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ACOUSTICS BULLETIN



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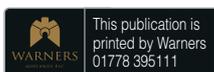
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ACOUSTICS BULLETIN

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Technical articles review procedure

All technical contributions are reviewed by an expert identified by publications committee. This review picks up key points that may need clarifying before publication, and is not an in-depth peer review.

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

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

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The 51st International Congress and Exposition on Noise Control Engineering will be held at the Scottish Event Campus (SEC) in Glasgow on 21-24 August 2022. This is the major international conference on noise control engineering and attracts scientists, engineers and consultants from around the world.
<https://internoise2022.org/>



 Institute of
Acoustics

Leading and supporting acoustic innovation and research...

It's in our name.



After learning about the work carried out by The Warren Youth Project in Hull the team at Cirrus Research, in partnership with The Warren, has completed an investigation into the application of Bradford University's TRAPT (Tranquillity Rating Prediction Tool) to indoor spaces.

For many young people in Hull, The Warren is a place to visit to feel empowered to make meaningful life decisions within a calm and open environment. The young people at The Warren do best when they feel able to relax, learn and be themselves without judgement from others. Therefore, the young people at The Warren thrive with tranquillity.

Tranquil places are important for everyone. They provide the chance to think, recuperate and unwind from the pressures of day-to-day life. Much research has already been conducted into tranquil spaces within smart cities, including the generation of the TRAPT, thanks to work carried out by the University of Bradford.

Following weeks of hard work, the team at Cirrus Research have written up the results of the research into a paper entitled "Bringing the Tranquillity Rating Prediction Tool (TRAPT) Indoors – A Case Study at The Warren, Hull." Senior Engineer, James Oatley, is set to present the paper at this year's Internoise Conference.

More than just being an academic exercise, our research is set to help The Warren improve its facilities. Staff at The Warren hope that soundscapes and visual cues developed through the research partnership will be used to make long-term improvements to the tranquillity of two of its most popular rooms. This will provide its young people with the space they need to thrive and improve the efficacy of the work The Warren's staff do.

Come and see us at this year's Internoise Conference to discover more.

Dear Member

Inter-noise 2022

Towards the end of May, I visited Glasgow with the rest of the Institute's Executive committee to look at the venue for this year's Inter-noise and liaise directly with those who are organising the conference. The complexity of such an operation is jaw-dropping. We have the best part of 800 papers to be allocated over up to 15 parallel sessions across three days. There is the associated accommodation to be sorted out and, this year, the arrangements to record all the presentations and for some of the sessions to be streamed live. The Institute's team of Barry Gibbs, Alistair Somerville, Martin Lester, Bob Craik, Chris Barlow and Allan Chesney have already put in hours of work.

There are also other initiatives with this year's conference, concerning sustainability, the internal soundscape of the general circulation area, and the budding scheme for those who are attending this type of event for the first time and may otherwise find it all a little daunting. At present we have over 600 delegates attending in person with about 160 online. This is looking to be one of the largest attended acoustics conferences since the pandemic.

If you have not already done so, please do register to attend. There will probably not be another Inter-noise in this country for at least 20 years, so it is an opportunity not to be missed. You can read more about Inter-noise on page 37 in this issue.

...and finally

A couple of days before writing this letter I chaired my last Council meeting as President. My term of office formally comes to an end at the next AGM which is being held immediately after Inter-noise on 24 August.

There is the general observation that each President has one big issue to address during their period in the role. Mine was clearly the pandemic. With the support of Council, those who serve on our various committees and the hard work of our HQ staff, we not only came through it, but also grew as an Institute.

One example was the realisation of how online events increase the reach of the Institute to our membership compared with just holding in-person meetings. As I have mentioned before, someone observed that they felt more part of the Institute than before the pandemic struck. The challenge for us now is to find the right balance between fully in-person meetings which have a huge value, beyond hearing the presentations, in terms of networking and talking with other acousticians hybrid meetings which provide the obvious compromise, but are technically challenging, but as we have demonstrated, not impossible to overcome; and the fully online meetings with access for all regardless of where they live or work.

In looking back at the past two years, I am very pleased that we established the Members' Forum sessions. They have evolved over time, initially being



an essential means of keeping us in contact with each other during lockdown to providing opportunities to learn about and discuss current issues. The Institute has also developed with the renaming of the former Environmental Noise Group (to the Environmental Sound Group, chaired by Steve Mitchell) and the formation of the new Sound, Noise and Health Group (chaired by Ben Fenech). We also have our Equalities, Diversity and Inclusivity Group, chaired by Angela Lamacraft, which is an extremely important area of activity for us.

There is a lot going on, including the schools' competition, our on-going STEM outreach, our representation on British Standards committees, our work with UKAN+, our liaison with other professional bodies to develop guidance documents and the work of the Parliamentary Liaison Group. And, of course, there is the on-going essential work in education, engineering, publications, membership and meetings which is so important to us.

I would like to thank all the volunteer members who are involved in some way with the successful running of the Institute. It is essential that we have your support and I would encourage others who are not yet on any committee or working group to consider participating. Not only does it help the Institute, but it also enhances your professional experience.

Finally, my thanks to all the office staff for their hard work on our behalf. Presidents come and go, but you provide the essential continuity, which is absolutely invaluable.

I will of course still be involved with the Executive Committee and Council for the next two years and I look forward to providing what support I can to Alistair Somerville (as our next President) and David Waddington (our next President-Elect).

My best wishes to you all

President

IOA MEDALS AND AWARDS entry deadline

The IOA annually honours people whose contributions to acoustics or to the Institute have been particularly noteworthy.

The medals and awards programme is wide-ranging in its acknowledgment of academic achievement, practical engineering applications and innovations, student achievement, contributions to the Institute and to the world of science and technology.

Nomination forms are at
<https://www.ioa.org.uk/about-us/awards>
all nominations for 2023 Medals and Awards must be received by
1 October 2022

Decisions will be made by Christmas and the winners will be announced early 2023.

The 2023 IOA medals and awards comprise:

- **The Rayleigh Medal**
This is the IOA's premier award, given to persons of undoubted renown for outstanding contributions to acoustics without regard to age.
- **The Tyndall Medal** is awarded biannually to a UK acoustician, preferably under the age of 40, for achievement and services in the field of acoustics.
- **The AB Wood Medal** (USA/Canada acoustician in 2023) is aimed at researchers aged under 40, whose work is associated with the sea.
- **The RWB Stephens Medal** was named after Dr Ray Stephens, the first President of the IOA. It is awarded in odd-numbered years for outstanding contributions to acoustics research or education.

- **The Peter Lord Award** is given annually for a building, project or product that showcases outstanding and innovative acoustic design.
- **The Peter Barnett Memorial Award** was inaugurated in 2001 by the Electro-acoustics Group, to honour Peter Barnett who died the previous year. This award, which is made annually, recognises advancements and technical excellence in the fields of electro-acoustics, speech intelligibility and education in acoustics and electro-acoustics.
- **The IOA Young Persons Award for Innovation in Acoustical Engineering** (sponsored by Cirrus) is awarded every two years and recognises excellence and achievement in acoustical engineering among those who are aged under 35, or early on in their careers in industry.
- **The Sustainability Award** is open to individuals, or teams, who are able to demonstrate and provide evidence of one or more of the following:
 - * An exemplar contribution towards the delivery of sustainability;
 - * Demonstration of value in all three key areas (societal, economic and environmental)
 - * Demonstration of a significant contribution – through education, design, construction practices or guidance – that promotes the implementation of sustainability through acoustics

This award is given on a rolling basis to those who reach the bar.
- **The Award for Distinguished Services to the Institute** was introduced so that the IOA could publicly acknowledge the debt owed to individual members who have provided sustained assistance over the years in some way with the running of the Institute. 🍷

2024 Awards
 Bob Peters Award
 IOA Engineering Medal
 Promoting Acoustics to the Public

More information and nomination forms are at <https://www.ioa.org.uk/about-us/awards>
 Nominations should be submitted by 1 October 2022 to ioa@ioa.org.uk



The deadline for nominations for 2023 Medals and Awards is 1 October 2022, and it's coming up fast.

IOA MEDALS AND AWARDS

Don't miss out, to nominate go to www.ioa.org.uk/about-us/awards



Engineering Division



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By Blane Judd BEng FCGI CEng FIET FCIBSE, Engineering Manager

Engineering Council

The UK Standard for Professional Engineering Competence and Commitment (UK-SPEC)

Fourth edition

Published August 2020

We are now operating a hybrid style of working in the office, which will continue for the foreseeable future. Our next set of interviews will be in July 2022. Candidates are provided with guidance material when they first apply, and we are always ready to comment on the content of their

professional review report prior to them submitting the final draft. Please take the time to study the guidance as it clearly sets out the process you need to go through, what documents are needed, and which items need to be endorsed by your sponsors. It also explains what to do if you cannot find IOA members to act as your sponsors.

All interviews are now conducted using The Engineering Council UK (ECUK) SPEC version 4, which is available from their website here: <https://www.engc.org.uk/ukspec>

Emma Lilliman is doing a great job in working hard to keep response times down to a minimum, but it seems a number of candidates who started the process have **P10**



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stalled in the compilation of their professional review reports. Neil Ferguson continues to help us with academic equivalence support for those candidates who do not have recognised qualifications. You can check for yourself if your qualifications meet the required specification by visiting the Engineering Council website <http://www.engc.org.uk/courses> but please don't panic if your specific qualification is not listed, as we can still help you through the process using individual assessment (see later in the article).

Interviews

For those candidates who have submitted draft reports we are working to get them ready for the next interview dates and we will be inviting our Engineering Council liaison officer, Malcom Carr-West from the Institute of Agricultural Engineers, to sit in.

Two candidates from the last round of interviews have kindly submitted comments on their experience, which you can find on page 12 of this issue. Congratulations to them both on joining the growing number of professionally registered engineers.

We hold several interview events through the year, depending on the number of candidates we have coming forward for registration. If you are interested in taking the next step to becoming a professionally registered engineer, email us at acousticsengineering@ioa.org.uk sending a copy of your CV and copies of certificates and transcripts of your qualifications. It is important that we have all your further and higher education certificates, not just your highest attainment.

There are two routes to registration:

The **recognised qualification** route, if you have achieved the required learning outcomes through recognised qualifications in acoustics. Qualifications which provide the required level of knowledge and understanding are for IEng and accredited Bachelor's

degree and for CEng an accredited integrated Master's degree or a combination of accredited Bachelor's and Master's degrees (see table below).

The **individual assessment** route, for applicants who do not have the recognised qualifications and who will have an individual assessment of their qualifications and any other relevant learning such as: formal academic programmes, in-employment training and experiential learning self-directed learning. In many instances, it is likely to be a combination of some or all these options.

Remember we are here to help you get through the process and advice and support is offered to every candidate personally.

For **individual assessment**, the Institute accepts several courses from certain academic centres in relevant subjects, such as audio technology, as being equivalent to accredited courses for the purposes of EC registration, without the need for further assessment.

The Institute recognises the IOA Diploma course and the several

Master's courses linked to it as providing evidence if you are looking to gain CEng registration. You could also offer a PhD qualification, depending upon the content of the associated taught element. We can also offer support for registration via a 'technical report' route, if you do not have the relevant qualifications to help you demonstrate you are working as a professional engineer in acoustics. If you need to follow the technical route, we will discuss this with you before you embark on that process.

Election process

The election process is overseen by the Institute's Engineering Division Committee, which is made up of volunteers from the membership, to whom we are extremely grateful. They represent the ever-growing number of members holding EC registration. They provide the essential peer review process that affirms that you are at the appropriate level for recognition as an Engineering Council Registered Professional Engineer. ☺

Recognised qualifications

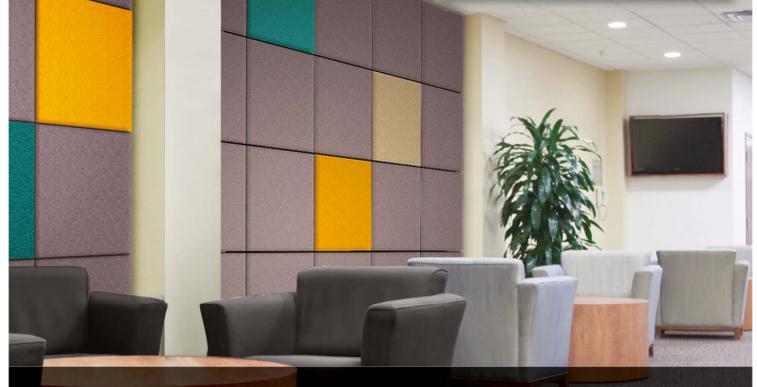
Incorporated Engineer (IEng) One of the following:	Chartered Engineer (CEng) One of the following:
An accredited Bachelor's or honours degree in engineering or technology	An accredited Bachelor's degree with honours in engineering or technology, plus either an appropriate Master's degree or engineering doctorate accredited by a licensee, or appropriate further learning to Master's level*
An accredited Higher National Certificate (HNC) or Higher National Diploma (HND) in engineering or technology started before September 1999	An accredited integrated MEng degree
An HNC or HND started after September 1999 (but before September 2010 in the case of the HNC) or a foundation degree in engineering or technology, plus appropriate further learning to degree level	An accredited Bachelor's degree with honours in engineering or technology started before September 1999
A National Vocational Qualification (NVQ) or Scottish Vocational Qualification (SVQ) at level 4 that has been approved by a licensee, plus appropriate further learning to degree level*	Equivalent qualifications or apprenticeships accredited or approved by a licensee, or at an equivalent level in a relevant national or international qualifications framework†
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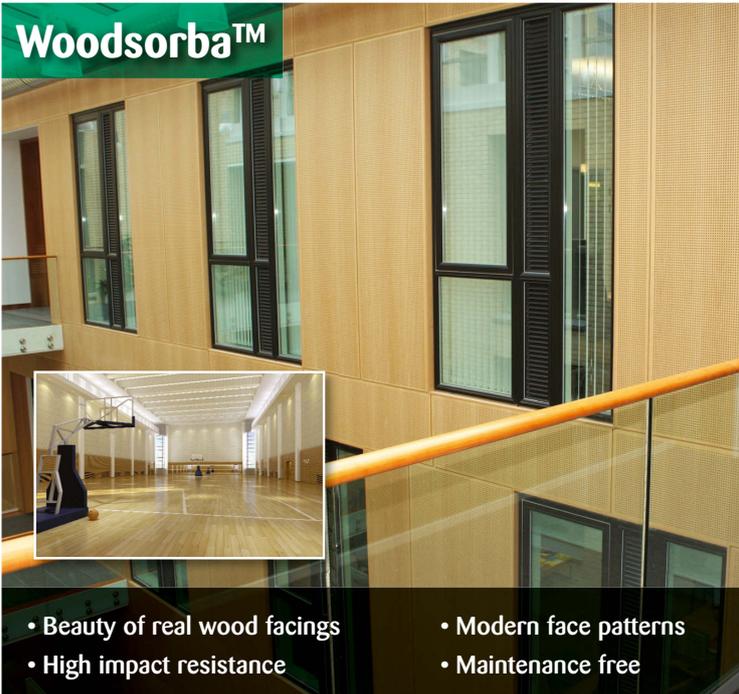
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Engineering Council successful candidates



The Engineering Council is the UK regulatory body for the engineering profession. It holds the national registers of Engineering Technicians (EngTech), Incorporated Engineers (IEng), Chartered Engineers (CEng) and Information and Communications Technology Technicians (ICTTech).

It also sets and maintains the internationally recognised standards of professional competence and ethics that govern the award and retention of these titles. This ensures that employers, government and wider society can have confidence in the knowledge, experience and commitment of professionally registered engineers and technicians.

The IOA is pleased to announce that Oshoke Wil Ikpekha and Adam Woolley have attained the standard required for admission to the national register.

Oshoke Wil Ikpekha PhD, CEng, MIOA

Oshoke works at Ventac & Co Ltd as an R&D engineer where his role principally involves providing technical acoustic knowledge in increasing customer support, developing new and advanced test capabilities, and conducting innovative acoustic research into new materials, products and processes. He received a PhD from Dublin City University (2016) with an interest in underwater acoustics, together with a BEng and an MSc in mechanical and manufacturing engineering. Oshoke is an avid reader and writer and has recently authored the book, 'Home Switch Home', in which he lucubrated Afro-European social-political issues from distinct perspectives.



Reflecting on the process of obtaining his Engineering

Chartership (CEng), Oshoke said: "From the outset of the process, Blane and Emma provided me with the necessary information, documentation and guidance with alacrity. This, ultimately, expedited the registration process and the eventual obtention of my Chartership even with the challenges posed by the pandemic. Attaining the CEng status has helped me efficiently evaluate my CPD in terms of career goals, objectives and plans for the future. With this, I would like to extend my utmost gratitude to the IOA Engineering Team and my colleagues who helped me throughout the process."

Adam Woolley BEng(Hons) IEng

Adam is an acoustic engineer at Thales, working on sonar technology for anti-submarine warfare and mine countermeasures. He joined Thales straight after graduating from the University of Salford in 2018 with a BEng(Hons) in audio acoustics. Outside of Thales, Adam is the IOA's Early Careers Group Secretary and the Early Careers Group Representative for the IOA's Underwater Acoustics Group.



He said: "The process for achieving IEng took a while, but the steps I needed to follow were well explained by the IOA. As well as some easier submissions, such a company hierarchy chart and my development action plan,

I had to produce two reports; one detailing my initial professional development and training and the other detailing my work as an engineer that demonstrated I had the competencies required of an Incorporated Engineer. Keeping a record of my work throughout my career made it a lot easier to write these.

"I had to defend the second report at an interview. The interview was done virtually and was fairly relaxed, although there were one or two unexpected questions such as "how do you follow the IOA code of conduct in your job role?" which caught me off guard. Thankfully, I had five minutes or so at the end of the interview to reflect on my performance while the panel discussed amongst themselves. The panel then gave me the chance to follow up on previous answers and add anything else that I felt would help my case (so I got a second chance at the code of conduct question!).

"My volunteering work as a STEM ambassador then found a way into the conversation, which the panel were most interested to hear about despite the fact I hadn't mentioned it in my report, so perhaps relevant volunteering work that furthers the engineering cause would have been something worth writing about.

"I am grateful to the IOA and to my employers at Thales for supporting me through this process. The qualification of IEng is a mark of professional credibility that I am proud to display after my name. My goal now is to complete my chartership journey and achieve CEng, which I hope to do as soon as I am ready."

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30 years of service, product development and work in standards committees speaks for itself.

Membership statistics

Each year we review the statistics on our various membership grades, group memberships, branch memberships and different areas of employments (interests).

The tables below show last year's composition and include figures for 2020 and 2019. Last year's figures were collated at the end of December.

(Please be aware that individual members can be in more than one group or branch.)



TABLE 1: Membership

Grade	2021	2020	2019
Hon Fellow	34	33	34
Fellow	151	150	156
Member	1911	1861	1854
Associate Member	770	789	791
Affiliate	53	59	70
Technician Member	122	122	129
Student	295	320	340
Totals	3336	3334	3374
Founding Key Sponsor	2	2	2
Key Sponsor	1	1	1
Sponsor	45	51	49
Institutional Subscriber	3		

TABLE 3: Branch membership

Branch	2021	2020	2019
Central	276	283	278
Eastern	282	292	285
Irish	137	142	136
London	959	992	990
Midlands	441	466	467
North West	463	483	481
Overseas	293	309	309
Scottish	199	204	196
South West	323	337	337
Southern	563	575	566
Welsh	96	93	84
Yorks and North East	258	272	265
Middle East	8		

TABLE 2: Group membership

Group	2021	2020	2019
Building Acoustics	1712	1729	1276
Early Careers	466	450	412
Electroacoustics	537	539	525
Environmental Noise	1944	1954	1942
Measurement & Instrumentation	880	882	866
Musical Acoustics	604	609	588
Noise and Vibration Engineering	1380	1403	1367
Physical Acoustics	430	436	408
Senior Members	129	123	120
Speech & Hearing	398	398	384
Underwater Acoustics	341	336	324

TABLE 4: Details of employment (interests)

Employment Category	2021	2020	2019
Architectural Practice	467	477	463
Consultancy	2075	2127	2127
Education	510	528	747
Industry/Commerce	674	711	697
Public Authority	365	382	394
Research & Development	757	792	769
Retired	97	100	102
Other	217	233	224



Sound Masking

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Open plan offices benefit from Sound Masking



Cellular offices achieve better speech privacy with Sound Masking

Sound Masking is a cost effective solution to the problem of improving speech privacy in today's modern office environment. Best installed during office fit out but often installed as retrofit, Sound Masking from AET has improved the office environment for many international companies throughout Europe over the last 20 years.

In today's office speech privacy becomes a key aim and open plan offices can suffer from two speech problems:

- Other people's conversations can be an irritating distraction
- Confidential conversations can be almost impossible to conduct

Similar problems also exist in cellular offices. Apart from noise breakthrough via partitions, flanking over, under and around them, other problem areas include light fixtures, air conditioning systems and services trunking. Sound masking compensates for these problems.

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Women in engineering

As Chair of the EDI (Equality, Diversity and Inclusion) Working Group, and being a woman working in the field of acoustics, I wanted to bring some examples of brilliant women who work in this diverse and dynamic profession to the attention of our members.

By Angela Lamacraft

International Women in Engineering Day took place on 23 June 2022, so this is the perfect time to showcase some of the brilliant women engineers working in acoustics. We will publish more of their profiles in subsequent issues of Acoustics Bulletin, but for now, we introduce Dr Hasina Begum and Nina Cherian.

Dr Hasina Begum



Dr Hasina Begum has recently completed her PhD from the University of Sheffield looking at acoustic insulation of pipes using aerogels. She now works as a project engineer looking at the flow monitoring and system maintenance of wastewater in pipes using dual-purpose fibre optic sensing technology. Throughout her academic career she has been involved in public engagement across the UK, encouraging young people, particularly women of minority groups, to pursue careers in STEM. Dr Begum loves

to empower and inspire the next generation of scientists and believes that significant change begins at the grass roots and through creating platforms for open discussions in smaller, less-progressive communities. She aspires to be a role model and a voice for the underrepresented, breaking barriers and succeeding as a Muslim woman in engineering. "Growing up, there were never any women in engineering that looked like me. I want to change that, so that hopefully, young girls can look at me and say I want to be just like her, or better yet, even better than her!"

Nina Cherian



Senior acoustics engineer, Nina, always enjoyed physics at school but was not inspired by the idea of traditional mechanical engineering degree. Whilst researching her options, she stumbled upon an acoustical engineering course, which intrigued her. Before she knew it, she says, she had applied and graduated from the University of Southampton with an MEng

and has been working within the building acoustics team of Hoare Lea in London ever since.

During this time, Nina has worked on numerous projects, primarily within the residential, office and education sectors; both new-build and refurbishment. She enjoys working within the construction industry, learning how things are built, and contributing to how people will experience these spaces. She has gained an appreciation for the extent of commitment and collaboration required from all engineers to design and build a good and functional space.

Her time at multi-disciplinary consultancy firm, Hoare Lea, has allowed her to learn from and appreciate fellow engineers. Working with colleagues from different disciplines has also enabled her to provide a more cohesive solution to any engineering problem at hand.

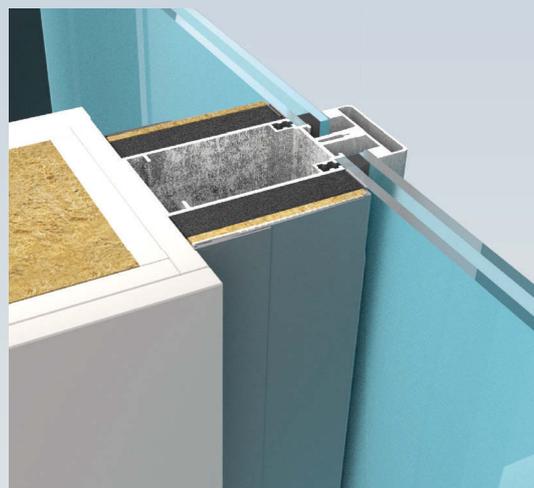
Nina said: "Unlike some of the other consultants within the industry, as specialist engineers, we have the opportunity to work on various projects in a very short amount of time. This is an aspect I enjoy as it allows me to develop different skills and keeps day-to-day life interesting." 🌀

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Government policies

The IOA continues to actively monitor developing noise policy across the UK government administrations. Members of our working groups respond to relevant government consultations; highlighting areas where acoustics issues should be considered. In addition, we keep our ears to the ground for any policy developments of relevance to acoustics professionals. Mary Stevens, IOA Policy Support, reports on the most recent activity.

New police powers on noisy protests

The Police Crime and Sentencing Act received Royal Assent on 29 April 2022. The majority of provisions in the Act cover England and Wales only. Following much discord in debate on the noise provisions in the Lords, who repeatedly voted out clauses referencing noise levels in protests, they were finally accepted as time ran short. The Home Office has now published factsheets explaining the provisions in the Act. The fact sheet on noise-related provisions states: *"This measure has nothing to do with the content of the noise generated by a protest, just the level of the noise."* It goes on to explain that the Act will allow police to place conditions on public protests and processions where noise generated by that protest may cause serious disruption to the activity of an organisation in the vicinity or have a significant impact on people nearby. The Home Secretary has a power, by regulations, to further define the meaning of serious disruption and provide further clarity to police in the use of these powers – and will work closely with the National Police Chiefs' Council, the College of Policing and other policing partners to produce guidance on the use of these new measures. The factsheet goes on to state that police will only be able to impose conditions on unjustifiably noisy protests that may have a significant impact and that the threshold for being able to impose conditions on noisy protests is appropriately high and that the police will only use it in

cases where it is deemed necessary and proportionate.

