended to be a Bentley, and the other called Tibet, which was intended to be a Rolls-Royce. They were the first cars from this stable to have chassis-less construction and independent suspension, both at the front and the rear. It was in one of these prototype cars that Andrew gained the distinction of being one of the few people to be in a Rolls-Royce when it was rolled over during testing at Oulton Park race track (he was not the driver at the time!).

In 1965 RR sent him to Southampton on an MSc course in noise and vibration. He returned to Crewe in 1966 and was promoted to assistant chief development engineer, in charge of a section dealing with noise and vibration and vehicle braking. In 1969 he left Rolls-Royce and took a post as a senior consultant engineer at the Wolfson Unit for Noise and Vibration Control, ISVR Southampton University.

In 1975 Andrew was promoted to technical manager of the Wolfson Unit. His activities included consultancy in noise and vibration control, mainly in the fields of vehicles, machinery, fans, marine installations and petrochemical plants.

He was never happier than when faced with a challenging technical problem which required considerable investigation, patience, persistence, inventiveness and attention to detail. Theses were all attributes he possessed in abundance. He was like a dog with a bone. One example of this was his work on toroidal fans for domestic gas appliances. A toroidal fan is rather like a siren. Andrew's challenge was to make this siren inaudible in a living room, so that it could be used in the British Gas high efficiency condensing boiler. It took him a few years of painstaking development. With a number of technical papers, and a few patents on the way, the objective was achieved, finishing up with beautifully shaped porous silencing vanes and quiet fans that met their objective.

In 1983 an old friend from Rolls-Royce days, Tony Best, had just started trading as a one-man band and Andrew joined Tony in his embryo company. At the time Andy had a much-loved 1957 3-litre Bentley. It was with a very heavy heart that he decided to part with this much loved possession in order to put money into Anthony Best Dynamics Ltd.

At that organisation, Andy was primarily involved in the development of measurement techniques for tonal noise such as gear noise, pump noise, and fan noise. He undertook many consultancy projects including the development of very quiet dynamometers for Froude Hofmann. Many of his ideas still exist in their products. He was also very much involved in opening up overseas markets for ABD.

For some 20 years Andrew was a keen sailor and raced in dinghies such as Mirrors, 420s, 470s and was active in the Weston Sailing Club, being Commodore in 1980-1981. He enjoyed and relaxed with classical music and was a great lover of opera.

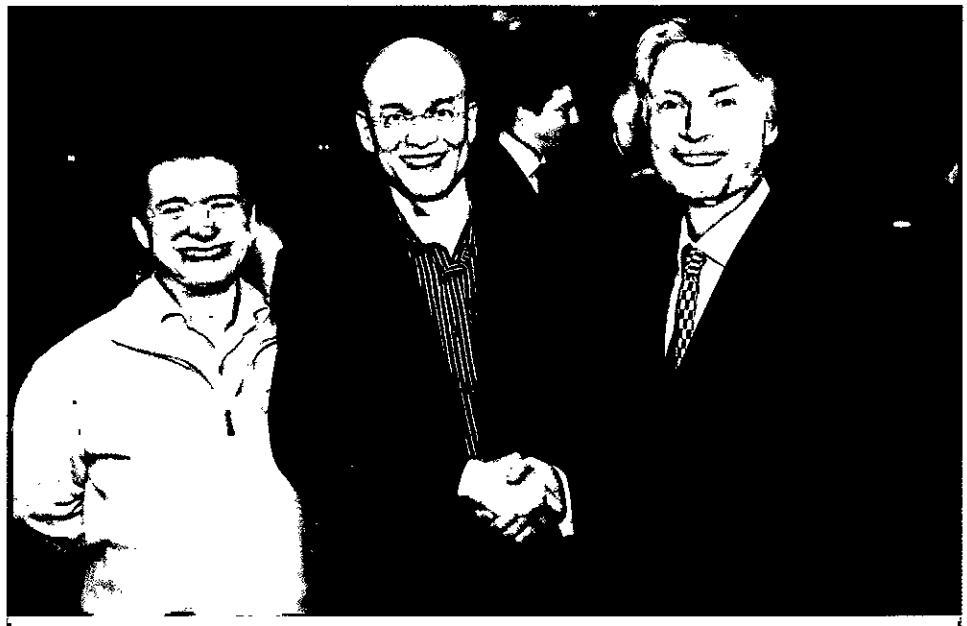
After a two year fight against cancer, Andrew died on 3 March 2010 at the age of 73.