See the full factsheet at: <https://tinyurl.com/7vrsmdvy>

Acoustic camera trials

Four areas across England and Wales are set to trial new acoustic camera technology to help clamp down on unnecessary engine revving and illegal exhausts. MPs were invited to submit applications to trial new acoustic cameras in their local area at the end of April.

The trial, led by the Atkins-Jacobs Joint Venture, is formed by the two professional services firms to provide technical consultancy including acoustics expertise, design, modelling and asset management. Technology used in the trial provides real-time reports that police can use as evidence – supporting targeted enforcement methods to crack down on noisy motorists. <https://tinyurl.com/bdt8xtxz>

Noise and vibration issues delaying armoured vehicle programme

Ajax armoured vehicles ordered by the Ministry of Defence in 2010 have been plagued by as yet unresolved noise and vibration issues – resulting in injury to servicemen. The House of Commons Committee on Public Accounts has looked into the issue and reported their findings.

Problems with the vehicles were first identified two years ago, and the Ministry of Defence said Ajax's safety problems had highlighted broader issues around noise-induced hearing loss, which formed the largest number of claims in the armed forces compensation scheme.

The Committee considers that as a matter of the utmost urgency, the Department must establish whether noise and vibration issues can be addressed by modifications or whether they require a fundamental redesign of the vehicle.

Read the full report at: <https://tinyurl.com/yx329c59>

Welsh Housing Standard

The Welsh Government is consulting on a Housing Quality Standard to improve the standard of social homes. Consideration of noise nuisance is one of a number of new considerations that have been added to the standard. Criteria include minimising exposure to noise, and impacts to physical and mental health resulting from exposure to noise inside the home caused by lack of sufficient sound insulation or within its curtilage. The draft standard states that design and construction of homes should protect the occupants from ordinary domestic noise from one home entering another, and from traffic or other ambient external noise. Measures proposed include appropriate glazing and siting plumbing away from separating walls and avoiding bathrooms above living rooms and bedrooms.

Read the Standard here: <https://gov.wales/welsh-housing-quality-standard-2023> 



About the author:

Mary Stevens supports the IOA to bring acoustics to the attention of policy makers.



experts in acoustics for industrial applications

Whether it's reducing dangerous noise to meet **Control of Noise at Work Regulations** or ensuring noise pollution falls within the **Pollution Prevention and Control Regulations**, CMS Danskin Acoustics have the products, knowledge and experience, from offshore platforms to power stations, oil refineries to cement mills.

Damping Sheet

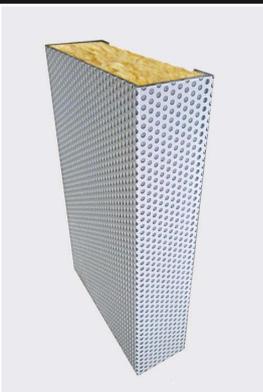
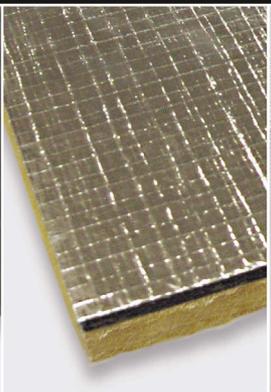
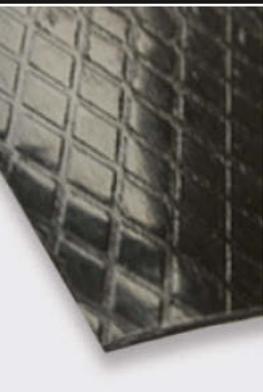
SuperLag

Plant Room
Wall Lining Panels

SuperPhon Hardface

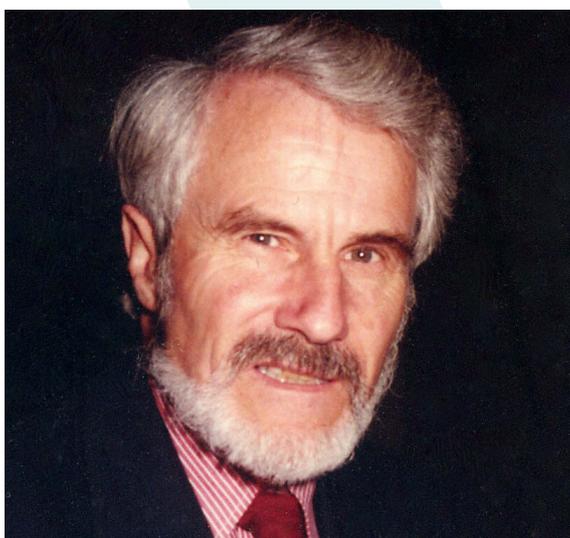
Quietslab Laminate

WB Barrier



Frank Fahy, 1936 – 2022

Frank Fahy, who has died at the age of 85, was Emeritus Professor of Engineering Acoustics at the Institute of Sound and Vibration Research (ISVR) at the University of Southampton.



Above:
Frank Fahy

His diverse interests in acoustics and vibroacoustics led to him being awarded the Tyndall Silver Medal (1982) and Rayleigh Gold Medal (1990) by the Institute of Acoustics, of which he was an Honorary Fellow and a member of Council for 10 years. International recognition included the Médaille étrangère from the SFA, the French acoustical society, for Anglo-French collaboration (1994) and the Helmholtz Medal of DEGA, the German acoustical society (2008) for 'Outstanding contributions to research and education in engineering acoustics'.

He had an inquisitive mind and insatiable appetite for knowledge, with an enthusiasm for both theory and experimentation, as expressed in his Helmholtz medal address: 'it is very important that engineers and their managers should be fully aware of the need to validate theoretical models with experimental data'. His ability to

explain complex technical ideas clearly led to him writing numerous books, five as sole author and six as co-editor, which have been widely read and are of lasting importance to the world of acoustics.

Personal background and early years at ISVR

Born in London in 1936, Francis John Fahy, better known as Frank, was proud of his Irish ancestry going back many generations in West Connemara. He studied aeronautical engineering at Queen Mary College, London, and started his career at the Aircraft Research Association in Bedford in 1958, where projects included studies on the aero-elasticity of the wing for the Concorde aircraft.

He joined the ISVR at its inception as a Research Fellow in 1963. He worked initially on turbulent boundary layer noise in Concorde, but after a while he was not happy with the project. Professor Elfyn Richards, founder and Director of the ISVR, told him to do whatever research interested him; so, he started work in the new area of Statistical Energy Analysis (SEA). He was appointed to a lectureship in 1966 sponsored by the Central Electricity Generating Board, leading a team investigating acoustic fatigue in nuclear power stations. This led to six PhD theses over the following decade, including his own on SEA published in 1969.

As a lecturer, Frank was noted for his energetic style and infectious enthusiasm for acoustics, something that was a fundamental part of his character and inherent in everything he did. His 'acoustic circus', a box of gadgets demonstrating

various acoustical curiosities and making various interesting noises, was regularly used to illustrate talks and engage the attention of his audience.

Contribution to acoustics

Frank's interest in all aspects of acoustics is amply demonstrated by the diverse content of his monograph *Foundations of Engineering Acoustics* (2000), which was a course book for students of acoustics in the ISVR and around the world.

One of his most notable contributions to acoustics was the development and standardisation of the sound intensity technique to measure the sound power of machinery. He started this pioneering work in 1973, using two closely spaced microphones and analogue technology to measure the flow of acoustic energy in a sound field, which culminated a decade later in him being invited to chair the International Organization for Standardization working group on measurement of sound power using sound intensity. This resulted in ISO 9614-1:1993 (BS 7703) and ISO 9614-2:1997. One of his best known books, *Sound Intensity*, was first published in 1989.

The successful publication of ISO 9614 provides an excellent example of how Frank's mastery of both experimental work and theory enabled him to achieve practical outcomes of lasting importance; in this case the possibility of measuring the sound power of a machine *in situ*, under less than ideal conditions, such as in a reverberant factory surrounded by other noisy equipment.



Left:
As a lecturer, Frank was noted for his energetic style and infectious enthusiasm for acoustics

bowling and Neil Halliwell as wicket keeper. He was known for perfecting a particular shot that became known as 'the hoik', which was basically a wild swipe that sent the ball over deep mid-wicket.

Frank retired from the ISVR in 1997 and moved to the village of King's Somborne near Romsey, where he was active as a Parish Councillor, member of the cricket team and tennis club, and an enthusiastic allotment holder. He stayed in touch and helped organise the symposium celebrating the fiftieth anniversary of the ISVR in 2013, and wrote a brief history of the ISVR for *Acoustics Bulletin* (Vol 39 No 1) in 2014. There is no doubt that he liked to see his name in print and was particularly amused that a local press item on the theft of vegetables from his allotment was picked up first by the UK national press, and then by many other newspapers around the world.

His legacy

Frank will be remembered around the world for his technical achievements in sound intensity and modelling of sound-structure interactions, but it is particularly his many books that provide a lasting legacy for the future. For friends and colleagues closer to home he will stay with us as an indefatigable enthusiast in everything he did. He is survived by his second wife of 44 years, Beryl, as well as four children, Paula, Hugh, John and Tom, from his first wife Jill, his eldest son, Adrian, having died in a tragic flying accident.

Malcolm Smith and Mike Lower ISVR Consulting, May 2022

Below:
Frank with Beryl on his retirement



Contribution to vibroacoustics

Of equal importance was his contribution to the field of sound-structure interaction, which is where he started with his work on Concorde. Vibroacoustics is a natural extension of SEA and was the topic of his first book, *Sound and Structural Vibration: Radiation, Transmission and Response* (1985), which was updated and republished with Paolo Gardonio in 2007. His outstanding ability to visualise wave interactions in fluids and structures, and to interpret dispersion curves that control the interaction of waves propagating at different speeds, meant that he could readily carry out thought experiments to guide practical investigations. His deep understanding of how to apply the principle of reciprocity to both acoustics and vibroacoustics was also invaluable for many studies.

Frank's interest in SEA lasted throughout his career, describing it as a "wolf in sheep's clothing" in a talk to *Euronoise 95*. He collaborated closely in the development of theoretical and experimental SEA methods with researchers at Southampton and Cambridge universities, government research laboratories and commercial software developers. In 1994, the Royal Society published his paper *Statistical energy analysis: a critical overview* and he co-edited the proceedings of the *IUTAM Symposium on Statistical Energy Analysis* which was held in Southampton in July 1997.

Other significant books include *Fundamentals of Noise and Vibration* with John Walker (1998); *Advanced Applications in Acoustics, Noise and Vibration* (2004), and *Fundamentals of Sound and Vibration* with David Thompson

(2015). He also published the monograph *Air: the Excellent Canopy* in 2009.

Consultancy and collaborations with industry

Beyond his research and teaching, Frank also greatly enjoyed working on practical noise control engineering projects with industry, as well as the design of more than 20 theatres and auditoria and many other acoustical design problems. With his quick intellect he could always be relied upon for at least one (and normally several) well-informed opinions on a diverse range of problems. His early work on acoustic fatigue in nuclear reactors led naturally into investigations of flow-induced vibration of piping systems for the oil and gas industry, and the transmission of turbulent boundary layer noise and jet noise into aircraft and spacecraft. He was a model for how academics could and should collaborate with industry.

Frank as a character

Although this obituary inevitably concentrates on Frank's technical achievements, for anyone who knew him it would be incomplete without reference to his ebullient character. Hilarious stories of his enthusiastic participation in ISVR Christmas shows, concerts, sports days and staff-student cricket matches abound, and are part of the history of the organisation. Frank notably captained the University of Southampton Academics Cricket Club, the 'Accies' with Phil Nelson opening the

The authors would like to thank the many friends and colleagues of Frank who provided anecdotes, comments, recordings and papers, and particularly Phil Nelson and Maureen Mew who were respectively ISVR Director and departmental secretary for many years.

THE JOHN CONNELL INNOVATION AWARD 2022

The IOA is sponsoring the John Connell Innovation Award again this year and they are now open to enter.

The John Connell Awards, were launched in 2000 by the Noise Abatement Society (NAS). They recognise and promote innovative ideas and solutions from local authorities, industry and individuals who have made a positive impact to reduce excessive noise to support health and well-being and improve the aural environment.

The Awards are named after NAS's founder, John Connell OBE, who lobbied the Noise Abatement Act through Parliament in 1960 when noise became a statutory nuisance in the UK for the first time. These awards, known as the 'Noise Oscars', acknowledge

the importance of the quality of sound in our lives, and champion vital advances in reducing the negative impact of unnecessary noise for the public benefit.

The John Connell Innovation Award is for:

(a) new or enhanced product(s), programmes or solutions demonstrating significant technological, managerial and/or process advancement; and/or

(b) organisations demonstrating a history of sustained innovation across product line(s) to resolve noise problems.

The submission should describe:

1	The degree of innovation, technological advancement and sustained commitment to reducing noise through product, programme and/or services development	12 points
2	Placement of the solution in the business context: i.e. how it helps to achieve sustainability targets and lower noise/improve the soundscape	3 points
3	Any additional social, environmental and economic benefits achieved	3 points
4	Evidence of overall solutions and impact including:	
	a) target and desired goals and outcomes	4 points
	b) measurement against agreed standards	4 points
	c) effectiveness in mitigating noise/improving the soundscape	4 points

Total possible points: 30

To enter

Entries should be submitted to johnconnellawards@noise-abatementsociety.org by **Friday, 16 September 2022**.

The shortlist will be announced on **Tuesday, 27 September 2022**.

Shortlisted entrants will be invited to the awards ceremony on **Wednesday, 19 October 2022** where the winners will be announced. ©

The John Connell Awards 2022 will be held at the Palace of Westminster, on Wednesday, 19 October 2022. They will be hosted by Sir Peter Bottomley, Member of Parliament for Worthing West and Father of the House.
<https://noiseabatementssociety.org/campaigns/john-connell-awards/>

See the 2021 award winners here:
<https://noiseabatementssociety.org/campaigns/john-connell-awards-2021/>



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- Environmental Noise: Measurement, Prediction and Control
- Noise and Vibration Control Engineering

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FOR MORE INFORMATION:

www.ioa.org.uk E: education@ioa.org.uk T: +44 (0)300 999 9675

Institute of Acoustics, Silbury Court, 406 Silbury Boulevard, Milton Keynes MK9 2AF



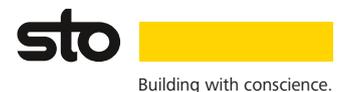
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Find out more about achieving perfect acoustics design.

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Approved Membership Applications

The Membership Committee reviewed 56 application forms on 19 May 2022 at their meeting held at the IOA HQ, as well 18 through the fast-track route for non-corporate applications. 30 corporate applications have recently been approved by the Council following the recommendations of the Membership Committee. 44 new members have joined the IOA, the remaining are members who have upgraded. The Committee also welcomed a new sponsor.

FIOA

Joseph Cuschieri
Philip Evans
David Owen

MIOA

James Allen	Charlie Jones
Krishna Balamurali	James Keegan
Imran Bashir	Alec Korchev
Daniel Bhatt	Nicolas Lum
Spyros Brezas	Gergely Orosz
Bo Ding	Dominic Perrett
Yevhen Fridlib	Alex Priestley
Man Kit Fung	Naveen Simha
Malvina Gjura	Paul Snaddon
Colin Gummer	Claire Starley
Stephen Hale	Davide Vinci
Michael Hartley	Lewis Wheatley
Jack Holmes	Peter Wheeler
Oshoke Ikpekha	

AMIOA

Badruddin Abdul Khadar	Luke Hine
Martha Bird	William Lowe
Julia Chieng	Justyna Lubas
Jack Collins	Joseph Mosley
Jonathan Croft	Jack Parrott
Angela Diaz Mena	Daniel Reeves
Btissam El Qouatli	Rebeca Sanchez Villalobos
Samuel Forrest	Henry Stead
Milo Fox	Mathew Vaughan
Daniel Hare	Ashley Willis
David Harrold	

TechIOA

Neil Forsdyke	Nicholas Mitchell
Charlotte Maxwell	David Waidson

Affiliate

Luke Barraclough	Gwilym Phillips
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Enhance your career prospects in acoustics

The IOA runs a range of certificated short courses nationwide, assessing competence in the areas shown. The courses run twice a year at accredited training centres across the UK (courses are held prior to exam dates and usually run for around five days).

To find out what's right for you and where in the UK the courses are running, contact the IOA at:

Silbury Court, 406 Silbury Boulevard
Milton Keynes MK9 2AF
Telephone: +44 (0)300 999 9675
education@ioa.org.uk
www.ioa.org.uk



- Workplace Noise Risk Assessment
- Environmental Noise Measurement
- Building Acoustics Measurement
- Occupational Exposure to Hand Arm Vibration
- Anti-Social Behaviour (Scotland) Act 2004 - Noise Measurements



IOA Events for 2022/3

IOA events 2022

Joint event with the University of Salford and UKAN+
Virtual Acoustic Prototyping: methods for predicting noise and vibration in complex structures

17-19 August 2022

University of Salford Research Centre

<https://bit.ly/VirtualAcousticProto>

Inter-Noise 2022

21-24 August 2022

SECC, Glasgow

<https://internoise2022.org/>

Organised by the Electroacoustics Group
Reproduced Sound 2022 (Auralisation and Personalisation – Beyond Reality)

15-17 November 2022

The Bristol Hotel, Bristol

<https://reproducedsound.co.uk/>

Organised by the Musical Acoustics Group
New Developments in Musical Acoustics

19 October 2022

Birmingham City University

<https://www.ioa.org.uk/civircrm/event/info?id=734&reset=1>

IOA events 2023

Organised by the Underwater Acoustics Group
5th International Conference on Synthetic Aperture in Sonar and Radar

6-8 September 2023

Villa Marigola, Italy

<https://www.ioa.org.uk/civircrm/event/info?reset=1&id=718>

11th International Conference on Auditorium Acoustics

28-30 September 2023

SNFCC, Athens Greece

<https://www.ioa.org.uk/civircrm/event/info?reset=1&id=717>

Other events 2022

IMA Maths in Music Conference

13-15 July 2022

Royal College of Music London

<https://ima.org.uk/18115/ima-maths-in-music-conference/>

12th Ibero-American Acoustics Congress

28 August-31 September 2022

Florianopolis, Brazil

<https://www.fia2022.com.br/ingles/index.php>

Other events 2023

NOVEM 2021 (Noise and Vibration: Emerging Methods)

Now 10-12 January 2023

Auckland, New Zealand

www.novem2021.ac.nz

Acoustics 2023

International Convention Centre Sydney (ICC Sydney)

4-8 December 2023

<https://acoustics23sydney.org/>

For up-to-date information visit www.ioa.org.uk

ANC Awards & Conference 2022

Don't forget to enter your projects into the **ANC Acoustic Awards 2022**.

These awards are scheduled for **13th October** – and now is the time to start thinking about submitting your entries.

You could be a winner, like these from 2021... www.theanc.co.uk/anc-awards/results-2021/

The Awards look for projects which demonstrate delivery of value and quality for the client, go beyond current good practice, justify how any problems were overcome and show creativity and innovation.

Size and prestige of the overall project are not significant as these awards recognise the acoustics consultancy within the project.

2022 Categories

- **Acoustics for Inclusion** (sponsored by Cirrus Research)
- **Building Acoustics** (sponsored by Getzner)
- **Environmental Noise: Non Infrastructure** (sponsored by CDM Stravitec)
- **Environmental Noise: Infrastructure** (sponsored by ANV Measurement Systems)
- **Innovation** (sponsored by AcSoft)
- **Vibration Prediction and Control** (sponsored by CMS Danskin)
- **Smaller Consultancies**

The **closing date** is midnight on **5th September**.

More details will follow on the ANC website:

www.theanc.co.uk/anc-awards-2022/

ANC ACOUSTICS & NOISE CONSULTANTS

Changes at the IOA Early Careers Group

In January, the Early Careers Group committee elected Josie Nixon to steer the group for the following two years, so my term as Chair of the Group has come to an end and I stepped down at the June 2022 quarterly meeting.

By Tom Galikowski, ECG past Chair

Left:
Josie Nixon, the
new Chair of the
Early Careers Group



It has been my utmost pleasure to chair the group during the past two years. I have met a lot of passionate, dedicated and knowledgeable people who made my task significantly simpler and very pleasant. Despite the pandemic, the group has grown – both in terms of numbers, representatives and recognition within the industry – with new initiatives in the pipeline aimed at keeping and accelerating this growth further. It was a privilege to chair the group during these exciting and unusual times. I wish Josie, the Committee and the entire Early Careers Group all the very best of luck.

Josie Nixon

Josie originally studied geography at Leicester University (2011) and lived in Vancouver for a year as part of her undergraduate programme. She then studied for a Master's degree in human geography at Bristol University (2012). She completed the IOA Diploma in 2017 and a Master's in environmental and architectural acoustics at London South Bank University two years later.

Before she took over as Chair, Josie was the ECG representative for the Eastern region, a position which she had held since 2018. She is active within the Eastern branch inviting presenters to meetings and participating in discussions.

She works for a small acoustic firm and has a personal interest in aeroacoustics, specifically drone noise. Josie has presented internationally (remotely) at the I-Ince Quiet Drone Symposium in Paris in 2020 and at Inter-noise Washington in 2021.

Within the ECG community, Josie has helped to arrange and co-present events/webinars, she has written articles for Acoustics Bulletin and is currently helping to coordinate student representation. She also helped organise the Art of Being a Consultant mini-series last year and helped to organise the 2022 one-day event.

Josie plans to continue the webinar series and also promote the integration of the UK Acoustics Network Early Career Group with the IOA ECG, creating a viable forum to encourage and engage practitioners with the research community.

Having worked with Josie over the last couple of years, I can say with absolute certainty that the Early Careers Group is in good hands.

Early Careers Group webinar – 'Getting chartered as acoustic consultant'

As part of the ECG webinar programme, James Hill from Apex Acoustics presented a fantastic

episode in May on how to gain engineering chartership. The online event was attended well with more than 50 participants. Josie Nixon (HA Environmental) reports:

The talk took us through the application process, the UK specification competencies required, and described the difference between a chartered and an incorporated engineer. James outlined the competencies required for IEng and CEng and discussed the different types of projects that would sit under both categories.

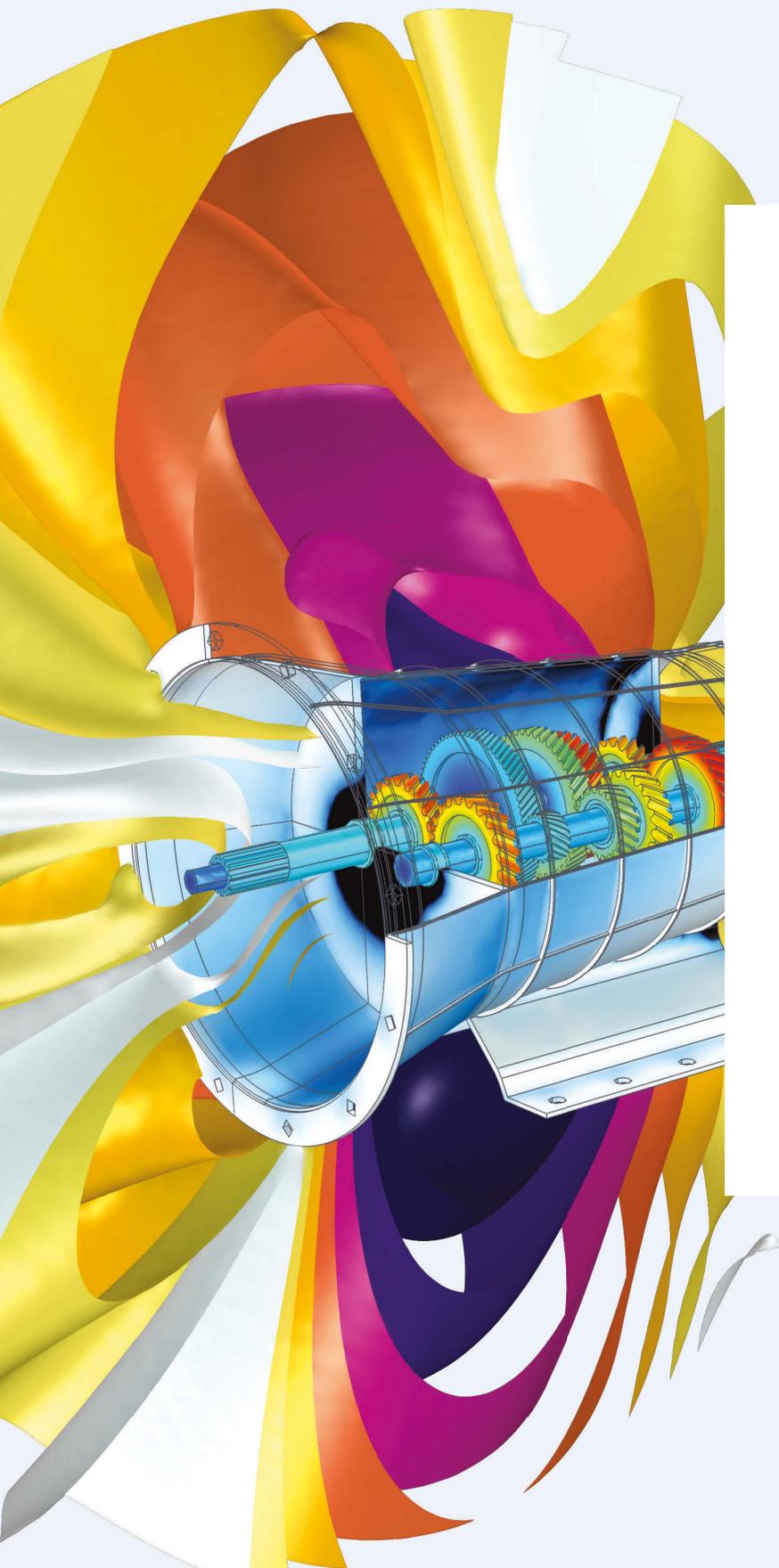
The definitions of CEng and IEng

The Engineering Council defines the two as:

Chartered Engineers develop solutions to engineering problems using new or existing technologies through innovation, creation and change and how they may have technical accountability for complex systems with significant levels of risk.

Incorporated Engineers maintain and manage applications of current and developing technology, and may undertake engineering design, development, manufacture, construction and operation.

James explained how, as consultants, we often struggle with the Chartered Engineer definition as we often work within guidance and regulations. Therefore, it can be felt to be harder to give examples of solutions and innovation. Typically, people applying for IEng/CEng would expect to be in a more senior roles within acoustics that **P28**



SIMULATION CASE STUDY

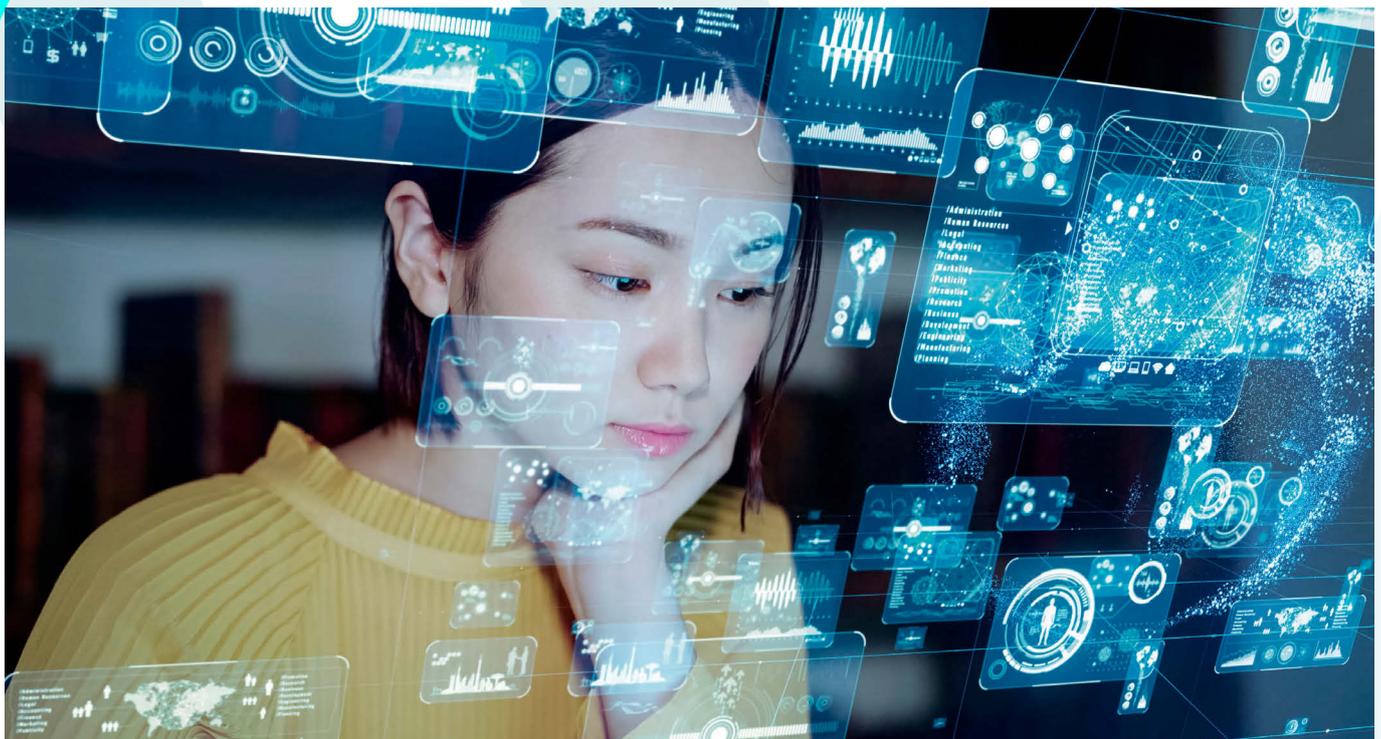
How noisy is this gearbox design?

Building quieter transmission systems starts with designing quieter gearboxes. Noise, vibration and harshness (NVH) testing is an important part of the process, but you are not limited to conducting physical experiments. To improve gearbox designs well before the production stage, you can perform vibroacoustic analyses using simulation software.

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come with a degree of autonomy which is needed to fulfil requirements of the CEng application.

There are two routes to chartership, one is an educational competence route, and one is a professional competence route. The 'non-standard' route tends to be the route people take when they do not have a relevant degree. (See more on page 8 of this issue.)

Hints and tips

James gave a couple of really useful hints in his talk. One of which was based around project examples, he said: "The jobs where lots of problems come up, or you have to think outside the box, are the better projects to use to demonstrate some of your competencies." He stated that candidates tend to shy away from talking about the 'problem' jobs, but he demonstrated how they could be used in a useful and constructive way to highlight the use of problem solving and innovation in a positive way. James had another great suggestion when talking about competences, he said: "Where you can't show leadership and teaching in a day-to-day role, getting involved in working groups are a great way to help show skills'. (There are a number of working groups within the IOA and UKAN.)

The event was fantastic at giving information on how acoustic

Above: The ECG webinar – 'Getting chartered as acoustic consultant' outlined the competencies required for IEng and CEng and discussed the different types of projects that would sit under both categories

"The jobs where lots of problems come up, or you have to think outside the box, are the better projects to use to demonstrate some of your competencies"

consultants can gain Chartership, as many consultants can find it difficult to meet some of the requirements due to job roles, so examples were given with how knowledge could be interlaced or aspects of roles utilised to meet certain criteria.

The importance of this webinar and people's enjoyment was clear during question time, as I think it was the best discussion we have had yet.

Thank you, James!

ECG vacancies

There are ECG vacancies at Central Branch, North West, Sound and Health and Physical Acoustics Group – if you are interested, please get in touch with the ECG or the relevant groups directly.

Come and join us

The IOA's Early Careers Group aims to bring together a diverse network of acoustic professionals in the early stages of their career. This is by promoting peer knowledge sharing and support, and providing a link to the knowledge of established acousticians and a platform for the continuing development of new and existing skills. The ECG is open to all members of the IOA (both corporate and non-corporate) who shall normally be under 35 years of age or within first five years of their career. The group is always keen to hear from members and non-members alike.

As well as being a good introduction to the IOA, the Early Careers' Group organises a variety of activities, such as social networking events, presentations and architectural tours.

To join the Early Careers Group, to find out more information or to ask questions, visit <https://www.ioa.org.uk/early-careers-group> ©



The Mobile Binaural Family

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Binaural recordings wherever you go: Combine our portable measurement units and highly-accurate binaural recording systems for smart recording and playback. Enjoy easy operation and reproducible aural accuracy.

The IOA Stammering Support Network

The IOA Stammering Support Network, in association with STAMMA (The British Stammering Association) aims to provide a place for professionals involved in acoustics across the UK who stammer, to come together in a mutually supportive environment.

By David Yates, Director of Acoustics at Syntegra Group, and Co-Chair of the IOA Southern Branch

We invite fellow acousticians who also stammer to discuss concerns they may have about carrying out their role, where speech may be an important aspect. Through sharing our experiences and insights we hope to provide support to acousticians in all levels of their career where there may be some challenges around speaking fluently.

The group is also open to those involved in acoustics who wish to seek advice in respect of stammering for an employee, colleague, or even friend or family member. All those who stammer are different and it may be that the best

Below: By sharing our experiences and insights we hope to give support to acousticians where there may be some challenges around speaking fluently

thing we can do for an individual is to signpost them to the most useful information on the STAMMA website www.stamma.org.

A little about me – I am acoustic consultant with more than 10 years' experience. I serve on the IOA Southern Branch committee and I am also active on ANC committees. I have stammered most of my life and have slowly gained greater fluency. I am now confident in meetings, addressing groups and giving presentations – but it has taken a while to get to this stage!

I have worked with STAMMA on several occasions throughout the years; having been featured in a book about stammering when I was a teenager, and then

presenting at the launch event at the British Stammering Association (BSA) conference in Leeds. I had two articles published in the BSA magazine, Your Voice, while I was at university.

EDI

I was inspired to create this group in response to the IOA's focus on equality, diversity and inclusion and have the support of both the IOA and STAMMA for this support network. I would have liked a place to go to be with likeminded professionals at times in my career for support with my speech, and I assume other acousticians who stammer would have too, so I am hopeful this group can fill that support gap for us all.

For support if you need it

The support network is set up as a private group in LinkedIn. The group will remain unlisted so that it does not appear on members' profiles, to allow discretion on the subject for those who require discretion. To gain access to the group the easiest way is to connect with me on LinkedIn www.linkedin.com/in/dave-gates-acoustics) and send me a private message, I can then invite you to join the group. 📍

STAMMA, the British Stammering Association, is dedicated to creating a world where people who stammer are able to fulfil their potential and enjoy respect and consideration.
www.stamma.org





IOA Equality, Diversity and Inclusion Working Group and Early Careers Group



Inter-noise 2022 Buddy Scheme

Nervous about attending Inter-noise 2022? Or keen to help people that are?

The IOA, EDIWG and ECG are putting together a Buddy Scheme for Inter-noise 2022. This scheme is to enable people who are not confident about attending the conference ('buddies') to have a point of contact ('mentor') throughout the conference, starting with the breakfast on the first day.

Each mentor will be grouped with two buddies. Where possible, buddies and mentors will be grouped

according to language requirements and specialist acoustic interests, if desired. Registration details for buddies and mentors are being finalised and will be communicated by email from In Conference Ltd, the conference organising company, to people registered for the conference.

For more information please visit: <http://internoise2022.org/buddy-scheme>

In Conference Ltd, Unit 1, Q Court, Quality Street, Edinburgh, EH4 5BP
Tel: +44 (0) 131 336 4203 Email: internoise2022@in-conference.org.uk
<https://internoise2022.org/>



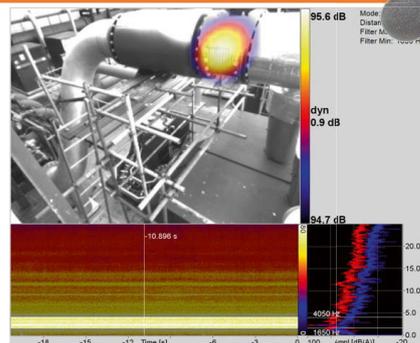
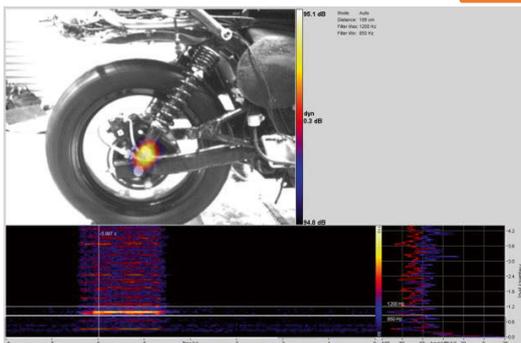
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Equality and inclusion in the IOA – the path to success

By Adam Lawrence, Associate Acoustician at Atkins

A small online survey of IOA members allowed them to describe their experiences of discrimination and their positive experiences in overcoming barriers in this area. This article reports five anonymised stories to increase awareness of discrimination that has occurred.

All the negative stories described started with the attitudes and behaviours of individuals. All respondents felt the need to modify their behaviour to minimise the impacts of the situations; most saying that people should be clear and honest about the situation and that discrimination should never go unchallenged.

We feel more positive and empowered to work when we are able to be more ‘ourselves’ and when differences are treated positively. There are clear benefits to open discussions between people and we must all recognise that there is often no single right answer. The general consensus was that things are improving, but slowly.

When people choose to listen, they improve their knowledge and understanding. This improvement encourages changes in behaviour, leading to reductions in barriers in the workplace and society. Reducing barriers helps people to contribute their best and feel accepted. The ultimate goal must be a world where everyone can excel and this will contribute to an equal society.

1. Introduction

The IOA Equality, Diversity and Inclusion (EDI) working group was set up to support all aspects of equality, diversity and inclusion across membership. The starting point for the group is to consider the UK Equality Act 2010¹ which provides protection against nine

characteristics. Wider society often portrays people who identify with these characteristics unfavourably, and part of the journey towards inclusion is improving awareness to help understand how people feel when they are treated unfavourably. Whilst the author is an acoustics consultant by profession, he has experience reporting the experiences of people with disability. He has the rare neurological condition, Hereditary Spastic Paraplegia (HSP), and conducts an annual online survey for people around the world with HSP². He is also Chair of the HSP Support Group³, a charity providing support to people with HSP in the UK, he is co-chair of the Atkins Enable staff network for people with disability⁴ and a member of the IOA EDI working group⁵.

2. Protected characteristics

The UK Equality Act 2010 prohibits direct and indirect discrimination, harassment and victimisation. It also prohibits discrimination in relation to a person’s disability and creates a duty to make reasonable adjustments for disabled people. The nine characteristics are:

- age;
- disability;
- gender reassignment;
- marriage and civil partnership;
- pregnancy and maternity;
- race;
- religion or belief;
- sex; and
- sexual orientation.

3. Survey details

A short online survey was set up with 13 questions, people could answer as many or as few as they wished and give details of positive experiences, negative experiences, barriers and challenges.

Although it was a small sample size, five members gave answers to these questions, allowing some experiences to be highlighted. It is considered that the sample size is too small to undertake any analysis or statistics. Table 1 identifies the number of respondents who identified with each of the Equality Act protected characteristics.

Characteristic	Respondents
Marriage and civil partnership	3
Sex	3
Age	1
Disability	1
Pregnancy and maternity	1
Religion or belief	1
Sexual orientation	1
Gender reassignment	0
Race	0
None of these	0

Above: Table 1: Number of respondents identifying with protected characteristics

All respondents identified with between one and four characteristics each. No respondents identified with the characteristics of gender reassignment or race. **P33**

References

- 1 Equality Act 2010: <https://www.legislation.gov.uk/ukpga/2010/15>
- 2 Blog: A Journey to HSP: <https://hspjourney.blogspot.com/p/my-on-line-resarch.html>
- 3 UK HSP Support Group: <https://hspgroup.org/>
- 4 Atkins staff network: <https://careers.snclavalin.com/equality-diversity-and-inclusion-uk-europe>
- 5 Meet the EDI Working Group, Acoustics Bulletin, Volume 47 No. 6 pp: 30-34 (November/ December 2021) ISSN 0308-437X



architectural acoustic finishes

SonaSpray fcx in the Hard Rock Hotel, London.

"Our experience over the years teaches us that architecture & interior design are so much more than just looks. We consider every factor with each project we work on & acoustics is no exception.

We knew we needed a premium acoustic product that would also work with our designs, which is why we chose Oscar Acoustics."

David Mason, Director of Scott Brownrigg Architects.



OSCAR
acoustics



4.Importance of characteristics

Respondents were asked how they find these characteristics influence their behaviour or decisions at work.

Sex

Two respondents, both female, noted that sex had played an important part at times. One commented that they have felt under-valued as a woman, resulting in them keeping their thoughts and ideas to themselves. Another noted that they felt frustrated that their ideas were not listened to properly until a male also felt the same. A consequence is that one respondent perceives their confidence to be lower than that of a younger man with less experience.

Age

One respondent noted that age is often associated with experience, and consequently people often put higher value on the opinion of an older person. They felt that they have had to work harder to prove the value of their ideas, opinions or innovations.

Pregnancy and maternity

One respondent said that they had delayed telling their colleagues about their pregnancies as long as possible because they felt that disclosing this would have an impact on their opportunities at work.

Marriage and civil partnership

One respondent noted that they felt their work-life balance had improved after getting married.

Positive stories

All respondents gave an example of positive stories and experiences.

Sex

One respondent moved jobs and now works for a company with a female managing director. With the move, this respondent has never felt so supported or valued, and now feels happy, comfortable and good at their job.

Another respondent says that they now feel like an equal, noting

that things are better than they used to be since teams aren't now just full of men. They feel part of the community and are able to contribute.

Age

One respondent has changed roles within their company to one more aligned to their skillset, allowing them to promote innovation and technology. They now feel elated, empowered and motivated to succeed.

Sexual orientation

One respondent has found they have been able to work with people with shared experiences through network groups and LGBT+ allies. This has given them surety that their experiences are valid, and they now have confidence to call out inappropriate behaviour.

Disability

One respondent with cognitive deficits noted that meeting formats had been adjusted to allow for focus breaks and memory breaks. This made them feel encouraged and welcome in the meeting.

Supporting behaviours

All respondents described behaviours which helped in their positive experiences. They all noted that open and honest communication was important. For some; it has been having shared conversations and understandings with others, for others it has been the openness of colleagues to listen, understand, and discuss in an accepting way.

Long-term views

Two respondents thought that their experiences were one-off or isolated, one thought that they happened to be in the right place at the right time to capitalise on their situation. One respondent thought that their experiences were starting to become the norm.

Negative stories

Disability

One respondent gave two separate stories, noting that they have had negative experiences on many occasions. Their disability means that they have to stop driving from time to time. They note that it is common for others to feel that one

cannot pursue a full career without the ability to drive. In senior or principal roles the respondent has encountered negative attitudes from employers about this, which attitudes have caused them to leave their job.

Their disability also results in neurological limits, with communication issues at times, which others have had difficulty understanding to be real. The respondent takes action to explain their situation when it is relevant, and their abilities quickly become limited if reasonable adjustments are not made. Over time their behaviours have changed: they no longer conceal their condition, and they explain their needs. They feel they are now more assertive.

Pregnancy and maternity

One respondent noted that they had been promised a promotion to a more senior position before they had announced their pregnancy. The promotion was due to start during their maternity leave, but did not happen, resulting in meetings with HR once back at work to receive the promotion and have the salary increase backdated. Their manager had a bad attitude towards their pregnancy, made discriminatory comments, and assumed that the respondent would not be as committed to their work now that they had a child.

During subsequent pregnancies they have held meetings with (now different) managers to be clear about their expectations and likely changes. Whilst their subsequent managers have been more supportive, they have still received inappropriate comments about pregnancy and maternity leave whilst at work.

Marriage and civil partnership

One respondent noted that before they got married, they were managing an offer which they completed and sent to the client, who sat on it and took no action. A few months later there was an internal call about the project and a director made discriminatory comments about this person, asking them why the contract was not signed and inferring to the whole team that this was related to them having been on their honeymoon.

The respondent felt that this was very personal and unprofessional, and raised this with the overall project manager, but doesn't know if any action was taken. They are now more guarded when working around that individual.

Sex

One respondent was working in a senior role for a company and a new manager started. The new manager made it clear that they didn't value women. They were obviously promoting male colleagues over female colleagues, using inappropriate language, sexualising women generally and not respecting female colleagues.

The respondent discussed their concerns with a director of the company and HR. However, when one of the company's partners made it clear that the manager was more valued than the respondent, the respondent had no choice but to leave the company. Female colleagues subsequently left the company for the same reasons.

Age

When one respondent was working in a large, multi-company project team, they suggested ideas and methods to prevent potential problems on the project. They recalled being quite upset on one occasion when they were laughed out of the room after presenting their work. Their ideas were not adopted until after some of those problems pinpointed earlier had, in fact, occurred.

Additionally, during lockdown they were the first of their team to be placed on furlough, which was advertised as a three week rotation between employees. The rotation didn't happen and the respondent was not invited back to work until eight months had passed. They note that some people have no intentions to sustain support for younger people developing their career.

Common threads

Each of these negative stories starts with the attitudes and behaviours of individuals. Four respondents said that they had taken action about their situation and this resulted in two respondents changing company and one respondent changing their line manager. The fourth respondent is not sure if their action resulted in any change.

These respondents have all felt the need to modify **their** behaviour to minimise the impacts of the situations. One respondent says they are more anxious to 'play the game' with issues so that they don't feel forced to leave. Another respondent realises that just because discrimination shouldn't happen, it doesn't mean that it won't happen.

Advice to others

Respondents were asked what advice they would give to others in their situations. Most said that people should be clear and honest about the situation, and that discrimination should never go unchallenged. One said that you should not accept others telling you how to manage your own situation (unless their advice is useful and given in a constructive way). One respondent advocated playing the long game, hoping that those in the wrong are made to leave.

The respondent identifying with the age characteristic said: "You should keep hitting your head against the wall until someone pokes their head out of the window and asks you what you are doing. The head-pokers are your allies, and trusted discussions with these allies can help you overcome blockers, help focus your application and give you their opinions on thoughts, ideas and approaches."

The long view

Changing views

The agreement amongst respondents is that things are generally improving, but at a slow rate. Improvements with gender and in flexible working practices, awareness and positive behaviours are mentioned. Open discussions are welcomed, although it is noted that it is quite easy for some people to fall back into old behaviours.

The increase in apprenticeships and STEM activities is noted as helping the young, and the move towards focusing on sustainability is helping to celebrate achievements in the context of values.

Remaining barriers

Remaining barriers noted included presumptions that it is predominantly women who take career breaks to care for their children, and that there is often unequal treatment of men and women with parental leave. There was a view that men are perceived to be taken more seriously than women, even in situations when the women have more experience than the men.

Barriers observed by one respondent included atrocious discriminatory language around race, sex, disability and sexual orientation. Similarly, another noted previous workplaces with lots of racist and sexist behaviours and where people have concealed being gay.

The respondent with disability noted a barrier for them is when they have to behave in a certain way because of the emotional reactions of others when their disability presents. They also have to be careful navigating their environment.

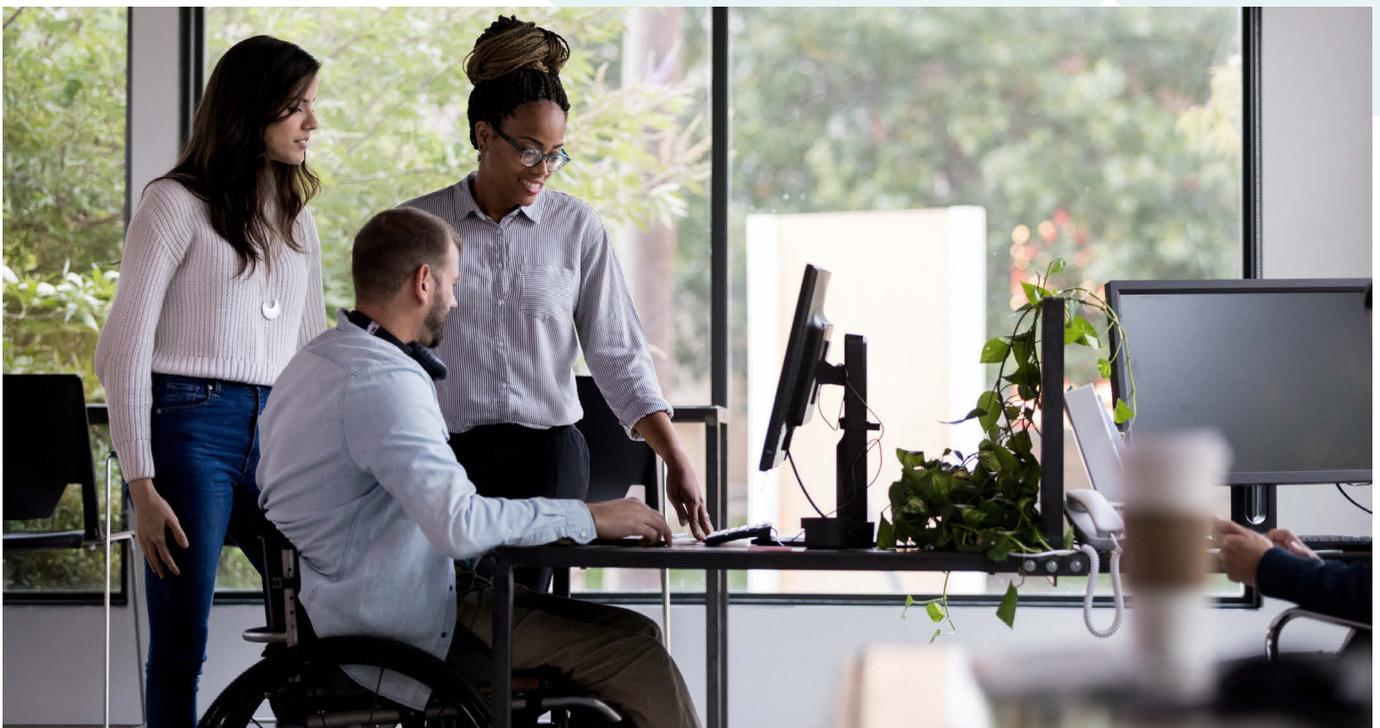
There is still a long way to go and it can take generations to alter beliefs and establish societal consensus and the drive for change tends to come from those affected rather than from society in general.

The future

Those who identify with the protected characteristics feel more positive and empowered when they are able to be more of themselves at work and when their differences are treated positively. There are clear benefits to open discussions between people, and we must recognise that there is often no single right answer. The cogs are beginning to turn because we know it's the right thing to do and collectively, we can make change. Let's share responsibility and communicate inclusion, equality and diversity with one voice.