Tony Best and **Peter Wheeler**

RBA Acoustics Prize for Best Dissertation

low-frequency acoustics of listening rooms

Gil van Buuren, a student at London South Bank University, has been awarded the inaugural RBA Acoustics prize for the best dissertation. The prize, which is awarded for, 'Excellence in the study of acoustics and its application to real world problems' was presented to Gil on 25 March 2010. His Masters dissertation was entitled *Parametric studies on the low-frequency acoustics of listening rooms using a numerical wave model.* Russell Richardson of RBA Acoustics commented that he had the pleasure of reading a selection of dissertations and Gil's was the most deserving winner. Gil has kindly donated the prize money to Moorfields Eye Hospital.



[l to r] Stephen Dance, Gil van Buuren and Russell Richardson

Rion NA-37 aircraft noise monitors

A viable and cost-effective alternative

Rion has introduced its sixth generation aircraft noise monitor, the NA-37, to the European market. The NA-37 and its predecessors are widespread in Japan with hundreds of units currently monitoring noise from both civil and military airports. The first few Rion NA-37s are now in service in Europe.

The NA-37 offers some unique features. Aircraft noise is distinguished from other sources of noise by a four-microphone system which identifies the location and direction of travel (in three dimensions) for each noise event. The system can also optionally include an SSR radar receiver. The ability to identify aircraft in this manner can eliminate the need for integration with the airport's radar system, which can be a very difficult task in practice. The ability to identify aircraft without access to the airport's radar system could also be a valuable feature for local authorities or other organisations that have a requirement to evaluate aircraft noise when they have, until now, had to approach the airport for tracking information in order to be certain of the identification of specific noise events. The NA-37 can also optionally make an audio recording (which can either be stored as a wav file or an mp3 file) of each event.

Rion has developed a new outdoor microphone for this application. The Rion MS-11 outdoor microphone and NA-83 sound level meter (part of the NA-37 system but also available separately as a front end to a long-term noise monitoring system) achieve full IEC 61672 Class 1 performance with the weather protection in place. Rion, of course, uses pre-polarised microphones which are inherently more suited to external measurements than pure capacitor microphones. Nevertheless, the MS-11 and NA-83 system incorporates a heating circuit to counteract condensation. The MS-11's remote calibration system is unique. Instead of employing an electrostatic actuator, which could potentially cause damage to the microphone if moisture was present, the MS-11 has an integrated sound source which produces 114dB at 1000Hz at the microphone diaphragm when activated. The microphone capsule itself is geometrically a standard half-inch configuration so a standard calibrator, such as the Rion NC-74, can be used for periodic external calibration.

The NA-37 can be used either as a fixed monitor or a mobile monitor out in the community (but mains power is essential in all practical terms).

The Rion aircraft noise monitoring system contains many features which have been fine tuned over the years to streamline data handling. With Rion's AS-50PA1 analysis software you can quickly see all the noise events (above a user-set event to background noise threshold) or just the aircraft noise events.

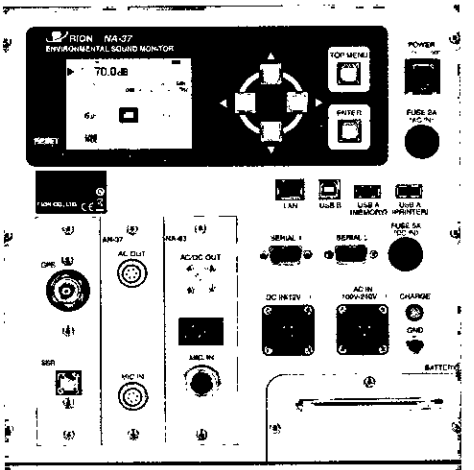
The noise events can be quickly and easily summarised into periodic reports (monthly, daily, annual or a user defined specific period). The software will handle the data from multiple NA-37s from one or more airports. The wide range of communication options make using multiple NA-37s but having all your data in one place (and easily manipulated) a realistic prospect. The system is suitable for use with LAN, wireless LAN or VPN for instance.

At the other end of the scale, clicking on the noise event in the tabulated record of noise events brings up a representation of the time history of the event and a plot showing the location and vector path of the event. Furthermore, if the sound recording option has been installed, the action of clicking an individual sound event will also initiate playback.

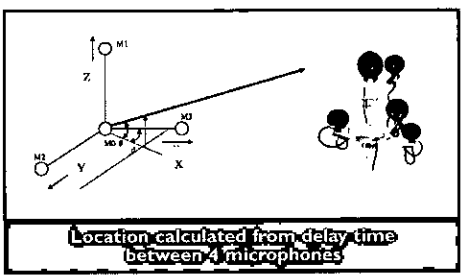
In summary therefore, with the Rion NA-37 and AS-50PA1 software, you can have a system which automatically detects and logs identifies aircraft noise events for one or many monitoring positions which can be evaluated either globally or individually within the Rion software, without the need to interrogate or integrate with the airport's radar records. The NA-37 is available at a fraction of the cost of 'traditional' aircraft noise monitors, and without the requirement to maintain the sometimes problematic integration between the noise monitoring results and the airport's radar, running costs are considerably cheaper too.