Acknowledgements

Thank you very much to the people who felt able to share their stories, helping to increase awareness, highlight problems they've encountered and share ideas for improving things in the future. 🌍



Inter-noise 2022

The 51st International Congress and Exposition on Noise Control Engineering will be held at the Scottish Event Campus (SEC) in Glasgow on 21-24 August 2022.

Inter-noise 2022 offers:

- **International perspectives on noise control** – Inter-noise is one of the biggest international conferences on noise control engineering, with 800 paper presentations to attract scientists, engineers and consultants from around the world.
- **Prominent topics** – showcase your research and learn from your peers in plenary sessions, symposia, poster presentations, workshops and professional training on 20 main topic areas including building noise control and architectural acoustics, transportation noise and vibration, environmental noise, and many more.
- **Grow your network** – with 800 delegates attending in person, reconnect and meet people in your specialism from all over the world.
- **Develop solutions** – meet with our 30+ exhibitors to learn about the latest on the market in noise control.
- **The opportunity to visit Glasgow** – voted as place for the ‘Best UK City Break in 2021’ by Condé Nast Traveller.

Keynote speakers

Professor Lily Wang



Presentation title: Linking indoor acoustic conditions to human wellbeing and performance.

Dr Yu Liu



Presentation title: Acoustic beamforming array design for source imaging.

The Salford Group: Professor Andy Moorhouse, Dr Andy Elliott and Dr Josh Meggitt



Presentation title: Virtual acoustic prototypes – a story of four decades.

Professor Bridget Shield MBE



Presentation title: A sound environment for schools (Subtitle: Sixty years of research into the impact of the acoustic design of schools – a review).



Maria Heckl



Presentation title: Sustainable combustion technologies need acoustics research.

Jin Yong Jeon



Presentation title: Soundscape and digital therapeutics: psycho-physiological restoration.

Find out more about our keynote speakers here: <https://inter-noise2022.org/keynote-speakers/> **P38**

Main topic spotlights

Building noise control and architectural acoustics

These sessions will give practitioners and researchers a great opportunity to get an international perspective on the latest developments in sound insulation, room acoustics and general aspects of building acoustics. They will also provide ample opportunities for networking with other consultants and researchers.

Led by Professor Carl Hopkins

Community noise and planning

Effective planning is vital for the successful management of our soundscape and to minimise impacts on affected communities. The 'Community noise and planning' sessions will include papers on building for quality of life including use of the WHO guidelines, the soundscape resulting from the pandemic and tranquillity.

Led by Mrs Hilary Notley

Computer simulation and modelling

During the past few years, research in computer simulation and modelling has moved forward with wave based prediction now possible using graphics processing units. These sessions explain how wave based predictions allow more realistic auralisations and focusing effects to be accurately modelled.

Led by Professor Stephen Dance

Soundscapes and acoustic quality

These sessions explore the scientific fundamentals and practical solutions on environmental sounds, as perceived, in context. Both outdoor and indoor soundscaping are considered. Sessions include indoor soundscape, restorative soundscape measurement, analysis and design, industrial and rural soundscapes, soundscape and health, and AI in soundscape.

Led by Professor Jian Kang

Underwater, ship and offshore acoustics

These sessions will cover topics that relate to sound underwater and the control of sound as it is generated and propagated in the underwater environment. Underwater noise control is a very challenging topic and the papers to be presented at Inter-noise 2022 are not to be

missed. This is a great opportunity to hear presentations about such a challenging topic.

Led by Dr Joe Cuschieri

Inter-noise 2022 buddy scheme

Would you like to attend Internoise 2022 but are nervous about going to an international conference? Perhaps you're the only person from your company or university department going and you want to make the most of your experience by making sure you know someone as soon as you get there?

Or maybe you remember your first conference and wished there had been someone you could meet at the start of it to show you the ropes and explain what happens, and maybe introduce you to some of their peers?

The Institute of Acoustics' Equality, Diversity and Inclusion Working Group (EDI WG) and Early Careers Group (ECG) are putting together a buddy scheme for Inter-noise 2022. This scheme is to enable people who are not confident about attending the conference ('buddies') to have a point of contact ('mentor') throughout the conference starting with the breakfast on the first day.

Each mentor will be grouped with two buddies. Buddies and mentors will be encouraged to have a video call to get to know each other a little before the conference and then will meet at the ECG breakfast on the Monday morning of the conference. From there it will be up to buddies and mentors to decide how often they would like to meet, but some possibilities include during the first break (to discuss how the first session has gone and if they have any queries about the conference so far), lunch break and conference dinner (if mentor and buddies are attending).

Where possible, buddies and mentors will be grouped according to their language requirements and specialist acoustic interests, if desired.

Register now at <https://tinyurl.com/yfhfjcwX> or sign up to receive the newsletter at <https://tinyurl.com/yk8xrvut> to receive updates on the buddy scheme.

Reduced registration fee for students (virtual or in-person)

 Registration Fees <small>Registration Fees are in GBP and include VAT @ 20%</small>		
REGISTRATION TYPE	DEADLINE	COST
Delegate Early Bird	by 8th July 2022	£488
Delegate Standard	from 9th July 2022	£535
Delegate Onsite	from 21st August 2022	£595
Student Early Bird	by 8th July 2022	£93
Student Standard	from 9th July 2022	£108
Student Onsite	from 21st August 2022	£130

If you are a student or early career professional, there are plenty of opportunities to meet and connect with others in the same position and specialists at all stages of their careers:

- Join us at the breakfast networking event on the morning of Monday 22 August
- Connect with your peers at the early career social event on the evening of Monday 22 August
- Come together at the conference social event on Tuesday 23 August for a night of dancing, good music and great company (see more on page 40)

To take advantage of the early bird rate, register now at <https://Inter-noise2022.org/registration/>

If you can't attend in person, join us live online

Inter-noise 2022 is an excellent opportunity to attend a major international conference on noise control engineering without having to travel far!

- 60 hours of live sessions
- 5 hours of live keynote speakers
- 20 Main topics including building noise control and architectural acoustics, transportation noise and vibration, environmental noise and many more
- 130+ session topics related to noise control engineering
- 40+ virtual Poster presentations
- Opportunity to take part in live Q&A
- Live networking <https://internoise2022.org/main-topics/>

If you can't attend live online, or if you want to attend more sessions,

register now to secure access to the on-demand content for two months after the congress ends, including:

- 240 hours of sessions
- 5 hours of keynote speakers
- 20 Main topics including building noise control and architectural acoustics, transportation noise and vibration, environmental noise and many more
- 130+ session topics related to noise control engineering. View the full list of topics here: <https://tinyurl.com/2p833dpn>
- 40+ virtual Poster presentations <https://tinyurl.com/2p833dpn>

Sustainability

This congress theme, ‘Noise control in a more sustainable future’, is particularly timely and the congress venue is the same as that for the recent conference on climate change, COP 26. The sustainability of events is more important than ever and Inter-noise 2022 has a responsibility to reduce our carbon footprint. Inter-noise 2022 will be held at the Scottish Event Campus (SEC) which is prioritising better outcomes for their clients, the community and the environment through a sustainability strategy and their SEC Net Zero 2030 ambition. Working with staff, organisers of the Inter-noise 2022 Sustainability Working Group, partners and visitors all forms part of the overall engagement plan to support the net zero journey. Learn more about sustainability at Inter-noise 2022 here: <https://Inter-noise2022.org/sustainability/>

Urban sound planning walks in Glasgow

When you get a break from conference sessions, join Trond Maag (urbanist, Federal Office for the Environment Switzerland) and other Inter-noise delegates, on an urban sound walk around Glasgow to see how planners and designers could develop their involvement in the everyday acoustic environment. On the walk you’ll experiment with various reference points in public urban spaces, actively connecting single sounds into a track of acoustic events to notice that a few steps can make a difference in how we experience urban sound. [Register for a walk at the Inter-noise 2022 registration desk in the conference centre.](#)

Explore Glasgow by bike



There are more 800 OVO bikes for hire in 79 locations around Glasgow, including a station located on the SEC campus. For more information visit: <https://www.nextbike.co.uk/en/glasgow/>

How to get there

There are more than 20 direct trains per day from London. Direct trains from Edinburgh run every 15 minutes on weekdays.

You can calculate the impact of your travel by measuring your carbon footprint <https://www.carbonfootprint.com/calculator.aspx>

- Here Students <https://herestudents.com/location/glasgow/base/>
- Aparto Students <https://tinyurl.com/2p896vte>
- City Room Rentals <https://tinyurl.com/2p833rdsp>
- We are Homes <https://wearehomesforstudents.com/student-accommodation/glasgow>
- There are some good Air BnB options – rent a room or book a home with a small group to cut costs <https://www.airbnb.co.uk/>

Check out these budget hostel and hotel options (from £13 a night):

- Glasgow Youth Hostel <https://www.hostellingscotland.org.uk/>
- Hostel World <https://www.hostelworld.com/>
- Stay Safe Glasgow <https://www.safestay.com/glasgow/>

Where to eat

If you are dining on a tight budget Glasgow is filled with delicious but affordable eateries. See our top suggestions below and find out more on www.Inter-noise2022.org

Paesano Pizza



All the ingredients here are sourced from Italy, and the pizzas are wood-fired in the traditional Neopolitan way by expert pizzaioli. Choose from around 10 toppings, including fennel sausage, spianata spicy salami, prosciutto, anchovies and vegetables. Our only word of warning? Be prepared to queue most evenings – this is a particularly popular spot.

Where: 94 Miller Street, Glasgow, G1 1DT
Price per head: Pizzas from £6
Book now: https://www.squaremeal.co.uk/restaurants/paesano-pizza-miller-street_16523



Where to stay

There are plenty of budget-friendly accommodation options including student housing, which is available during the summer for short-term accommodation (from £30 per night):

- Glasgow School of Art <https://www.gsa.ac.uk/visit-gsa/summer-accommodation/>

Kimchi Cult



Great fried chicken, huge portions and plenty of vegan options.

Where: 14 Chancellor Street, Glasgow, G11 5RQ

Price per head: Mains £6-9, sides £2-8

Book now: https://www.squaremeal.co.uk/restaurants/kimchi-cult_23273

Dumpling Monkey



Dumpling Monkey ticks all the boxes you look for in a Chinese takeaway. Choose between steamed and potstickers, then pork and Chinese leaves, beef and carrot, pork with king prawn and chives, chicken or vegetable. The noodle and rice dishes are great as mains and sized very generously for the price.

Where: 121 Dumbarton Road, Glasgow, G11 6PR

Price per head: £2-9 per dish

Book now: https://www.squaremeal.co.uk/restaurants/dumpling-monkey_23282

Finsbay



Open all day, this charming eatery works as a cafe, bar and restaurant

simultaneously, offering fry-ups, lunches, cocktails and beers.

Where: 44 Main Street, Glasgow, G62 6BU

Price per head: Breakfast/brunch under £10, dinner £12-15

Book now: https://www.squaremeal.co.uk/restaurants/finsbay_23411

The Inter-noise conference dinner and ceilidh



A ceilidh is a Scottish social event which involves traditional folk music and dancing and promises a fun-filled night of wild dancing, good music and great company! Have your chance to experience this at our Inter-noise 2022 social event at the Merchant Square on Tuesday 23rd August to get a real taste of Scottish culture.

Once part of the old Glasgow Fruit Market Merchant Square is at the heart of Glasgow's cultural, fashion and food quarter, with an eclectic selection of restaurants and bars.

Even if you are on a tight budget you won't get better value than the conference social event. Rather than a traditional conference dinner – for just £20/head, you can enjoy

Above: Merchant Square, Glasgow, venue for the Inter.noise conference social and ceilidh

a two course meal with drinks in a restaurant of your choice and then on to the ceilidh!

Many of the dance steps, including the do-si-do and swing-your-partner moves are similar to those performed in American square dancing. It's more about fun than getting the steps right, but there is always a 'caller' with the band, who leads everyone and reminds dancers where they should be!

Know your Glasgow

1. Until recently, Hamilton Mausoleum held the record for longest man-made reverberation time. The new world record holder is approximately 150 miles north at the Inchindown Tunnels, Invergordon.



Above: Hamilton Mausoleum

2. Glasgow has the third oldest underground railway system in the world.



3. The Finnieston Crane (adjacent to the SEC campus) was turned into a musical instrument for an exhibition in 2013 <https://www.scotsman.com/arts-and-culture/finnieston-crane-become-musical-instrument-1585488> and <https://galleryofmodernart.blog/portfolio/bill-fontana-silent-echoes/>

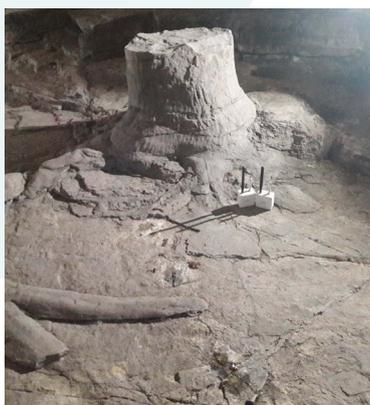
4. Glasgow's Britannia Panopticon is the world's oldest surviving music hall. Stan Laurel made his stage debut there.



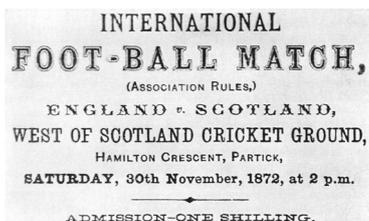
5. The remains of St Valentine were sent to Glasgow in 1868. They are currently in Blessed St John Duns Scotus in the Gorbals.



6. Victoria Park in Glasgow features 11 extinct trees that are over 330 million years old.



7. The first ever international football match took place in Glasgow on Saturday 30 November 1872 in front of a crowd of 4,000 people.



8. Baird transmitted the first moving TV images in 1926 from London's Royal Institution to Glasgow's Grand Central Hotel.

9. In August 2008, Glasgow was named the UK's first UNESCO City of Music.



<https://citiesofmusic.net/city/glasgow/> <https://glasgowmusiccitytours.com/walking-tours/music-mile/> <https://www.glasgowlife.org.uk/glasgow-unesco-city-of-music>

10. The City Chambers building has more marble than the Vatican – it cost £578,232 to build in 1889, the equivalent of more than £40 million today.



11. Obstetrician, Ian Donald, and engineer, Tom Brown, created ultrasound technology in Glasgow <https://tingurl.com/yckjvp7>

12. Lord Kelvin worked at Glasgow University for 53 years, where he devised the first harmonic synthesiser in 1872 and the first harmonic analyser in 1876 <https://www.gla.ac.uk/hunterian/collections/permanentdisplays/lordkelvin/>

13. 9,000 objects form The Burrell Collection, including one of the most significant holdings of Chinese art in the UK, medieval treasures, over 200 tapestries (which rank amongst the finest in the world) and paintings by including Manet, Cezanne and Degas <https://burrellcollection.com/>

Out and about

Glasgow is famous for being one of the friendliest cities in the world. A cultural hub with a vibrant nightlife, Glasgow is home to a dynamic arts scene, 19th-century Victorian architecture, and Charles Rennie Mackintosh, Scotland's most famous architect of all time. Glasgow has something for everyone and most of it is free!

Travel around Glasgow by rail for just £5 for five days with the Scotrail Conference Rover. The SEC campus has its own railway station – Exhibition Centre and there are six trains an hour from Glasgow Central Station.



Enjoy a walk around the city to appreciate the architecture (always look up), explore art, history and nature in many of the free museums and Glasgow's music events take place every night. If food and drink is up your street there are plenty of restaurants, bars, breweries, and distilleries – you will struggle to choose just one. You can get around by walking, by bike, or by bus and you will never get bored. See some of our tips for Glasgow and Scotland below.

Get to know Glasgow better with the Glasgow Walking app developed by Glasgow City Council <https://apps.apple.com/us/app/glasgow-walking/id930428468>

Learn more about Scotland's noise here: <https://noise.environment.gov.scot/noisemap/> **P42**

If you don't have time for a day trip, these sights and attractions are within a 10-minute walk of the SEC:

The Finnieston Crane

0.2 miles from SEC



This is a disused giant cantilever crane in the centre of Glasgow. It is no longer operational, but is retained as a symbol of the city's engineering heritage. It was used for loading cargo, in particular steam locomotives, onto ships to be exported around the world – as many as 30,000 locomotives were hauled through the streets of Glasgow by Clydesdale horses, traction engines and diesel tractors, from the works at Springburn to the crane for export to the British Empire. <https://bigcranco.co.uk/>

Glasgow Science Centre

0.3 miles from SEC



Open Wednesday to Sunday
10am-5pm

Glasgow Science Centre is situated on the banks of the Clyde, it presents concepts of science and technology in unique and inspiring ways with interactive exhibits, planetarium, live science shows and an Imax 3D cinema.

By showing your Inter-noise delegate badge, Glasgow Science Centre will give you a £2.00 discount on 22 August from 10am-5pm. <https://www.glasgowsciencecentre.org/>

Clydeside Distillery

0.5 miles from SEC



Here you can find out about the history of whisky, see craftsmen at work creating a new single malt and savour some samples – all with spectacular Clydeside views.

Book a tour here

<https://www.theclydeside.com/>

Rotunda

0.5 miles from SEC



Just outside of the SEC you'll see the Glasgow Harbour Tunnel Rotundas, which flank the River Clyde. Built between 1890 and 1896 by Glasgow Tunnel Company, they covered 24-metre-deep (79 ft) shafts to tunnels, which enabled vehicular and pedestrian access to the other side of the river. Pedestrians, horses and carts – and later motor vehicles – would be hauled up by hydraulic lifts. <http://www.clyde waterfront.com/clyde-heritage/queen's-dock--yorkhill-quay/harbour-tunnel-and-rotundas>

Finnieston

0.6 miles from SEC



Only five minutes' walk from the SEC, explore Finnieston; a hip foodie hub of gourmet sandwich shops, artisanal coffee bars and trendy organic restaurants specialising in Scottish meat and seafood. Craft beers and gins are served up at stylish bars, while old-school pubs offer vast whisky selections and traditional folk music sessions.

Kelvingrove Art Gallery and Museum

0.9 miles from SEC



Free entry, open Monday to Thursday and Saturday: 10am-5pm. Friday and Sunday: 11am-5pm

Kelvingrove Art Gallery and Museum has 22 themed, state-of-the-art galleries displaying 8,000 objects. The collections are extensive, wide-ranging and internationally-significant including natural history exhibits, arms and armour, art works from many art movements and periods of history. Make sure your visit to Kelvingrove Art Gallery and Museum coincides with the organ recitals which are daily at 1pm (3pm on Sundays). <https://www.glasgowlife.org.uk/museums/venues/kelvingrove-art-gallery-and-museum>

Mitchell Library

0.9 miles from SEC



Free entry. The Mitchell Library is one of Europe's largest public libraries with over one million items of stock and, with its distinctive green dome, is one of Glasgow's iconic landmarks. The building opened in 1911 and is also home to the Mitchell Theatre, an exhibition hall and the Herald Cafe Bar. The Mitchell is a true hub of information and the library also includes the rare and specials collection, family history resources and local history resources. <https://www.glasgowlife.org.uk/libraries/venues/the-mitchell-library>

Riverside Museum

One mile from SEC



Free entry, Monday to Thursday, Saturday: 10am-5pm. Friday and Sunday: 11am-5pm

This Zaha Hadid-designed waterside museum carries an extensive collection of vehicles

including ambulances, buses, police cars, horse-drawn taxis and motor cars that look as if they drove to Glasgow from the set of a 1930's action movie. <https://www.glasgowlife.org.uk/museums/venues/riverside-museum>

The Tall Ship

One mile from SEC



Free entry, open 10am-5pm every day except Tuesday, which is 11am-5pm

Right next to the Riverside Museum lies the impressive late Victorian, three-masted Tall Ship that's berthed outside the museum in the River Clyde – a stunning monument to Glasgow's rich maritime heritage. <https://thetallship.com/>

West end

Only 15 minutes from the SEC, the leafy west end of Glasgow is known for its top attractions, quirky lanes, amazing food scene and relaxed vibe. Kelvingrove Park is another brilliant spot full of things to do.

University of Glasgow

1.1 miles from SEC



At 560 years old, the University of Glasgow is a stunning piece of gothic architecture where you can explore the quadrangles and cloisters. The fourth oldest university in the English-speaking world has four museums: The Hunterian Museum; the Hunterian Art Gallery, The Mackintosh House and the Zoology Museum.

<https://www.gla.ac.uk/> for details on taking a self-guided tour of the Cloisters and for more on each of its attractions.

(Hunterian Museum and Art Gallery, free entry, Tuesday to Sunday 10am-5pm

Mackintosh House, £8, Tuesday to Sunday 10am-5pm

Hunterian Zoology Museum, free entry, Tuesday to Sunday 10am-5pm)

Ashton Lane

1.5 miles from SEC

Located in Glasgow's West End, Ashton Lane borders the University of Glasgow and is renowned for its



bars, restaurants and cinema. Its cobblestones and fairy lights give it a unique charm, particularly after dark, and the lane is always busy with locals and visitors enjoying its vibe. Walk down one of the city's longest roads, Great Western Road, for vintage shops, old-fashioned street lamps, churches transformed into arts spaces and Glaswegian businesses with international reach, such as Timorous Beasties and Paulin watches <https://peoplemakeglasgow.com/see-do/shopping/independent-shopping>

Duke of Wellington

1.5 miles from SEC



One of Glasgow's most iconic landmarks is an equestrian statue with a traffic cone on the rider's head – despite the best efforts of the local council, the statue of the Duke of Wellington in Royal Exchange Square is rarely to be found without (at least one) traffic cone on his head. It was listed in a 2011 Lonely Planet Guide as 'one of the top 10 most bizarre monuments on earth'.

Gallery of Modern Art

1.5 miles from SEC



Free entry, open Monday to Thursday, and Saturday 10am-5pm
Friday and Sunday open 11am-5pm

Found in the heart of Glasgow in Royal Exchange Square, GoMA is Scotland's most popular contemporary art gallery, it features modern works from international artists, housed in a graceful neoclassical building. <https://www.glasgowlife.org.uk/museums/venues/gallery-of-modern-art-goma>

Sharmanka Kinetic Theatre

1.7 miles from SEC



Wednesday to Sunday 1-3pm
Entry: £8

This extraordinary mechanical theatre is located at the Trongate 103 arts centre and showcases, through a 30 to 60-minute shows, a series of large, wondrous mechanical figures sculpted from bits of scrap and elaborate carvings. Set to haunting music, the performances explore humorous [P44](#)

and tragic stories of the human spirit. <https://www.sharmanka.com/Home/Welcome.html>

Glasgow Botanic Gardens and Kibble Palace
1.9 miles from SEC



Free entry to grounds 7am-dusk (all year) and to Kibble Palace 12pm-4pm

Founded in 1817, Glasgow Botanic Gardens is located in the heart of the city's West End by the River Kelvin and contains a variety of plant collections, woodland copses and riverside walks as well as Kibble Palace, a magnificent glasshouse designed by John Kibble, which houses the national collection of tree ferns. Plants from tropical rainforests grow in the palm house. <https://glasgowbotanicgardens.co.uk/>

Glasgow city centre



Only a few minutes away by train or a 20-minute walk you can join the hustle and bustle of Glasgow city centre renowned for high

street brands and designer stores in Princes Square, St Enoch Centre and Buchanan Galleries. The city's wealthy past has left a legacy of some of the finest Victorian architecture such as the iconic City Chambers, which sits majestically overlooking George Square.

The Burrell Collection
3.3 miles from SEC



Free entry. The Burrell Collection, named after its donor, the shipping magnate Sir William Burrell, is one of the greatest art collections ever amassed by one person and consists of more than 9,000 objects and spans 6,000 years of history. It is housed in an award-winning building in the heart of Pollok Country Park. The displays include work by major artists including Rodin, Degas and Cézanne to important examples of late medieval art, Chinese and Islamic art, ancient civilizations and more.

<https://burrellcollection.com/>
Get to know Glasgow better
Glasgow Walking app developed by Glasgow City Council <https://apps.apple.com/us/app/glasgow-walking/id930428468>

Short trips from Glasgow (one hour away or less)

Loch Lomond



Less than an hour's train ride from the bustle and sprawl of Glasgow, the bonnie banks and braes of Loch Lomond comprise one of the most scenic parts of the country. At the heart of Scotland's

first national park, the loch begins as a broad, island-peppered lake in the south, narrowing in the north to a fjord-like trench ringed by 900m-high mountains.

Falkirk



Falkirk is a town in Scotland's central belt, located around a 30-minute drive or 45 minutes on the train from Glasgow. The Falkirk Wheel, the world's first and only rotating boat lift is an engineering masterpiece which transports boats 115 ft between the different levels of the Union, and Forth and Clyde canals. <https://www.visitscotland.com/info/see-do/the-falkirk-wheel-p248061>



While you are there, you could also visit The Kelpies, the two 30-metre-high horse head sculptures which are a true feat of engineering. This interactive map is packed full of ideas for day trips and longer stays in Falkirk and the surrounding area. <https://www.visitfalkirk.com/plan-your-visit/map/>

Forth and Clyde Canal

The Forth and Clyde Canal crosses central Scotland east to west and is linked to the Union Canal via the Falkirk Wheel. With the building work beginning in 1768, the Forth and Clyde Canal was the first canal to be built in Scotland and played a vital part in the Scottish Industrial Revolution by helping to transport materials. Today, the Forth and Clyde Canal hosts a variety of activities including boating, fishing, cycling, walking and wildlife spotting. <https://www.scottishcanals.co.uk/canals/forth-clyde-canal/>

Edinburgh



Edinburgh is the second most visited city in the UK after London. With an abundance of history, top quality attractions and beautiful architecture, Scotland's capital city is unforgettable. Explore the Medieval Old Town and the elegant Georgian New Town, which sit side-by-side. Direct trains from Edinburgh run every 15 minutes on weekdays and take 45 minutes. You can reach Edinburgh by car from Glasgow in around an hour.

Stirling



Stirling's top attractions have witnessed some of the most defining and dramatic moments in Scotland's history. Stirling is the ancient capital of Scotland, lying at the heart of the nation's history and linked to two of its best-known heroes, William Wallace and Robert the Bruce. Occupying a strategic position in the cultural heartland of Scotland, it is surrounded by glorious countryside and is only 45 minutes on the train from Glasgow.

Tempted to stay longer?

If you have time to venture further afield, try these:

Inverness



Inverness is known as Scotland's 'Highland Capital', however, it still retains its market town feel, dating back to its early development. Nearby Loch Ness is the largest body of fresh water by volume in Britain, holding more water than all the lakes and reservoirs in England and Wales put together. Loch Ness is best known for sightings of the Loch Ness Monster, "Nessie", the Loch's water visibility is exceptionally low due to a high peat content in the surrounding soil, making the mystery of Nessie even more intriguing. <https://www.visitscotland.com/about/uniquely-scottish/loch-ness-monster/>

Glen Coe



Glen Coe is one of the most beautiful and other-worldly places in Scotland and has featured in films such as James Bond's Skyfall and several Harry Potter movies. <https://www.visitscotland.com/destinations-maps/glenceoe/>

St Andrews



Andrews, Scotland's world-famous home of golf, is known for its historic university, medieval streets and gorgeous traditional buildings. <https://www.visitscotland.com/destinations-maps/st-andrews/>

West Highland Way



Scotland's most well-known long-distance trail. The traditional start is from Milngavie in the south and walked to finish in Fort William in the north. The route passes some of the best scenery in Scotland. <https://www.westhighlandway.org/>

Scottish islands and island hopping



Whether you've only got a couple of days or a couple of weeks, island hopping in Scotland is well worth the time, each of which have their own unique character. The main groups of Scottish isles which are best suited for touring include the Inner Hebrides and the Outer Hebrides in the west of Scotland, and Orkney and Shetland in the north. <https://www.visitscotland.com/see-do/island-hopping/>

One of the most iconic travel routes in the world



Taking the NC500 route allows you to discover the best the Highlands has to offer, such as its magical and mystical castles, amazing local produce, wonderful distilleries [P46](#)

and breweries and exhilarating wildlife safaris.

The 516-mile-long route is a five star-rated experience and is truly unforgettable. The route begins and ends at Inverness Castle which, perched on top of a hill, is the perfect starting point to the route and offers unparalleled views from its viewing tower over the capital city of the Highlands. <https://www.northcoast500.com/explore-the-route/>

Conference app

We are pleased to advise that we will be using a mobile app for Inter-noise 2022.

We encourage you to download the app as it provides useful information on the conference. Please note that there will be no printed programme book, however all abstracts, programmes, posters and conference information will be featured in the app.

Before you attend the conference, we advise you to download the app by following these instructions (help will also be on hand at the event):

- Go to the 'App Store' (on Apple devices) or 'Google Play Store' (on Android devices)
- Search for 'The Event App by EventsAir' and download
- You will be asked for the event app code, which we will send to you by email nearer the time of the conference
- You will receive log in details (email and PIN) for the app from the Inter-noise Secretariat nearer the time of the conference

Features

Programme: You can find the schedule for the conference including all presentations, workshops and keynote speakers.

My Agenda: You can add favourite sessions in the programme tab in the app by starring the session and it will appear here.

Online Programme and Abstracts: View and download the online programme and abstracts.

Posters: View the poster presentations.

Oral Presenters: Where you can view the list of all of the oral presenters.

Attendees: You can view the list of delegates attending the conference.

Meeting Hub: Where you can connect to and speak to other delegates in private chat. You can also scan and connect with other delegates and export your contact details.

Sponsors: Details and profiles of all this year's conference sponsors.

Exhibitors: Where you will find a full list of all exhibitors together with their company profile and a floor plan.

Location: Including a map of the venue.

Social Events: Find the details of the social events and how to get there.

My Photo: Upload your photo so that other delegates can find you easily.

Contact Information: Choose what contact information you want to share with other delegates on the app and virtual platform.

Our sponsors

We would like to thank our Platinum Sponsors for their support of the Inter-Noise 2022 Congress



In the 80th year since Brüel & Kjær was founded, Hottinger Brüel & Kjær (HBK) is delighted to be a Platinum Sponsor of Inter-noise 2022.

HBK was formed in 2020, when the two market-leading companies, HBM and Brüel & Kjær, joined forces to become the world's foremost provider of integrated test, measurement, analysis, and simulation solutions.

For more information, please visit www.hbkworld.com



Mason UK is a specialist in noise and vibration control and an agent for Mason Industries Inc. with an extensive range of solutions for architectural, structural, mechanical and industrial applications. With more than 70 years of experience they can provide comprehensive assistance to any project related to noise or vibration.

For more information, please visit www.masonuk.co.uk

Learn the lingo

"Aye": Means yes, often replacing the latter in day-to-day life in Scotland

"Banter": Thrilling conversation, witty repartee or quips and wisecracks – all in all, just good chat

"Bonnie": Used to describe something or someone beautiful, pretty or attractive

"Braw": Used to describe all things nice, brilliant and fantastic

"Coorie": Is to snuggle or cuddle

"Piece": Is a sandwich

"Wheesh": Means to shush, or to be quiet 🤫

XL3

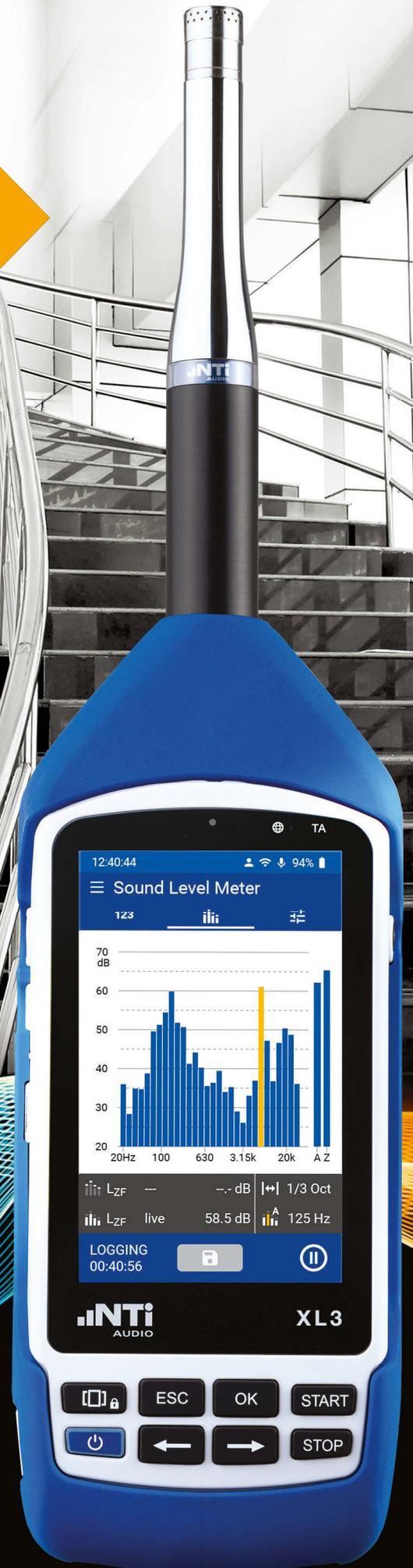
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(L-R): Kate Castle (bridges), Sian Cleaver (space), Jo Evans (maritime), Andrew Smyth (planes and baking), Michael Sulu (biomedical), Helen Sheldon (sound), Robyn Grant (whiskers), Matt Calveley (metals) and Kat Smith (crisps) (Image © Ian Bowkett (www.ianbowkett.com))

Bedtime stories for very young (acoustic) engineers

In this article, Helen Sheldon, Associate at RBA Acoustics Ltd, relates the tale of how she contributed to the *Bedtime Stories for Very Young Engineers* project, which aims to turn toddlers onto engineering through the power of storytelling.

By Helen Sheldon

I was scrolling through twitter late last year, and saw that someone had shared a post by Anna Ploszajski saying: 'Today is the deadline for my @RAEngnews funded project *Bedtime Stories for Very Young Engineers*. Steve Cross and I will train you in storytelling and you'll turn tiny people off princesses and onto piling'.

I have two young daughters who are VERY princess-oriented, but also into figuring out how things work, and as an engineer myself I was intrigued. I looked at the link and discovered that it was a project aimed at writing engineering-themed bedtime stories for two to five-year-olds, to try and generate interest in those themes from an

early age. It was the day of the deadline, so I fired off a rather rushed application and didn't think much more about it.

Fast-forward a couple of weeks and I received an exciting email saying that I was one of the 31 very cool engineers who had been selected to take part in the project.

We had six weeks of training by Anna and Steve ahead, followed by a period of writing and editing. After that we would film our stories to be published online, then have celebration event at the end of the project where we could all get together.

Training

The weekly training sessions were held over Zoom thanks to Covid restrictions, but this turned out to be a benefit as engineers from all over the UK (including myself) could take part – I wouldn't have been able to attend in-person sessions in London. We covered storytelling and structure, reading aloud, writing for kids, and worlds and characters. In the very first week we were given a few kick-off scenarios and tasked with quickly writing a story. I picked the topic 'what if new neighbours moved in next door' and wrote a quick tale of an elderly man who liked a quiet life, but a noisy family moved in next door. It was less about engineering, and more about how they could all learn to rub along together.

Herbert and the New Neighbours

Herbert was a little old turtle. He lived in a little old house, and loved nothing more than to spend his days in the garden, tending to his beautiful roses and cooling his toes in his little old pond.



One day, he heard a loud roar from outside, and an enormous van came driving down his quiet lane. Out of the window, he saw that a family of elephants were moving into the house next door. The Elephant family laughed and tooted happily as they unloaded all their boxes.

The next day, Herbert went into his garden, and was about to water his roses when he heard screams and shouts and trumpeting; the Elephant children were playing out next door. They shouted to Herbert 'Hello Mr Turtle!! We're Gina and George, and we're twins!!'



'Hello,' said Herbert softly to the children, but he soon got a headache from all the noise and went inside to lie down where it would be quiet. But suddenly, he heard the noise of very large feet running up and down the stairs in the house next door – THUNK, THUNK, THUNK. 'Oh no!' thought Herbert, 'I can't sleep for all this noise!'. He tried to ignore it, but he just couldn't.

The next day, he got up to make a cup of tea and THUNK THUNK THUNK – there it was again. He tried wearing earplugs, but he could still hear it. By the third day, with all the THUNK THUNK THUNKS Herbert was feeling so tired and so sad, that he didn't want to go out at all. He looked out of the window and saw that his beautiful roses were wilting and beginning to die.

Suddenly, there was a knock at the door. It was Gina and George. 'We noticed your beautiful roses are dying and wondered if we might be able to help you in the garden? We're VERY good at watering flowers!' they said. Herbert started to snap 'No! Go away!!', but his manners took over. 'Ahem, I mean...would you both like a drink?' he asked, and they all sat out in his pretty little garden.

Mummy and Daddy Elephant looked over the fence. 'Hello Mr Turtle! How are you today?' Herbert was quiet and shy but plucked up all his courage to say 'I'm not feeling very well as I'm so very tired. I can't sleep since you moved in, as the noise of the children running on the stairs is so loud in my bedroom. I've tried ignoring it, and I've tried wearing earplugs, but it still keeps me awake!'

Mummy Elephant replied 'I'm so sorry, we didn't realise we were disturbing you! We'll have to see what we can do to stop the noise.' Daddy Elephant told the children they must tiptoe on the stairs until they could find a way to fix the problem.

Mummy and Daddy Elephant called Tilly the Giraffe, who was the local handy-animal – she always wore her hard hat and helped the animals in the lane with jobs around the house. She put in a thick fluffy carpet with a lovely squidgy layer underneath, to stop the Elephants' footsteps shaking the whole house.

And since then, the children come round every weekend to help the Herbert in the garden – they use their trunks to suck up water from the pond and spray it onto the roses, and they play and trumpet to their hearts content. Herbert watches and listens to them happily, while they look after his garden together. And in the evenings, he can't hear the footsteps in his bedroom, since the thick, squidgy carpet soaks them all up...but the children tiptoe up and down the stairs anyway, just be safe.

Below:
Helen in a dramatic storytelling moment
(Image: ©Ian Bowkett)



I wound up developing that story over the course of the project. I changed the human characters to animals and switched the focus onto more engineering solutions, I decided to develop more stories with the same protagonist (Herbert the Turtle), each focusing on a different aspect of how acoustic design can affect everyday life.

Tough editing job

We went through a fairly intense drafting and editing process, and I finally came out with four stories: *Herbert and the New Neighbours* (in which a family of elephants move in next door and control of impact sound is required), *Herbert and the Bypass* (in which Herbert is affected by construction and traffic noise), *Herbert and the Festival* (Herbert has to upgrade his windows to deal with music noise), and *Herbert and the Party* (where Herbert hires the village hall but needs some help controlling reverberation).

I was filmed while reading each of these stories, but budget constraints on the project meant that only two videos per person could be edited, so two of my storytelling videos have been published online along with a raft of stories from a wide range of engineers.

A highlight of the project was the celebration event – it was great to meet some of the fabulous engineers who've also been involved in this project and hear some of the stories read in person. There are stories about kites, poo, whiskers, gloop, noise (of course) and much more. My recommendation to everyone, from the very young to the not-so-young, is to check them out! 🎧

Below:
Herbert, the star of the show



Bedtime Stories for Very Young Engineers is a movement that makes engineering one of the ideas very young people have for their futures via a medium they already love – bedtime stories. They aim to revolutionise the bedtime story from princesses and dinosaurs to problem-solvers and inventors, and this first-of-its-kind project gives UK engineers the skills, information and raw materials they need to create fun and engaging bedtime stories about engineering. <https://www.storytellingengineers.com/>

Machine learning and acoustics

The areas of artificial intelligence (AI) and machine learning (ML) have seen rapid advances in recent years. These advances, coupled with the widespread availability of powerful computing in the cloud and on portable devices have opened the way for a wide range of exciting technical applications in almost every field.

By Paul McDonald, Managing Director at Sonitus Systems.

The acoustics industry is certainly no exception and the development of artificial intelligence for audio recognition has led to a range of new applications, ranging from the trivial to the almost indispensable.

This article is a very brief introduction to some of the concepts involved in machine learning and its applications in acoustics. Given the complexity of most of these topics, it only skims the surface of a very rich and interesting area of acoustics that will, no doubt, become more common as a field of study and practice in the industry.

Machine learning is the process of teaching a computer to perform tasks that might have traditionally required a human making a decision about some information without having an explicitly programmed set of instructions.

The 'machine' is usually taught how to recognise a particular event or condition through training, which can be supervised, semi-supervised or unsupervised. For the case of audio event detection, a supervised learning approach is commonly used. This involves labelling a large number of audio samples that the user knows to be examples of the target event. The computer is trained using this data, along with a certain number of samples that are not examples of the target event. This training data provides some comparison, making the system more robust. This process of data input and labelling is used to

develop a machine learning model that can identify occurrences of the event of interest.

Consider a common audio example that is available in most smart home devices; the detection of breaking glass for home security. The smart home device is installed in the kitchen or living room and has at least one microphone which is always on. The device is continuously capturing an audio stream and checking that stream for occurrences of key events, such as breaking glass. If the sound of glass being broken is 'heard' then the device will initiate some predefined process such as notifying the homeowner.

Training the model

The key part of the technical process here is the training of the AI model to recognise breaking glass. The manufacturers of the smart home device would presumably need to have recorded hundreds or thousands of panes of glass being smashed to pieces under various conditions and then labelled these recordings in order to train a model. This manual process is the most time-consuming and therefore expensive process (not to mention the cost of the glass).

The trained AI model can then be used to check any future audio samples for the sound of breaking glass. The accuracy and robustness of the detections depends heavily on the quality of the training data. The greater variation available in the labelled training audio the

better; consider double glazing vs. triple glazing, breaking glass with music in the background or attenuated sound coming from the next room. The machine's decision-making can only be as good as the training system that taught it.

Model effectiveness: detection, precision, recall

To evaluate the effectiveness of a model there are two key metrics that need to be assessed: precision and recall. These two parameters look at key concepts of AI decision-making, and both are concerned with the accuracy of the machine's decision, although from different points of view.

Precision is a test to ensure the model is not over-zealous (everything sounds like broken glass and we call the police for a false alarm).

The most desirable behaviour will identify real true positives without introducing too many false positives.

$$\text{Precision} = \frac{\text{True Positive (TP)}}{\text{True Positive (TP)} + \text{False Positive (FP)}}$$

Recall on the other hand looks at how many actual occurrences of the event did the AI model fail to identify (the burglars have made off with the jewellery and the smart device thinks it's listening to the cat).

$$\text{Recall} = \frac{\text{True Positive (TP)}}{\text{True Positive (TP)} + \text{False Negative (FN)}}$$

A high recall rate indicates that key occurrences of the target event are not being missed. (For a more complete description of these terms see this resource

<https://tinyurl.com/984c2p3p>).

Effective performance of a model is a balance between these two metrics; the model needs to be able to make a decision that may not be perfect, and the user (human) may need to apply some constraints to how that decision is used.

Use cases – what question are we trying to answer?

The use case for the machine learning model will usually determine how accurate it needs to be and to what degree false positives, or false negatives can be tolerated.

The smart home example is a use that is becoming more ubiquitous and provides some comfort to property owners, but other applications can be of a more serious nature. Companies like ShotSpotter use acoustic sensors to detect gunshots and dispatch local law enforcement. The technology has the potential to be lifesaving, but it is not without controversy (<https://www.shotspotter.com/shotspotter-responds-to-false-claims/> and <https://www.datasciencecentral.com/shotspotter-ai-at-its-worst/>).

In most applications, the use case will depend on the question that the machine is being asked. A very specific question can be answered specifically. This is where machine learning excels, repeating a well-defined task over and over. However, a more general question requires a more nuanced approach and a more comprehensively trained model.

Consider the following questions:

1. Was that the sound of glass breaking?

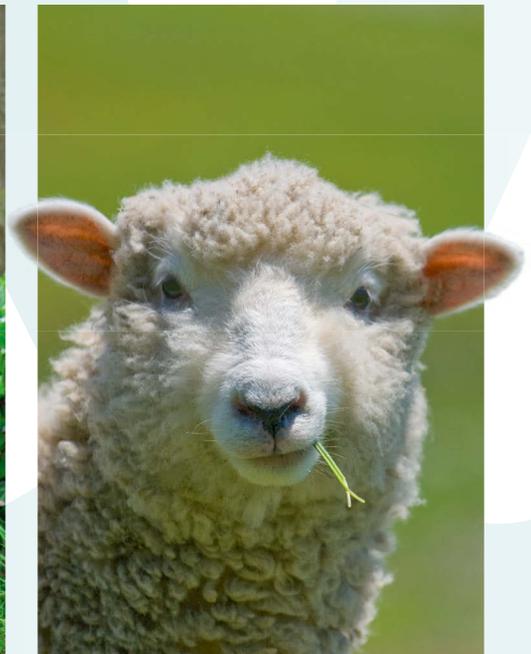
or

2. What was that sound?

The first question has a specific frame of reference, and the decision-making process only needs to evaluate if this is glass or not glass. A well-trained model with a comprehensive library of sample data would most likely produce reliable results.

The second question however requires far more ‘intelligence’ to be included in the AI model. The machine must be able to categorise a sound into one of many choices, based on some training and then make a decision about the most suitable option for the classification. This requires much more extensive training data and subsequently leads to a more involved process.

The following visual example illustrates this idea and the complexity that can be involved in automating a decision-making process. Much like in acoustics, introducing some background noise can quickly make things more complicated.



Machine learning techniques for audio analysis

The first technical step in a machine learning task is feature extraction. This is the process of analysing the input to find some high-level indicators that can be used to identify these inputs under one or more headings. Of course, in the case of acoustics we are most commonly talking about audio files and features of a sound signal. Feature extraction allows an ML algorithm to identify and learn the key aspects of characteristic audio samples such as speech, music, specific events, gender or emotion, depending on the granularity of the application. **P52**

Below left:
Figure 1:
Is this a dog?

Below Right:
Figure 2:
Is this a dog?

Bottom:
Figure 3:
Is this a dog?

Audio feature extraction is usually performed on short time frame segments, usually of 10 to 100ms duration. So rather than analyse a full audio sample of say 30s, much shorter segments are analysed separately, and the results can be averaged across the full recording. There are a few reasons for this approach, but of most relevance is the robustness that it delivers for an audio classification model.

This windowing technique splits the audio sample into a number of short segments. The short frame sizes also allow for better separation between audio events, which might otherwise be conflated in one long audio sample. Analysing a signal in short windows helps to account for the fact that the acoustic signal is always changing. Short duration events and more salient features in the audio sample can be detected more accurately using this approach.

Any audio file contains a wealth of information that can be used to detect patterns and label content. The analysis techniques used to extract these features can vary depending on the application i.e. speech recognition, music genre identification or more general audio scene classification. The features that are computed for each individual segment can either be time-based features, based on the raw audio signal e.g. wav file, frequency domain features from a Fast Fourier Transform (FFT) or cepstral features based on the cepstrum of the signal. The short audio segments sacrifice resolution in the frequency domain (less samples for an FFT), but they add flexibility to the technique by allowing larger audio samples of varying lengths to be analysed in micro segments, with the average results being used to classify the full file.

Audio signal features

Energy – assuming all audio recordings are normalised, the RMS amplitude can give an indication of the overall loudness of the file. Rock music will usually have a higher RMS amplitude than classical music, while angry or emotional speech track may be higher than a calm conversation.

The zero crossing rate is extensively used in music genre and speech recognition analysis.

The zero crossing rate measures how many times the waveform crosses the zero axis within an audio frame. This feature is used good to effect in music recognition applications, with highly percussive genres like rock and pop generally having a higher zero crossing rates. The metric can also be used a rough indicator of the presence of speech in an audio track, with speech segments having distinguishable characteristics when compared to instrumental music frames.

Spectral features

Where machine learning approaches differ from more traditional acoustic signal analysis is the ability to leverage the extensive work that has been done in image recognition to identify sounds based on a spectral image of the signal i.e. a spectrogram. Converting an audio track into a frequency domain image file allows the use of highly sophisticated image processing tools to develop faster and more efficient ML models. In essence, the machine is ‘looking’ at the signal and deciding what the spectral image represents.

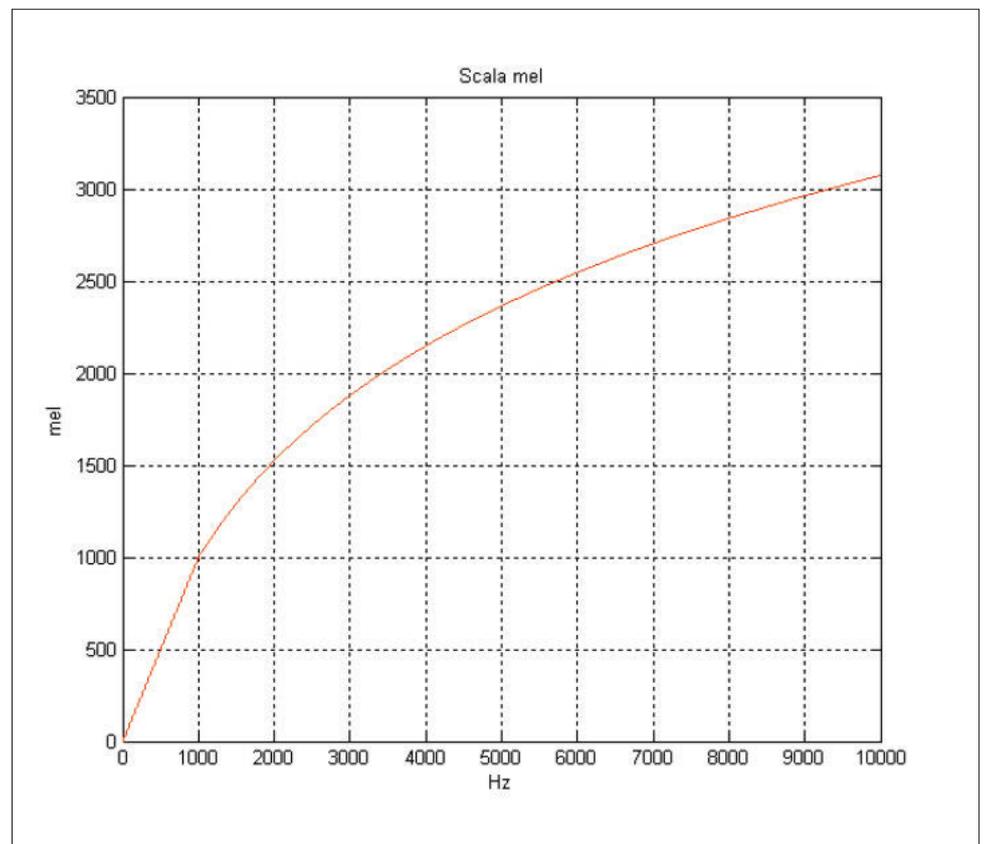
Representing perceptual information

In this approach, sound samples are converted into visual representations of the most important information in the signal before being processed in the AI model. This additional step of extracting the most relevant data involves the use of the Mel Scale to highlight perceptually important features.