For further information contact Mike Breslin **mbreslin@anv.uk.com 01908 642846**.

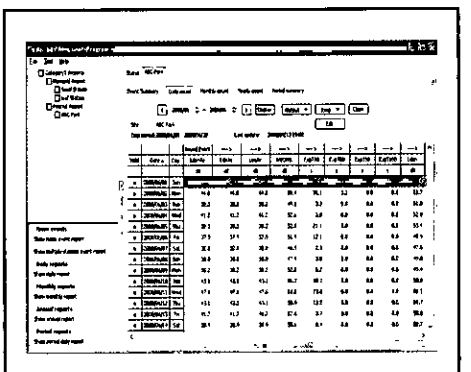
A typical Rion aircraft noise monitor installation



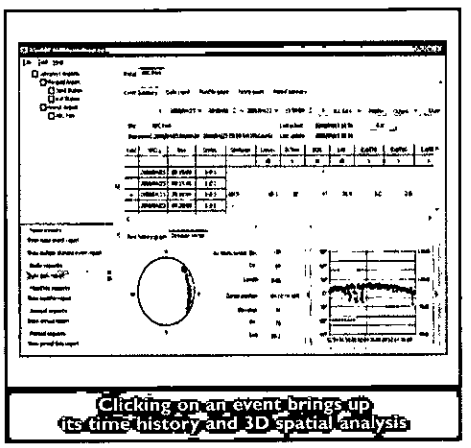
The Rion NA-37 aircraft noise monitor



Location calculated from delay time between 4 microphones



All events or just aircraft noise events are easily listed and periodic reports generated



Clicking on an event brings up its time history and 3D spatial analysis

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Committee meetings 2010

DAY	DATE	TIME	MEETING
Thursday	1 July	10.30	Engineering Division
Tuesday	6 July	10.30	ASBA Examiners
Tuesday	6 July	1.30	ASBA Committee
Thursday	8 July	10.00	Meetings
Tuesday	3 August	10.30	Diploma Moderators Meeting
Thursday	2 September	10.30	Membership
Thursday	9 September	11.00	Executive
Thursday	16 September	11.00	Publications
Thursday	**23 September**	**11.00**	**Council**
Thursday	30 September	10.30	Diploma Tutors and Examiners
Thursday	30 September	1.30	Education
Thursday	7 October	11.00	Research Co-ordination
Thursday	14 October	10.30	Engineering Division
Thursday	4 November	10.30	Membership
Tuesday	9 November	10.30	ASBA Examiners
Tuesday	9 November	1.30	ASBA Committee
Thursday	11 November	10.00	Meetings
Thursday	18 November	11.00	Executive
Wednesday	24 November	10.30	CCENM Examiners
Wednesday	24 November	1.30	CCENM Committee
Thursday	25 November	11.00	Publications
Thursday	**2 December**	**11.00**	**Council**
Tuesday	7 December	10.30	CCWPNA Examiners
Tuesday	7 December	1.30	CCWPNA Committee

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

Examination dates

CCENM - 22 October
CCWPNA - 5 November
Diploma: - 10 and 11 June

Meetings Programme 2010

14 July
Measurement & Instrumentation group
Construction noise and vibration
London

13-14 September
Underwater Acoustics group
Synthetic aperture sonar & radar
Italy

28 September
Noise & Vibration Engineering group
Transportation noise
Loughborough

2-3 November
Building Acoustics Group
Autumn Conference 2010
Birmingham

18-19 November
Electroacoustics group
Reproduced Sound 2010
Cardiff

Further meetings are already planned for 2011 and will be announced shortly.

Further details on all conferences are available on the IOA website **www.ioa.org.uk**

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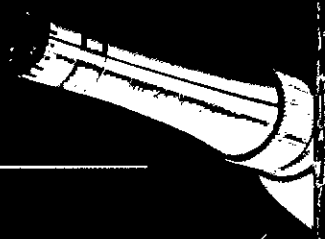

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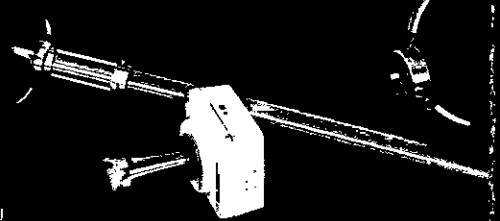

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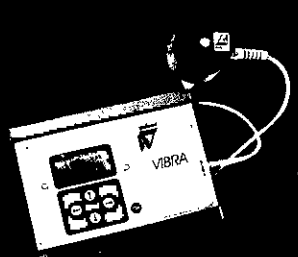

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