The Mel Scale accounts for the human ear’s ability (or inability) to distinguish between changes in frequency. In the same way as we use the decibel scale to represent changes in amplitude with more relevant steps, the Mel Scale represents changes in frequency in perceptually relevant steps.

So rather than using a spectrogram as an image of the signal, most audio classification techniques use the Mel frequency approach to ‘zoom in’ on the perceptually relevant information within the spectrogram. An additional step of calculating the cepstral coefficients may also be used to give a representation of the short-term power spectrum, resulting in a bank of Mel Frequency Cepstral Coefficient (MFCC) values which are used to represent the signal.

Below:
Figure 4: Mel Scale plot
Mel scale (https://en.wikipedia.org/wiki/Mel_scale)



Model development and detection

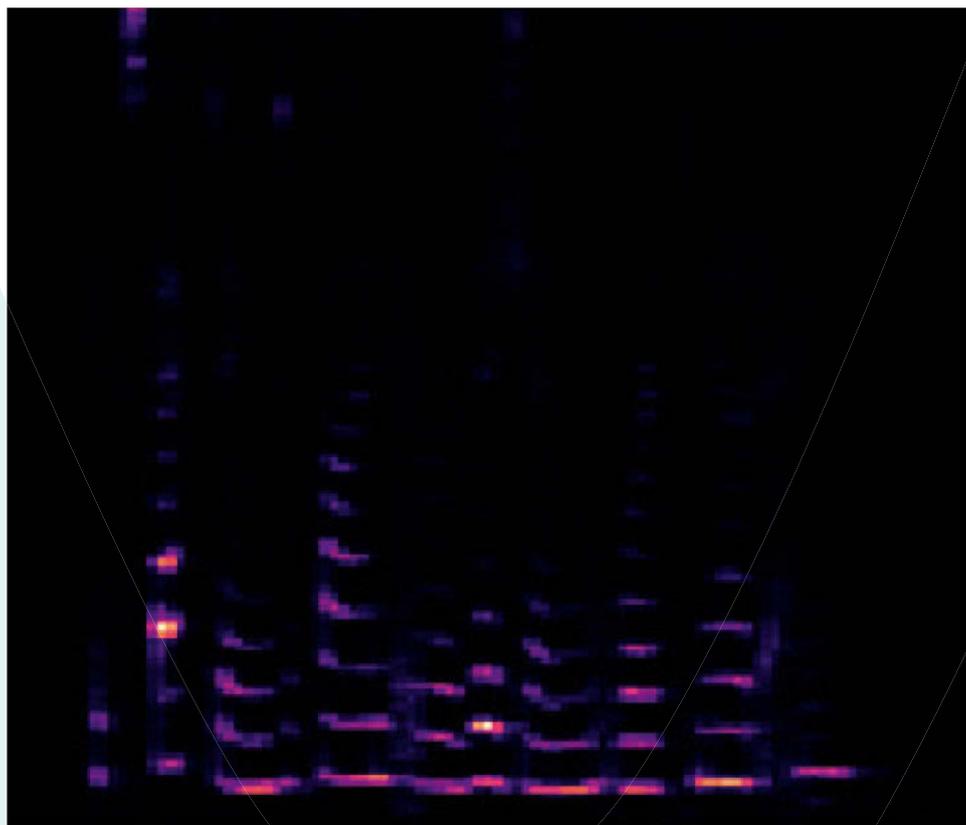
These Mel frequency spectrograms are then fed to a Convolutional Neural Network (CNN), a classification technique which is widely used in image processing and recognition applications. This type of algorithm is highly effective at analysing and weighting the content of images and also requires less pre-processing than alternative classification approaches¹.

The CNN extracts the features of the spectrogram which are relevant for machine learning model classification. The labels applied to the original audio training files are then associated with these feature sets. When the AI model detects the occurrence of a particular feature set in any subsequent audio stream (from the averaged results of the microsegments) then the associated label can be applied.

Instrumentation and measurement

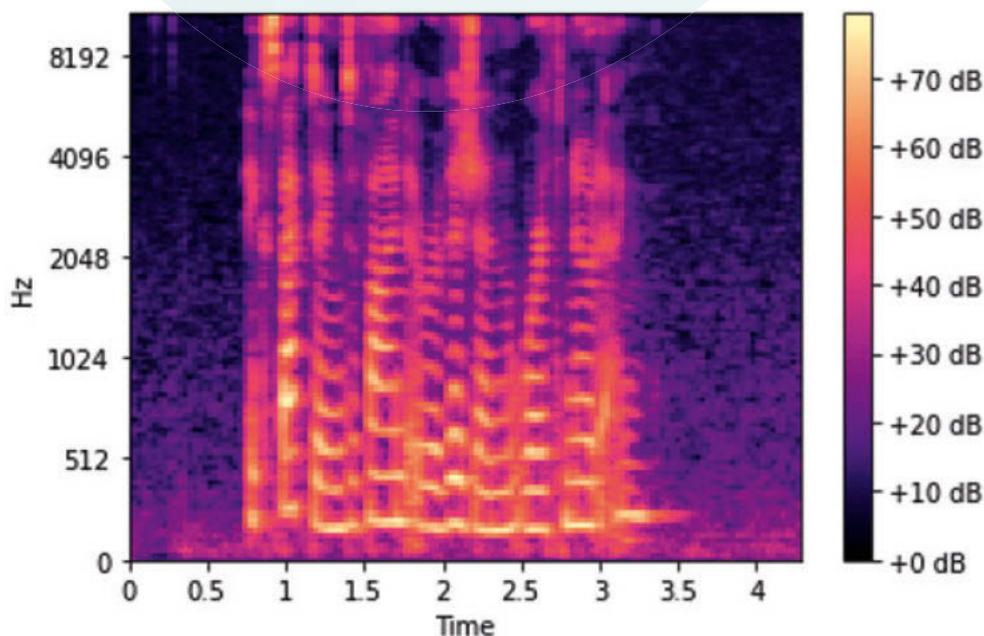
So, what does all this have to do with instrumentation and measurement? Well, with the proliferation of smart devices and the increase in portable computing power, far more of this computation is now possible in the field. This is known in the sensor network industry as “processing at the edge,” where most of the data processing is done on a device in the field.

The processing intensive steps of training and developing audio recognition models can be done using cloud computing resources or high-powered computers, but the final AI models that are used can be relatively lightweight in computing terms. This means that the hardware that is performing the audio recognition does not need particularly large amounts of power or resources to simply capture an audio stream and classify the sounds. Furthermore, all major chip manufacturers are now including artificial intelligence hardware in their future roadmaps. This hardware-accelerated AI will perform these classifications faster and more efficiently than current versions, further reducing the barriers to wide-scale deployment of the technology. [P54](#)



Above:
Figure 5: Spectrogram of a signal with sparse information

Below:
Figure 6: Mel Frequency Spectrogram of the same signal with rich information (Ketan Doshi, <https://tinyurl.com/45zptxfk>)



Footnote

1. <https://ieeexplore.ieee.org/abstract/document/7952132r>

This gives audio professionals the opportunity to develop and deploy networks of sensors, appliances or sound level meters that can not only measure sound, but also understand the context of the soundscapes they are measuring.

A short search in any patent listing can reveal a range of possible applications from lifesaving medical devices to coffee machines that can hear when the washing machine stops. As the technical barriers continue to fall, audio recognition will no doubt become even more ubiquitous.

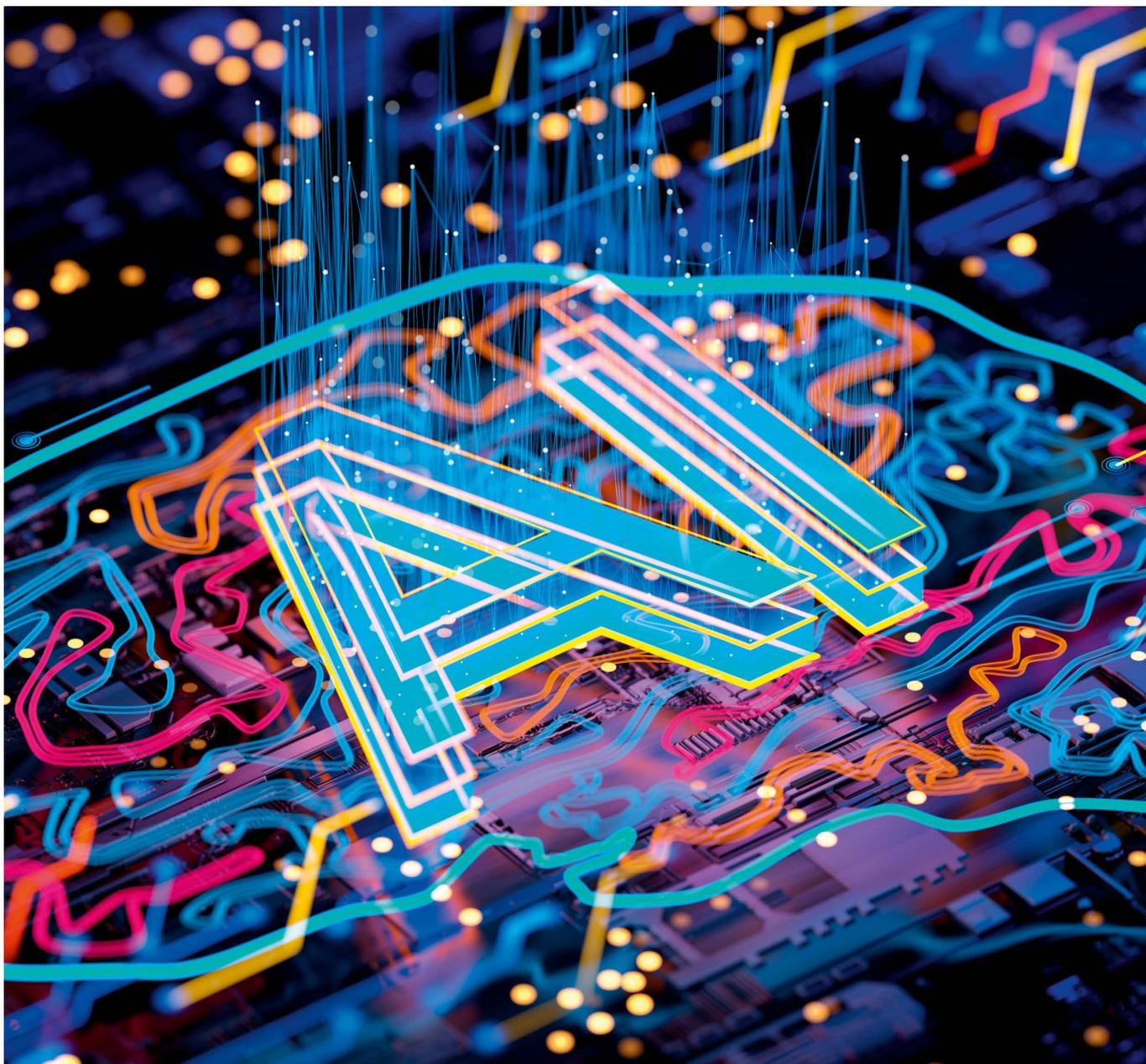
Frequency response and microphones

For use cases with high accuracy requirements; consideration should be given to how the training audio data is captured and how that compares to the audio device used in the field. For example, if an AI model is trained using audio files sampled at 48 or 96kHz and recorded with studio quality microphones in an anechoic chamber then the resulting audio will sound impeccable. If the resulting AI model were deployed on a device with a low-cost microphone, housed inside an appliance, mounted in a dashboard or carried in one's pocket, then the quality of the measured audio in the field could vary significantly. The influence on frequency response by

a change of microphone or a device housing cannot be neglected where computational resources at the edge might be constrained. Model development and training should either be done on representative audio samples or should be tested extensively for robustness to field conditions.

While the technical barriers to developing a sensor and ML tools are certainly dropping, there are sensitive applications in healthcare, condition monitoring and security that will always require the expertise of a seasoned acoustician to use their own ears and make sense of the signals.

And for those among you who get the sense that your phone might be listening to you...the answer is almost certainly, yes. 📍





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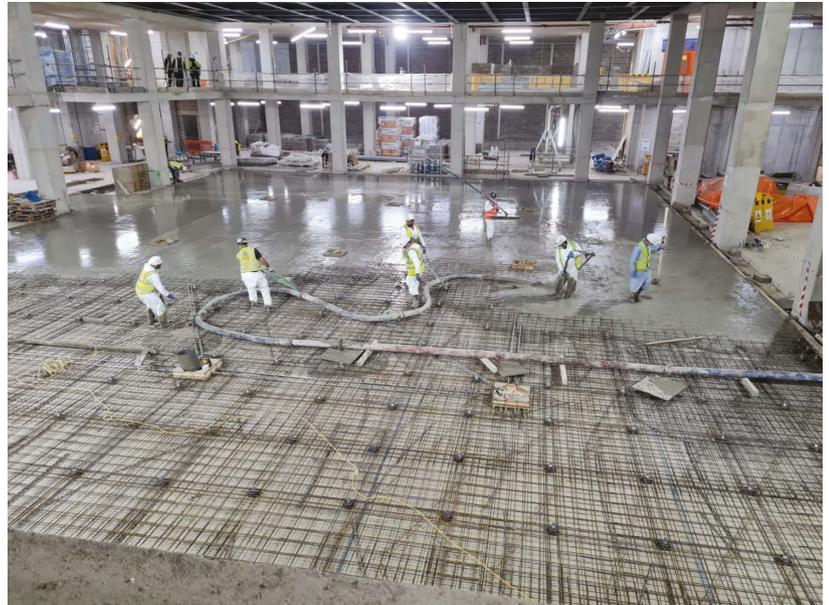
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The Game of Tones

A discussion about the past, present, and possible future of tonality evaluation in BS 4142.

By Matt Torjussen CEng MIOA, Acoustics Lead at ANV Measurement Systems

This article explores the different ways in which BS 4142 treats tonality in industrial and commercial sound, the underlying evidence, and emerging alternative techniques. Results from a recent online aural experiment (the 'Game of Tones') are also presented, which underline the need for improved guidance on how tonality should be treated in the standard.

The 2014 edition of BS 4142¹ was a major revision of the standard with greater provision for the treatment of noise 'character' of industrial and commercial sound. The standard includes three methods for assessing the prominence of tones in the sound of a specific commercial or industrial sound source: a subjective method, an objective method and the second version of the Joint Nordic Method² (JNMv2) used as a reference method. There is also provision for a graded penalty to the 'specific sound level' to derive the 'rating level' for the Subjective and Reference methods.

The inclusion of two objective methods was specifically to address problems with the implementation of BS 4142 that were highlighted as early as 1990;³ however, the Subjective method of assessment remains the primary means of evaluating the prominence of tones.⁴

The decision to include JNMv2 in BS 4142 followed an extensive review carried out to identify objective methods for identifying acoustic features in industrial sound, which was completed in 2005.⁵ In total, 20 different methods were identified for evaluating the

tonal content in sound. Each of these methods was examined for; how sophisticated/complex they were, how representative they were of the human auditory system and whether or not they estimated the extent of the adverse response (i.e. what penalty to be applied to the L_{Aeq}). The lineage of each method was traced as part of a literature review, which illustrated how many had evolved from common roots, and the methods tended to fall within three broad camps: Tone-to-noise ratio (TNR), prominence ratio (PR), and psychoacoustic.

Tone-to-noise ratio

The TNR family of methods ratios the rms sound pressure contained within a narrow band of sound considered to be the tone to the rms sound pressure of the masking noise. At its most simple level, this takes the form of comparing the sound pressure in the 1/3rd octave band containing a tone to that in the two adjacent bands. TNR is more commonly implemented using spectral estimation, comparing the rms sound pressure within the half or quarter-power bandwidths of the tone to the remaining rms sound pressure within the critical band. The idea of the critical band is a psychoacoustic concept so, in this respect, the more sophisticated TNR methods can be considered to be at least partially psychoacoustic.

Both the 'Objective' and Reference methods from BS 4142 for evaluating tonality use the tone-to-noise ratio principle. The 'Objective' method uses 1/3rd octaves and the Reference method is version

two of the Joint Nordic Method (JNMv2). Note that the 'Objective' method from BS 4142 has been differentiated from others using inverted commas.

Prominence ratio

The PR family of methods ratio the rms sound pressure contained within the critical band to the rms sound pressure contained in the adjacent critical bands. This makes the method suitable for tonality caused by sounds containing more than one pure tone (i.e. more than one peak in the spectrum); however, the method could be limited where the adjacent critical bands also contain tones.

Both TNR and PR require high frequency resolution, which for industrial and commercial sounds, can be challenging where both the specific sources and the residual sound are constantly changing in time and frequency.

Psychoacoustic tonality

Full psychoacoustic tonality takes account of the physical characteristics of the human auditory system. During the original 2005 review psychoacoustic metrics were restricted to the Aures method,⁶ which was not thought to be implementable the type of equipment commonly used by environmental acoustics practitioners at the time. The results of the Aures method are also potentially less useful than PR and TNR as it provides only a ratio of the overall tonal to non-tonal loudness. Without spectral information, the scope of the method is limited as it could not be used to identify the most dominant tonal

References

- BRITISH STANDARDS INSTITUTE (2019), BS4142: 2014+A1: 2019 Methods for Rating and Assessing Industrial and Commercial Sound, [Online] London, BSI
- PEDERSEN, T. H., SONDERGAARD, M., ANDERSON, B. (1999). Objective Method for Assessing the Audibility of Tones in Noise (Joint Nordic Method – Version 2), [Online], DELTA Acoustics & Vibration
- PORTER, N. D. (1995) Study of the Application of British Standard BS 4142:1990 Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas (The Data Sheet Study), [Online] London, National Physical Laboratory
- THE ASSOCIATION OF NOISE CONSULTANTS, (2020). BS4142: 2014+A1: 2014 – Technical Note (Version 1.0), [Online], ANC
- BERRY, B. F., PORTER, N.D., (2004). National Measurement System Acoustics Programme: NMS Project 2.2: Environmental Noise, Progress Report 5, [Online], Hoare Lea Acoustics
- FASTL, H. AND ZWICKER, E., (2007). Psychoacoustics: Facts and Models, 3rd Edition, Springer

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1	Fluid Layer	Fluid Layer	50
2	Porous Layer	Porous Layer	50
3	Perforated Plate	Perforated Plate	5

Total Thickness: 105.00 mm

Perforated Plate Properties

Hole diameter (mm): 1.0

Perforation ratio: 0.100

Width (m): 3.00 Area: 12.0 m²

Length (m): 4.00

Graph: Absorption coefficient (Random incidence) vs Frequency [Hz]. The curve shows a peak absorption coefficient of approximately 1.0 at 500 Hz.



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features from a variety of industrial or commercial sources.

Whilst a full intercomparison was not made at the time, JNMv2 was not superior to other methods that had been tested, which included DIN 45681 2002, ANSI S1.13 TNR and ANSI S1.13 PR.⁷ Subsequent to this original review TNR, PR^{8,9}, and psychoacoustic methods¹⁰ for evaluating tonal content in sound have been developed and further standardised. All these methods are readily implementable in modern PC software and handheld analysers.

Subjective vs. objective

As part of the original review carried out in the UK, sound recordings which had previously been used by W. Pompetzki in Germany,¹¹ were presented to a panel of listeners at an IOA conference.¹² The listeners were asked to rate the recordings as to what degree they contained ‘...droning, whining, singing, screeching and whistling...’ on a scale from 0 (no tonal components) to 5 (clearly heard). These ratings corresponded to an acoustic feature penalty applied during the numerical assessment from BS 4142 in dB. The results of this study are the results presented in Figure 1.

With the 2005 review of objective metrics seemingly a distant memory, there was a flurry of ‘subjective vs. objective’ studies carried out in the wake of the revision of BS 4142

in 2014.^{13,14,15,16,17} These tended to illustrate that the objective methods were not strongly correlated with the subjective rating. Acousticians’ opinions on the principal conclusions that should be drawn from these studies seem to be broadly that:

- 1 The objective measures of tonality do not provide an accurate prediction of their own professional opinion and are, therefore, unreliable; or
- 2 The subjective ratings vary widely for any given audio sample, which necessitates an objective measure based on a statistical model to provide a repeatable and reproducible means of evaluating tonality.

A statistical model is a formal representation of the relationships between variables, which can be used to try and explain an underlying relationship or predict future outcomes.¹⁸ The relationship between the perception of a sound and its physical characteristics is often characterised using statistical models; this is not always as grandiose as it sounds. Figure 1 showed a scatter plot from Berry & Porter’s study in the early 2000s where it is clear that the objective penalty obtained using JNMv2 is broadly correlated with the subjective penalty from the audience at the IOA conference.

The line fitted to the data is a very simple example of a statistical

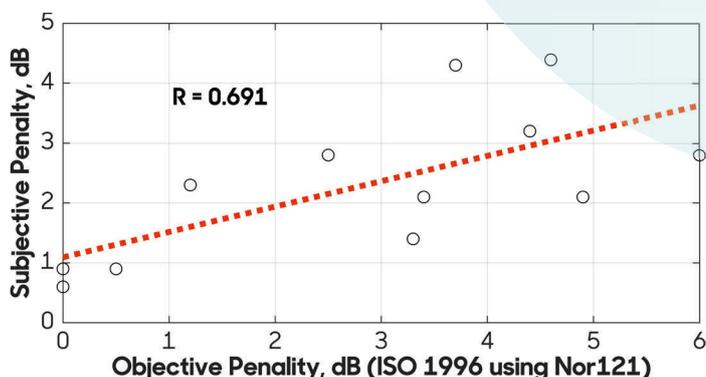
model. For any straight line that is chosen, each data point gives rise to a residual, which is the size of the error that would result from using the straight line to predict the subjective penalty given the objective evaluation (and vice-versa it should be added). These residuals can be minimised by using least-squares regression, which is as simple as ensuring that the sum of the squared differences between the observations and the line is minimised. It is this line that is generally referred to as the ‘best-fit’ line.

In regression analysis, the dependent variable is the quantity that we want to predict or explain, usually forming the vertical (or ‘y-axis’) on a scatter plot. The independent variable is the quantity that we use for doing the prediction and is usually on the horizontal (or ‘x-axis’). The resulting gradient of the line indicates the degree to which the dependent variable changes on average, if we observe a one-unit difference for the independent variable.

Those who prefer to rely on a subjective assessment tend to make two errors in their interpretation of any ‘subjective vs. objective’ study, that:

1. The subjective penalty is the independent variable, and the objective penalty the dependent variable; and
2. The residual is a failure of the statistical model.

The correct approach should be to consider the subjective penalty as the dependent variable, understand that any observation will always be the sum of the deterministic model plus some residual error, and then to investigate whether the independent variable is the correct measurand, where it is failing and how it may be improved. We do not expect this difference to be the one true value, **but it is the best guess.** 



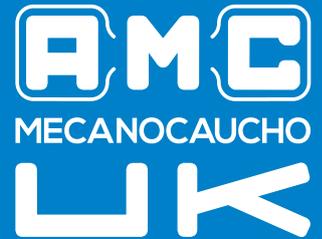
Left:
Figure 1:
Subjective vs. objective results for Berry and Porter’s study carried out in the early 2000s

References

- 7 BERRY, B. F., PORTER, N.D., (2005). National Measurement System Acoustics Programme: NMS Project 2.2: Environmental Noise, Progress Report 6, [Online], Hoare Lea Acoustics
- 8 BRITISH STANDARDS INSTITUTE, (2016). BS ISO PAS 20065: 2016 Acoustics – Objective Method for Assessing the Audibility of Tones in Noise – Engineering Method, London, BSI
- 9 DEUTSCHES INSTITUT FÜR NORMUNG, (2006). DIN 45681-2:2006 Acoustics – Determination of Tonal Components of Noise and Determination of a Tone Adjustment for the Assessment of Noise Immissions, DIN
- 10 ECMA INTERNATIONAL, (2020). ECMA-418-1 Psychoacoustic Metrics for ITT equipment – Part 1 (Prominent Discrete Tones), Geneva, ECMA
- 11 POMPETZKI, W., (1999). Vergleich der Tonhaltigkeit nach DIN 45 681 mit subjektiven Bewertungen, Fortschritte der Akustik, DAGA 98, pp.224-225
- 12 BERRY, B. F. & PORTER, N. D., (2005). A Review of Methods for Quantifying Acoustic Features in Environmental Noise, Proceedings of the Institute of Acoustics, Volume 27(4)
- 13 TORJUSSEN, M., (2017). A comparison of the subjective and Reference methods for evaluating the tonal character correction in BS4142:2014, Proceedings of ICSV
- 14 WISNIEWSKA, S., (2018). Evaluation of the Subjective method in BS4142:2014 for sound characteristics, Proceedings of the IOA
- 15 GHANI, R. & WADDINGTON, W., (2018). Perceptual Testing of BS4142: 2014 character corrections, Proceedings of the IOA 2018
- 16 BRESLIN, M., (2018). Subjective evaluation of tonality and impulsivity in accordance with BS4142:0214 – and analysis of the audience results from five IOA branch meetings (Part 1), IOA Bulletin
- 17 BRESLIN, M., (2018). Subjective evaluation of tonality and impulsivity in accordance with BS4142:0214 – and analysis of the audience results from five IOA branch meetings (Part 2), IOA Bulletin
- 18 SPIEGELHALTER, D., (2019). The Art of Statistics: Learning from Data, Pelican

Efficient isolation solutions for light wooden structures.

This article shows the tests results for floating floor and hanging ceiling installations when used in light wooden structures, the results are compared to a solution without isolation elements.



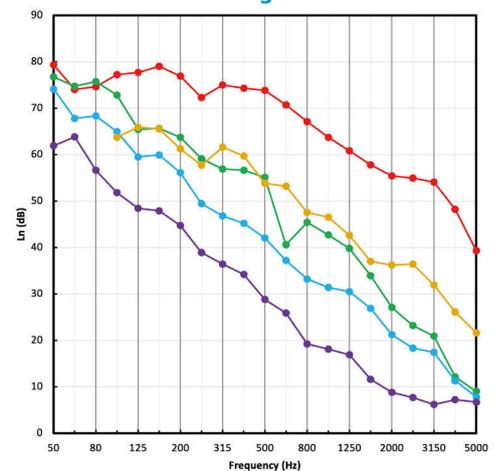
Manufacturing solutions for architectural acoustics and vibration problems since 1969.



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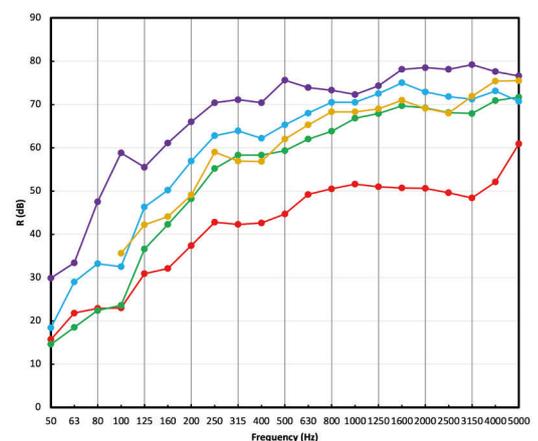
RESULTS OF THE LABORATORY TESTS

IMPACT NOISE RESULTS Calculated according to ISO 717-2: 2013



- RC Reference - 70,6 (0) dB
- S1 System 1 - 57 (3) dB
- S2 System 2 - 50,2 (2) dB
- S3 System 3 - $\geq 38,3$ (2) dB
- S4 System 4 - 55,8 (1) dB

AIRBONE NOISE RESULTS Calculated according to ISO 717-1: 2013



- RC Reference - 48 (-2;-7) dB
- S1 System 1 - 59 (-7;-16) dB
- S2 System 2 - ≥ 67 (-7;-15) dB
- S3 System 3 - ≥ 74 (-2;-7) dB
- S4 System 4 - ≥ 63 (-3;-10) dB

SCHEME

DESCRIPTION

REFERENCE CONFIGURATION

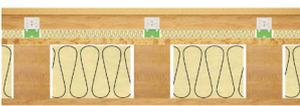
RC



- 22mm Chipboard
- 120x180 mm section wooden beams (100mm mineral wool between)
- 24 mm wooden battens
- Plasterboard

SYSTEM 1

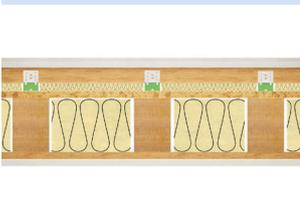
S1



- 22mm OSB
- 50mm wooden battens (45mm mineral wool between battens)
- **Akustik + Sylomer® floor mount 25**
- 22mm Chipboard
- 120x180 mm section wooden beams (100mm mineral wool between)
- 24mm wooden battens
- Plasterboard

SYSTEM 2

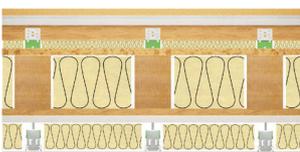
S2



- Rigidur plate H13 BR - 13mm (cement board)
- Rigidur 20mm
- 50mm wooden battens (Mineral wool between battens)
- **Akustik + Sylomer® floor mount 25**
- 22mm Chipboard
- 120x180 mm section wooden beams (100mm mineral wool between)
- 24 mm wooden battens + 1 gypsum board

SYSTEM 3

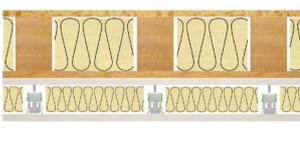
S3



- Rigidur plate H13 BR - 13mm (cement board)
- Rigidur 20mm
- 50mm wooden battens (Mineral wool between battens)
- **Akustik + Sylomer® floor mount 25**
- 22mm Chipboard
- 120x180 mm section wooden beams (100mm mineral wool between)
- 24 mm wooden battens + 1 gypsum board
- **Akustik + Sylomer 30** Acoustic Hanger with a 280 mm plenum (90mm of mineral wool)
- 2 laminated 12,5 mm thick plasterboard

SYSTEM 4

S4



- 22mm Chipboard
- 120x180 mm section wooden beams (100mm mineral wool between)
- 24 mm wooden battens + 1 gypsum board
- **Akustik + Sylomer 30** Acoustic Hanger with a 280 mm plenum (90mm of mineral wool)
- 2 laminated 12,5 mm thick plasterboard

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The regression model used to derive a predicted subjective rating is designed specifically for this task. The purpose of the regression model isn't to predict the response of any one individual but to predict the average response of a group. What's important to keep in mind is that all models are wrong but this doesn't mean they're not useful. If an environmental noise practitioner is relying on their own subjective judgement alone, their conclusions are subject to their own hearing acuity, past experience and social views and, crucially, technical ability. BS 4142 asks us to apply character penalties if they 'are present', not whether one individual can hear them, whether that individual thinks it is audible but is ok in that particular context, or because they'll add 5 dB anyway because they're not sure and they always add 5 dB to be on the safe side.

The objective methods in BS4142

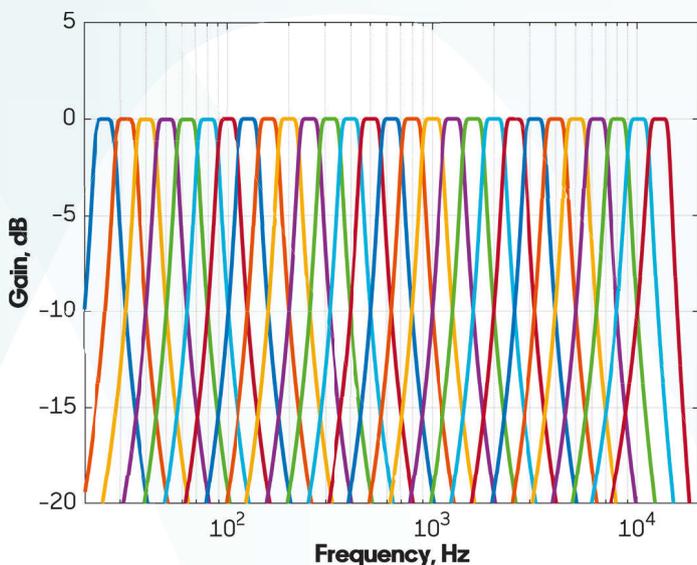
The 'Objective' and Reference methods from BS 4142 are limited and were selected because they were a practically implementable field measurement and the state-of-the-art at the time, respectively. Both methods were already present in what was the current version of ISO 1996. It is obvious that they will

now have been surpassed given the intervening time and resulting technological advances.

The 'Objective' method, whilst rigid and readily implementable using technology available to the typical environmental noise practitioner, often fails to capture tonality because the frequency resolution is far too broad, the bands are not centred on the tones under assessment and overlap each other. This is illustrated in the filter responses shown in Figure 2.

The frequency resolution of the overlapping bands means that the method can poorly resolve tones in broadband noise, be unable to handle multiple tones and miss tones that fall between the bands. Some of the quirks of the "Objective" method have been illustrated in Figure 3, which presents (a) a tone in random noise, (b) three tones, each in adjacent bands, and (c) a tone on the edges of two bands. These shortcomings are documented in the recent ANC guidance document.¹⁹ [P62](#)

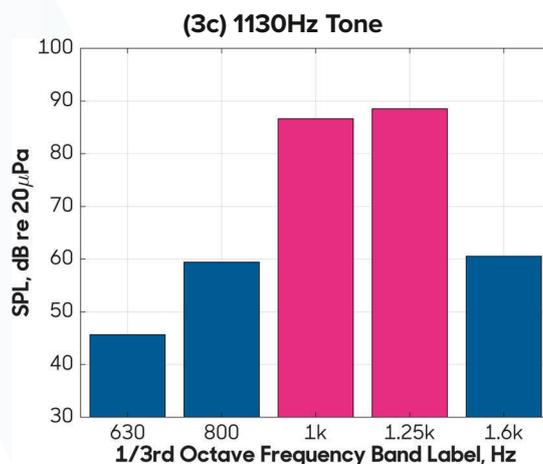
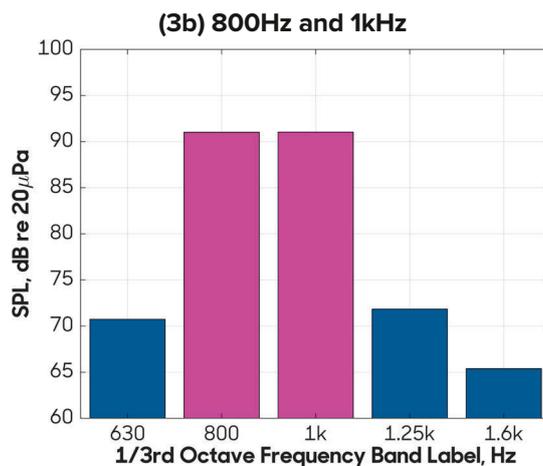
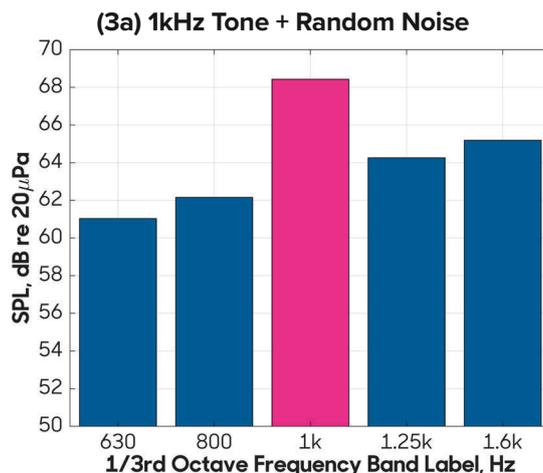
Right: Figure 3: 1/3rd octave band spectra for three signals on which the 'Objective' method performs very poorly. Scan the QR codes to hear the sounds on a smartphone or tablet



Above: Figure 2: Frequency response of a 1/3rd octave frequency filter bank between 25Hz and 12.5kHz. The filtering is implemented as described in ISO 532-1:2017

References

19 ASSOCIATION OF NOISE CONSULTANT, (2020). BS 4142:2014+A1:2019 Technical Note Version 1.0 the audience results from five IOA branch meetings



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Below:
Figure 4:
 Illustration of how the FFT analysis of intermittent tones can change the results of a tone audibility assessment using JNMv2.
 (a) A continuous 1kHz tone at 94dB,
 (b) A pulsing 1kHz tone with a duty cycle of 50%,
 (c) Beating tones at 1kHz and 1000.5Hz,
 (i) Complete 10-second signal,
 (ii) 12ms 'snippet',
 (iii) Resulting autospectra created with 2^{15} point non-overlapping Hann windows, the signal's sampling rate was 48kHz and the resulting frequency resolution was $\Delta f = 1.46\text{Hz}$.
 Scan the QR codes to hear the sounds on a smartphone or tablet

In the case of Figure 3(a), there is a 1kHz pure tone in random noise that is elevated 4 dB above the adjacent band, but this would be insufficient to be deemed a 'prominent discrete tone' using the 'Objective' method. In Figure 3(b), two tones in sequential bands mean that no single one is elevated sufficiently above another despite these two tones combining to make a sound that could easily be described as more tonal than either of them individually. Finally, Figure 3(c) shows the biggest oversight; a tone right on the edge of two bands contributes energy to both because they are overlapping, which results in a tone that would not be considered prominent and discrete despite being quite obvious to the listener.

BS 4142's Reference method is based on the psychoacoustic principle of critical bands but it is not a 'full' psychoacoustic method and is a simple ratio of the sound pressure attributed to the tone with the sound pressure in the critical band attributed to the masking

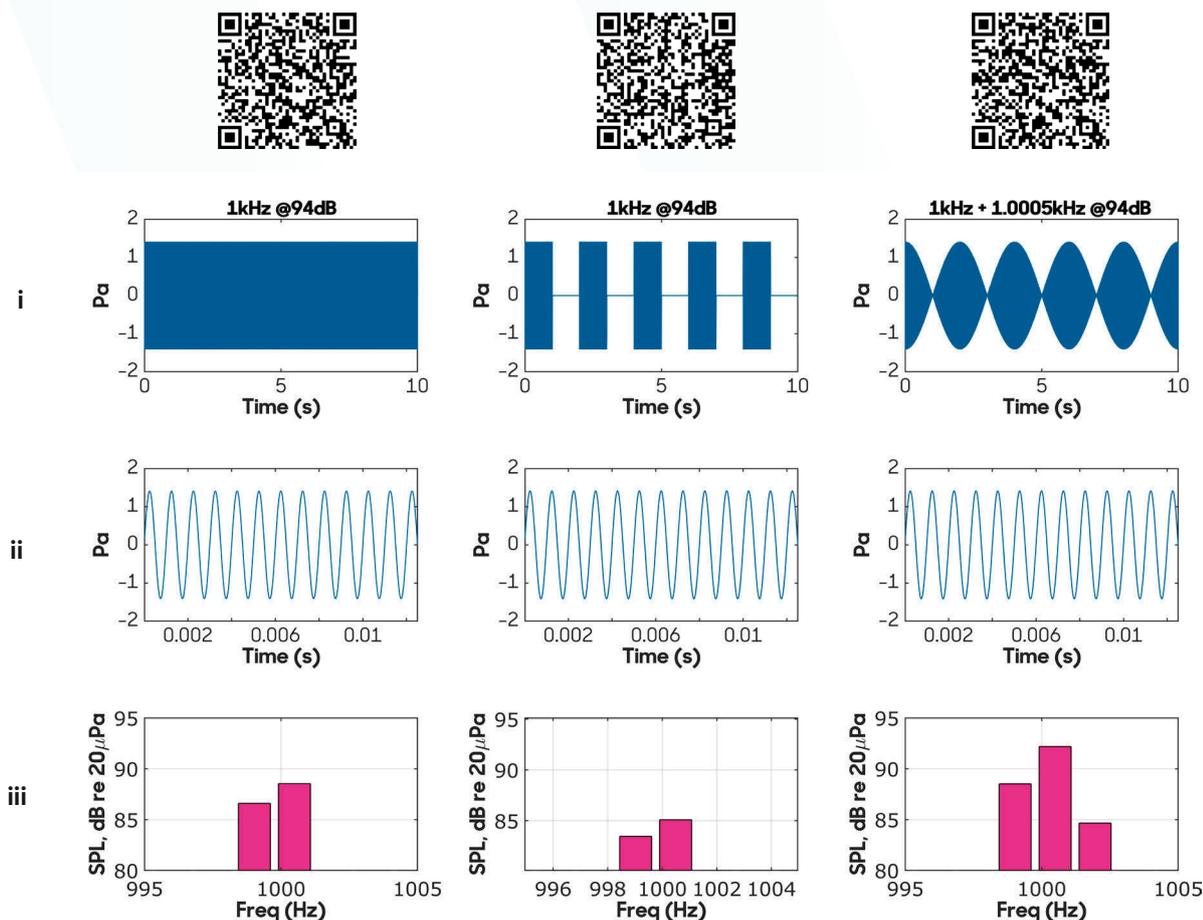
noise. This simple ratio doesn't take into account the absolute level of the tone, which overlooks the perceived loudness, something that isn't a linear quantity.

As well as this fundamental flaw, there is also significant scope for interpretation in the method because it uses 'preferably FFT analysis'. Anyone who's ever sat down to do FFT (Fast Fourier Transform) analysis of a sound signal will know that that the Fast Fourier Transform really is only the foundation of frequency estimation, there's also windowing and averaging to consider and then there's the decision about whether you're interested in power spectra, rms spectra, autospectra or maybe even the power spectral density? Physically, these are all very different things and some of them will produce meaningless results for an acoustician concerned with human response to sound. For those who want (or need!) to know more, the white paper on the subject by National Instruments is recommended reading.²⁰

BS 4142 asks for 'averaging for at least 1-min' and that if 'the frequency of the audible tones in the spectrum varies by more than 10% of the frequency range of the critical band within the averaging time, it might be necessary to subdivide the long-term average into a number of shorter-term averages'. 'It might be necessary' underplays the problems that are encountered regularly when analysing real environmental sound signals and glosses over some of the technical knowledge that might be required just to understand what it means. By way of example, we can look at how time averaging could affect the results of FFT analysis for intermittent tones and tones that vary in frequency.

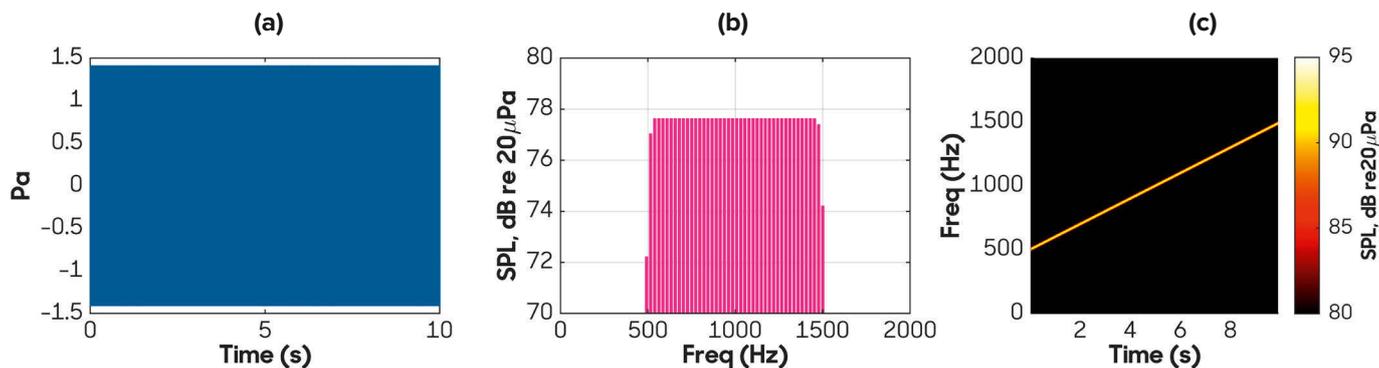
Intermittent tones

For simple intermittent tones, like reversing alarms or beating tones, averaging FFT windows over time will result in the tones having reduced amplitude. This is illustrated in Figure 4.



References

20 NATIONAL INSTRUMENTS, FFT Use in NI DAdemTM, www.ni.com



Above: Figure 5: Illustration showing how a tone that varies in frequency with time is poorly characterised by a time-averaged autospectrum. Scan the QR code to hear the sounds on a smartphone or tablet



The first row of Figure 4 shows the time signal with (a) a continuous tone, (b) containing a pulsing tone and (c) containing two tones beating with each other; the second row zooms in on these time-series to show that the sounds are, or are a combination of, pure sine waves. The autospectra for these signals is shown in the third row.

When the tone is pulsing on and off there is a clear 3 dB drop in sound pressure level and it is obvious why; there is reduced energy at these frequencies because it is only present for half of the time. However, this wouldn't correlate with the perceived tonality in the same way because the intermittency could make the sound more noticeable. The practitioner would need to be aware of this when carrying-out a tone audibility analysis using JNMv2. When the 1kHz tone is supplemented by one at 1000.5Hz and the peak amplitude

maintained at 94 dB the two beat with one another, the amplitude of the spectral lines containing these tones increases by 3 dB despite the perception not being dissimilar to case (b). The same would be the case for a continuous tone in time-varying background noise, with the tone audibility level being affected by the changing sound pressure level of masking noise for a fixed tone sound pressure level.

These quirks are born out of the FFT analysis, not of any psychoacoustic principle. The human auditory system doesn't operate like a pure Fourier analyser but, in fact, pitch perception is based on both spectral and temporal cues.²¹

Tones varying in frequency

With the exception of tones produced by resonances or machines whose speed is regulated by the mains supply, the vast majority of tonal sources

will produce tones that vary with frequency as loading changes. An extreme example of this has been presented in Figure 5.

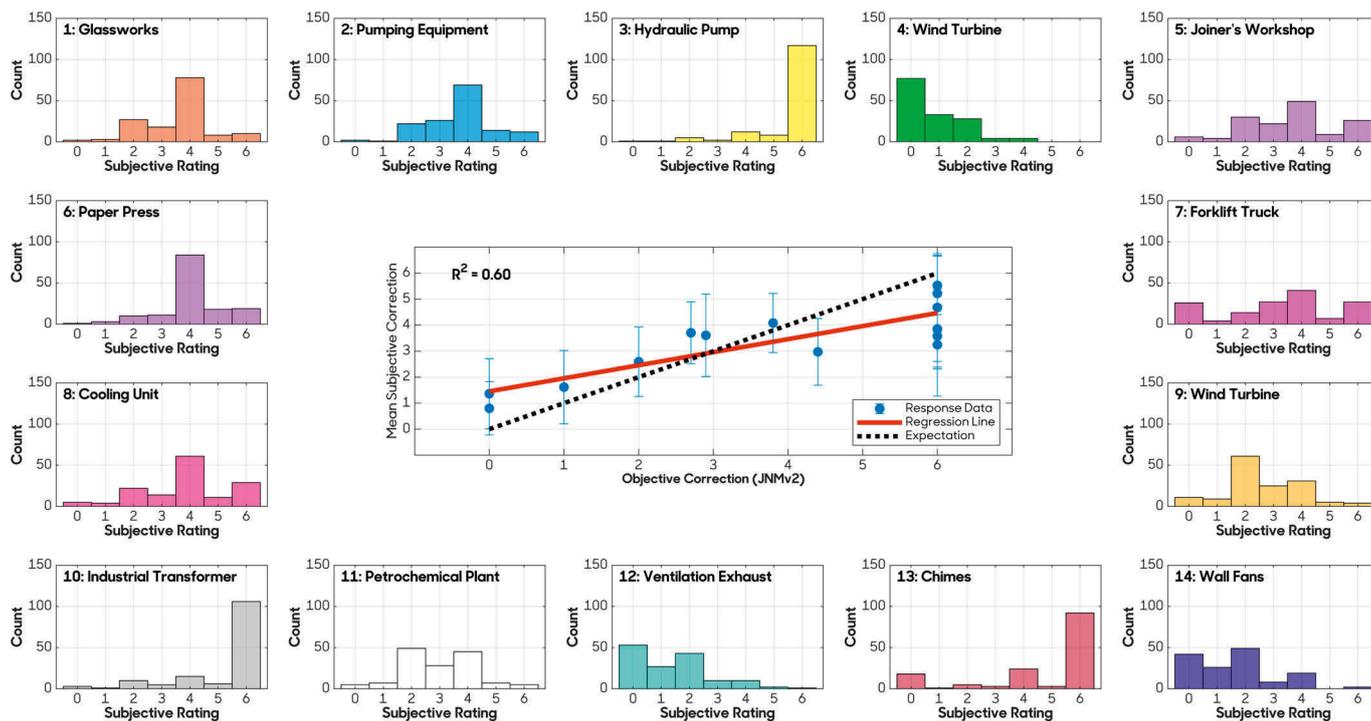
Figure 5(a) presents the time series for a constant amplitude tone with ramping frequency from 500Hz to 1.5kHz linearly over 10-seconds. Figure 5(b) shows that when the spectrum is averaged over the full 10-seconds, the tone appears as a smeared mess, and you wouldn't know from looking at it that there was a tone in the signal at all. By presenting each FFT window as a spectrogram instead, as in Figure 5(c), the highly tonal content becomes obvious. In this situation the tone audibility would be calculated for each window and then the results averaged afterwards; the risk with this approach is that, without averaging the non-tonal components, masking noise could be overestimated and the overall tone prominence underestimated.

P64



References

21 LICKLIDER, J. C. R., (1951). A Duplex Theory of Pitch Perception, Cellular and Molecular Life Sciences, vol. 7(4), pp. 128-134



Above: Figure 6: Subjective vs. Reference method results for the 14 Pompetzki recordings of industrial/commercial sound

The Game of Tones

In the early stages of the first 2020 Covid-19 lockdown, via the magic of Zoom, Pompetzki's original 14 recordings were played to an audience at an IOA online CPD session and 146 subjects completed an online survey, giving their subjective rating of the perceptibility of the tones in each recording. The results have been summarised in Figure 6.

It is clear from Figure 6 that there was near unanimity in opinions about some of the recordings, the most obvious examples are the hydraulic pump and the industrial transformer; which are both specific sound sources that might be expected to receive unanimous subjective ratings without the subjects even needing to listen to the recordings! Other recordings received a more mixed response and it is easy to imagine why this variation might come about.

Whilst BS 4142 encourages practitioners to apply penalties only for dominant acoustic features, consideration of context is not part of the numerical 'initial estimate'. The best example of this is Recording 13: Chimes, where 18 subjects identified chimes as not being tonal. Based on some nervous emails sent through after the survey, these respondents

are likely to have thought 'this isn't industrial sound, it's pleasant; therefore, I shan't apply a character penalty'. But this is not the instruction in BS 4142; the purpose is to apply a penalty if tonality is just, clearly or highly perceptible in the sound being assessed. Of course, chimes would never feature in a BS 4142 numerical assessment (except for maybe a chime manufacturing and test facility?) but it does illustrate the point that when left to a subjective judgement, other non-acoustic factors could clearly affect the practitioner's judgement.

The playback systems and audio quality are very likely to contribute to some of the more unexpected responses; this study was by no means gold-standard research. Whilst instructed to wear headphones it is likely that some of the participants didn't have access to headphones or that the headphones they were using were poor quality. This is likely to be why 40 people didn't rate Recording 10: Industrial Transformer as containing highly perceptible tones, with the correct playback system and an otologically normal expert listener, it is difficult to see how this recording could have been rated as anything but because of its strong 120Hz tone. This was confirmed by several of the objective methods presented in this article.

A scale of $KT = 0 \rightarrow 6$ dB in 1 dB steps was provided for respondents; however, BS 4142 only provides subjective descriptions for 0 dB (not tonal), 2 dB (just perceptible), 4 dB (clearly perceptible) and 6 dB highly perceptible. Overall, 79% of responses were even-numbered, which perhaps increases the standard deviation of the responses for each recording, masking what in reality might have been greater agreement.

There are also the grey areas discussed in the previous section. How does one subjectively rate modulating/beating, ramping or otherwise transient tones? It is reasonable to assume that some respondents would have rated them more highly because their transience makes them more noticeable in a short recording; equally, others may have rated them lower because they weren't present for a very long time. This is perhaps less ambiguous in BS 4142 than it first appears; a tonal character penalty should be applied 'where such features are present' depending on 'the extent to which such acoustically distinguishing characteristics will attract attention'. Note 2 in Section 8 of BS 4142 states that where more than one acoustic feature is present in the specific sound, character penalties

may be added arithmetically. Informal conversations with members of the EH/1/3 suggest that this only applies to impulsivity and tonality, reflecting Note 2's location after these two features in the commentary of section 9.2 but before intermittency and 'other sound characteristics'. What is certain is that further research is required on how the character penalties should be applied in combination with one another.

It seems that the lack of 'perfect' agreement between the subjective and objective ratings can be explained by how the sound was interpreted by the subjects and that there are unlikely to be any lurking factors in the Reference method's simple psychoacoustic regression model. Correct use of the Reference method requires some knowledge of the underlying signal processing but can help to avoid problems encountered when retrospectively analysing recordings, for example: a 120Hz tone from a (non-British/EU) transformer wouldn't be missed by the Reference method but could be missed by an environmental noise practitioner reviewing recordings in an office environment. The problems with the Reference method lie in the manipulation required to obtain meaningful results; adjusting averaging so as not to miss time-varying tones without allowing artifacts to contribute to the total tone sound pressure level, selecting the right FFT size to resolve the tone, deciding what the 'most-significant' tone is when dealing with multiple tones in a critical band and whether techniques such as overlap should be used, which aren't mentioned in the standard. Problems of level dependency remain.

The Reference method in BS 4142 is taken from ISO 1996-2:2007 which, in its 2017 revision, has now been superseded by a new engineering method for determining tonality. This is detailed in ISO/PAS 20065:2016, which is a publicly available standard that presents a very similar method to JNMv2, but with added detail about averaging,

the underlying signal processing and how to evaluate the uncertainty of the procedure. But the world of tonality evaluation is changing.

A hearing model approach

Hearing model tonality (HMT) was included as an appendix to the 15th and 16th editions of ECMA 74 before forming its own standard in ECMA 418-2:2020. The method is based on Zwicker specific loudness and a hearing model is used to separate the loudness caused by tonal and non-tonal components, which has a number of advantages. Most importantly, elevated bands of sound proximate to tones are differentiated from other masking sound and, because the method is based on a hearing model, the relative loudness and threshold of hearing are intrinsic.

By implementing many overlapped 1/2 critical bandwidth filters, the frequency resolution ranges from 3Hz at lower frequencies to 24Hz at the highest frequency, whilst maintaining a time resolution of between 40 and 5ms respectively.²² This can provide the time and frequency resolution required to identify time-varying tones that are often associated with industrial and commercial sound. It also resolves the periodic signature of beating tones within a critical band, which would allow these additional features to be identified and considered in any assessment.

A distinct advantage of using HMT for assessment of industrial or commercial sound is that it captures all of the features with a single set of input parameters, making it fully automated. This is important because planning applications in the densely populated UK often hinge on the outcome of environmental noise assessments. A robust, repeatable and reproducible evaluation procedure is essential for the avoidance of doubt and possible debate in a planning enquiry. This is an important point because the purpose of the existing Reference method is to be absolute; something it cannot claim to be.

Right: Figure 7: Stages of the HMT calculation procedure broken down into 9 Steps, referencing Figure 8 - Figure 13

Step 1

The signal

The method relies on a sound pressure time-series that has been measured with a sample rate of 48kHz. One can downsample a signal, taking care to avoid high frequency artifacts or, upsample with care to observe imaging (a form of aliasing).

Step 2

Outer and middle ear transfer function

The sound pressure signal is pre-processed using a filter to account for the transfer function of the outer and inner ear.

Step 3

53 1/2-bark critical band filters

The auditory filter bank consists of overlapping asymmetric filters and the tuning curves of the frequency-to-place transform of the inner ear. Higher frequency resolution at lower frequencies allows for human hearing's recognition of short duration low-frequency events. The filtering is not dissimilar to the 1/3rd octave filtering that the reader might be familiar with and this is visible by comparing Figure 2 and Figure 9.

Step 4

Threshold of hearing

The threshold of hearing is accounted for by removing the sound in bands that is below the threshold shown in Figure 10.

Step 5

Segmentation into blocks

In each of the 53 overlapping bands, the signal is chopped up into overlapping blocks. The block size is frequency dependent, and the blocks have a 75% overlap. Subsequent operations occur on each individual time block highlighted in pink in Figure 11, which are subsequently averaged both in time and frequency.

Step 6

Transformation into loudness

The relationship between sound pressure and 'specific loudness' (the loudness in each 1/2 Bark band) is not linear and is calculated for each of the overlapped blocks, in each band, using Equation 1, which is similar in form to the one found in ISO 532-1:2017 but has been modified to better correlate with human hearing at high sound pressure levels.

Equation 1

$$A'(p) = c_{N'} \cdot \left(\frac{\tilde{p}}{p_0} \right) \cdot \prod_{M_i} \left(1 + \left(\frac{\tilde{p}}{p_i} \right)^\alpha \right)^{\frac{v_i - v_i - 1}{\alpha}}$$

Step 7

Autocorrelation function

An unbiased auto-correlation function is applied to each block and then normalised using the specific loudness calculated in Step 6. The autocorrelation function reveals periodicity in the signal, which is clearly visible in Figure 12. This enables the metric to account for tone harmonics. Adjacent time blocks in the lower frequency bands are averaged to reduce noise.

Step 8

Fourier transform

The averaged autocorrelation results for each time block are then windowed to eliminate noisy content. The windowed autocorrelation results are Fourier transformed to quantify the periodicity in the signal and this is also highlighted in Figure 12.

Step 9

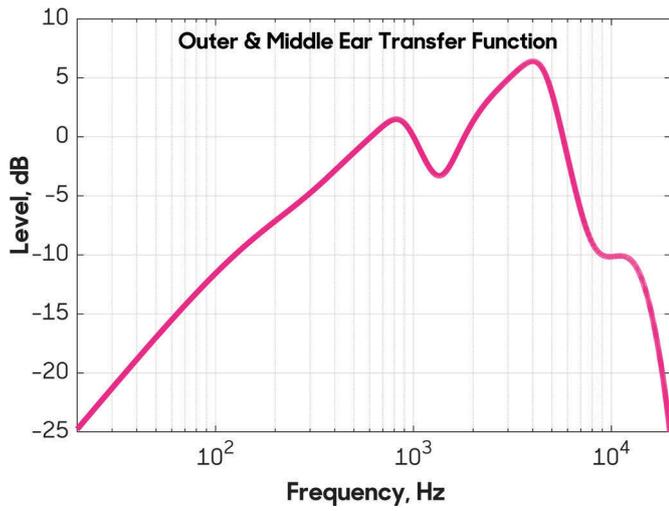
Averaging and noise reduction

The data is first resampled to account for the block sizes not being the same for each of the 53 1/2-Bark bands. This is followed by noise reduction using lowpass filtering and sigmoid weighting functions. The specific loudness results can then be presented as a colormap for each averaged time block, in each of the 53 frequency bands. A procedure for determining representative values in time and frequency is also provided, should single-number quantities be required.

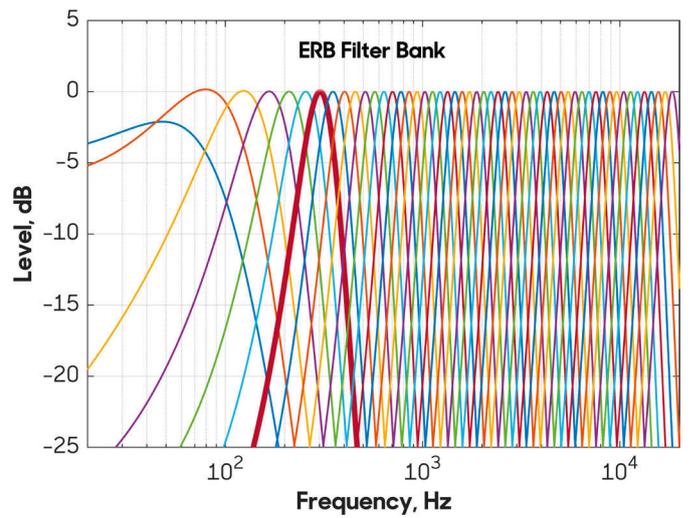
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References

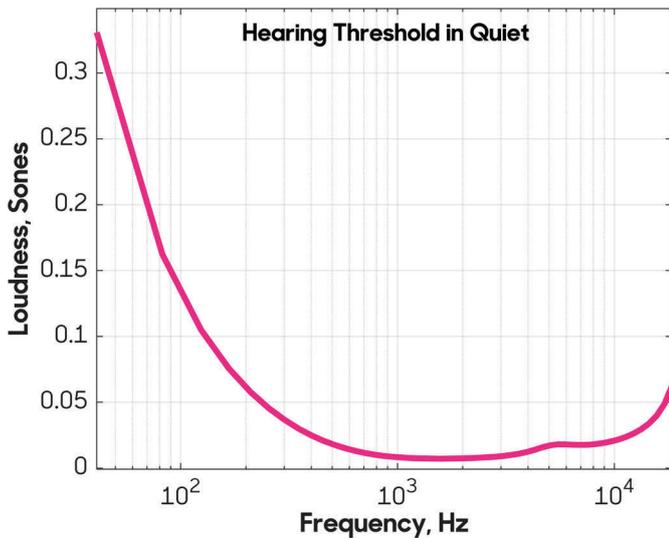
22 BRAY, W. R (2018), A New Psychoacoustic Method for Reliable Measurement of Tonalties According to Perception, Proc. InterNoise, Chicago



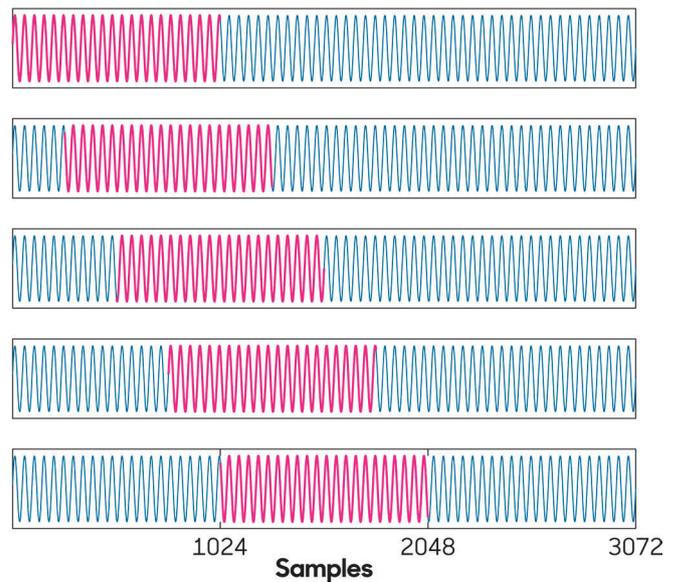
Above:
Figure 8: Frequency response function for the outer and middle ear



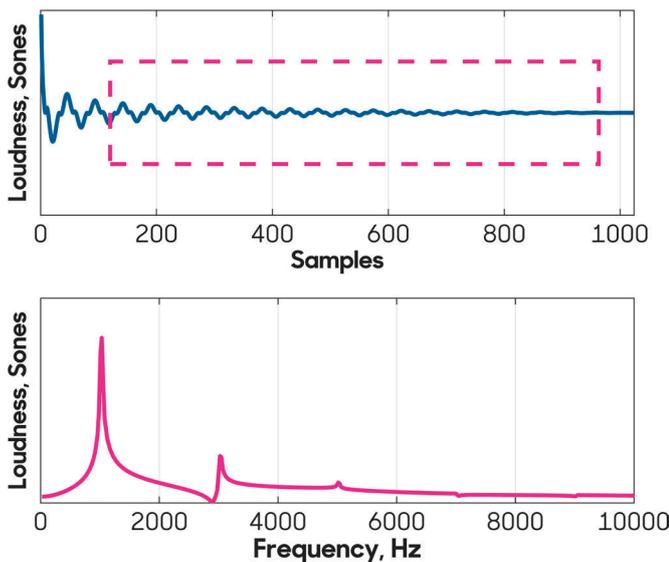
Above:
Figure 9: Frequency response functions for the 53 1/2-Bark frequency band filters



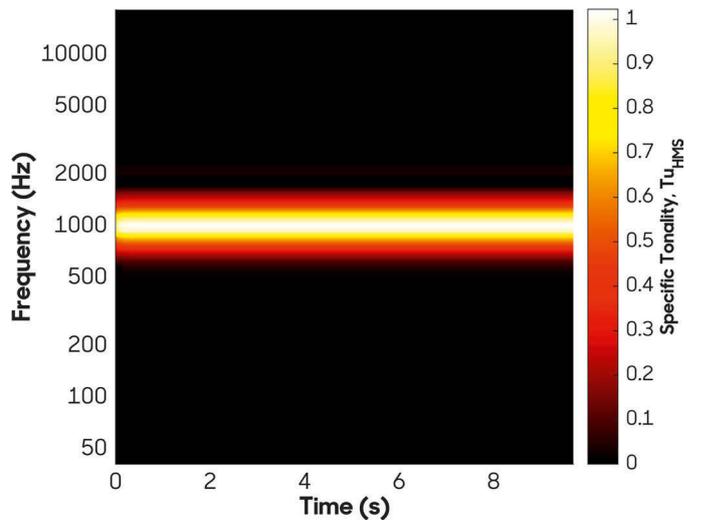
Above:
Figure 10: Threshold of hearing in quiet for comparison with the filtered data after being transformed from sound pressure into loudness



Above:
Figure 11: Illustration showing how each of the 53 filtered signals is divided into overlapping time-blocks



Above:
Figure 11: Illustration showing how an autocorrelation function is applied to each time block with a Fourier transform applied to the result to reveal the periodic components



Above:
Figure 12: Results in each time block for each of the 53 frequency bands after averaging and noise reduction



ROOM ACOUSTICS MEASUREMENTS

MODEL 831C-RA

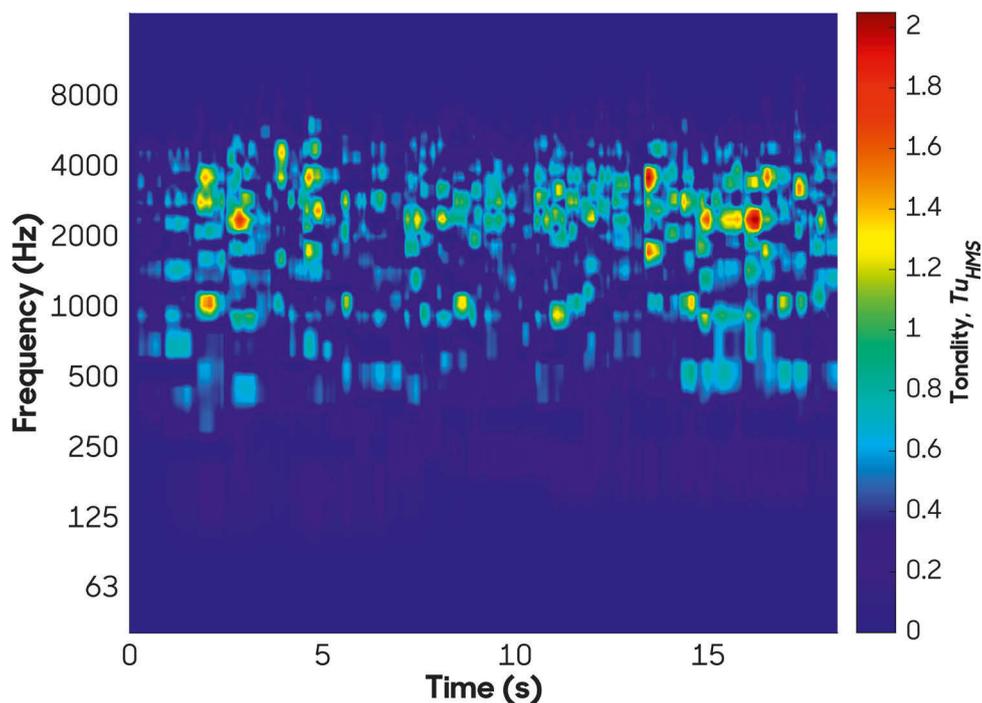
SOUNDADVISOR™ SOUND LEVEL METER

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A key question would inevitably be; does HMT improve correlation between objective and subjective evaluation of tonality? The answer to this is, in practice, absolutely. There will still be variation in how practitioners assign their subjective rating and this will never go away, but by evaluating tonality using HMT it is possible to view the tonality contained in a sound recording with the time and frequency resolution required to pair what was heard subjectively with what is present in the objective data. This is illustrated very well using the 13th Pompetzki recording, which contained numerous chimes being struck with each having a different note. The results of the HMT analysis have been presented in Figure 14.

By way of reference $>0.1 Tu_{HMS}$ is generally considered to be the threshold where sounds can be considered tonal, sounds $>0.4 Tu_{HMS}$ would be considered to contain prominent tones and sounds $>0.8 Tu_{HMS}$ would be considered to have very highly prominent tones.²³ You can see that the chimes are, unsurprisingly, extremely tonal.

It is visible in Figure 14 when each chime was struck by the small clusters of concentrated, high-level tonality, and the tonality is seen to decay after each of these strikes with time. It has a similar appearance to a sound pressure level spectrogram but only sound that is tonal is presented. Once the analysis has been completed, the practitioner can calculate the representative values; 90th percentile, maximum, average, etc. These results would then all be based on a rigid analysis – there’s no way to game the procedure by tinkering with the FFT size or misuse it out of ignorance. A full statistical model would need to be derived for a penalty to L_{Aeq} , in dB, for a given Tonality rating, in Tu , but this could be achieved using a



Above:
Figure 14: Analysis of the 13th recording, chimes, using HMT

suitably designed jury study based on a sample of environmental noise practitioners.

The trade-off for this exhaustive solution is that it is, well, *exhausting*. Implementing the method for calculating HMT from ECMA 418-2:2020 is a somewhat daunting task for an environmental noise practitioner; filtering using complex filter coefficients, auto-correlation across 53 filtered signals, averaging across these signals with different block sizes and topped-off with a Fourier transform. Fortunately, there are a few off-the-shelf solutions, it is currently a module in HEAD Acoustics’ Artemis Suite and there is an open-source project initiated by EOMYS Engineering, which is currently under development. The author also has a script written in MATLAB and would greatly appreciate help in validating and publishing the code for wider use. ©

My thanks go to Chris Hummersone (the serendipity of his surname didn’t escape notice) and John Fenlon for helping me to fathom HMT, Stephen Turner for giving me the platform for The Game of Tones, and Mike Lotinga for helping me put this article together. If anyone would like to discuss tonality, and psychoacoustics in environmental sound more generally, please get in contact. I love to talk shop. matt@anv.uk.com



About the author:
Matt Torjussen is Acoustics Lead at ANV Measurement Systems and has experience in consultancy, product design and instrumentation. He has a keen interest in the acoustic features in environmental noise and their effects on human perception.

References

23 HEAD ACOUSTICS (2008), Advanced Acoustic Analysis – Tonality, https://www.youtube.com/watch?v=ZZyk_pEjydu, YouTube

NEWS



Above: Pupils conducting cognitive tests in Barcelona.
(Credit: Barcelona Institute for Global Health (ISGlobal))

Noise exposure can have an impact on cognitive development and function

A new study, published in PLOS Medicine, has found that schools situated near noisy roads may be causing memory and attention issues for pupils.

A team of scientists measured the intensity and fluctuation of road noise in classrooms across 38 schools in Spain. Participating children (aged seven to 10) were also asked to complete computerised cognitive tests four times across one year. The tests included working memory, complex working memory and inattentiveness.

The scientists found that exposure to higher intensity levels of traffic noise both inside (above 30dB) and outside (above 55dB) of the school, but not at home, was associated with slower improvement of working memory, complex working memory and attentiveness. For example, a 5 dB increase in outdoor noise levels resulted in an 11.4% slower development of working memory, 23.5% slower development of complex working memory, and 4.8% slower attention capacity development on average.

“This could be because noise exposure at school is more detrimental, as it affects vulnerable periods of concentration and learning processes,” says Dr Maria Foraster, from the Institute for Global Health Barcelona, Spain, and lead author of the study.

“On the other hand, although noise measurements were taken at the schools, noise levels at the children’s homes were estimated using a noise map that may be less accurate and, in any case, only reflected outdoor noise. This, too, may have influenced the results.”

Inside the classroom, these associations were more strongly linked to noise fluctuations rather than average noise levels. “This finding suggests that noise peaks inside the classroom may be more disruptive to neurodevelopment than average decibel level,” says Foraster. “This is important because it supports the hypothesis that noise characteristics may be more influential than average noise levels, despite the fact that current policies are based on average decibels.”

The study demonstrates the need to re-examine local noise pollution inside and around school environments, especially in heavily populated urban environments, and how this might be mitigated.

Inspiring women in engineering

IOA member, Jennifer Glover, has been selected as one of the Women’s Engineering Society (WES) Top 50 Women in Engineering (WE50) 2022: Inventors and Innovators.

The judges stated that the standard of the nominations was extremely high and is testament to the difference that female engineers are making in creating or improving products and processes to make our lives easier.

The Women’s Engineering Society is a charity and a professional network of women engineers, scientists and technologists offering inspiration, support and professional development. Working in partnership, they support and inspire women to achieve as engineers, scientists and as leaders, they encourage the education of engineering and support companies with gender diversity and inclusion. (www.wes.org.uk)

Sound printing

Most 3D printing methods currently in use rely either on photo or thermo-activated reactions to achieve precise manipulation of polymers. The development of a new platform technology called direct sound printing (DSP), which uses soundwaves to produce new objects, may offer a third option.

The process, as described in a paper published in Nature Communications, shows how focused ultrasound waves can be used to create sonochemical reactions in minuscule cavitation regions – essentially tiny bubbles. Extremes of temperature and pressure lasting trillionths of a second can generate pre-designed complex geometries that cannot be made with existing techniques.

“Ultrasonic frequencies are already being used in destructive procedures like laser ablation of tissues and tumours. We wanted to use them to create something,” said Muthukumar Packirisamy, a professor and Concordia Research Chair in the Department of Mechanical, Industrial and Aerospace Engineering at the Gina Cody School of Engineering and Computer Science.

DSP relies on chemical reactions created by fluctuating pressure inside tiny bubbles suspended in a liquid polymer solution, and researchers found that if they used a certain type of ultrasound with a certain frequency and power, they could create very local, very focused chemically reactive regions, and the bubbles can be used as reactors to drive chemical reactions to transform liquid resin into solids or semi-solids.”

The reactions caused by ultrasound-wave-directed oscillation inside the micro-sized bubbles are intense, though they only last picoseconds. The temperature inside the cavity shoots up to around 15,000 Kelvin and pressure exceeds 1,000 bar. The reaction time is so brief the surrounding material is not affected.

The researchers believe that DSP’s versatility will benefit industries that rely on highly specific and delicate equipment. The polymer PDMS, for instance, is widely used in the microfluidics industry, where manufacturers require controlled environments (cleanrooms) and sophisticated lithographic technique to create medical devices and biosensors.

See more at <https://youtu.be/97vaWUhc3Eo> ©

BRANCH NEWS

Eastern Branch Tour of new acoustic laboratory

By John Campbell

On a beautiful early summer evening in May, Eastern Branch members were given a guided tour of the new acoustic laboratory at SRL Technical Services Limited, Holbrook House in Suffolk.

It was great to be back meeting in person and we had 34 attendees who were able to get a first-hand view of the range of testing and services that a modern acoustic laboratory offers. Members were divided into groups to tour the reverberation chamber, the new five-room transmission suite for airborne and impact transmission testing, the rainfall/roof test facility and given an overview of the monitoring services.

Many thanks to the SRL team for opening their facilities and giving their time to host a very informative and interesting meeting. After the tour the group went to Lavenham and enjoyed drinks and a buffet. It was great to catch up again after a couple of years of Zoom meetings!



Eastern Branch members at SRL Technical Services Limited in Suffolk

Click on www.srltsl.com/timelapse-videos/ to see lapse videos of the construction of the new lab.

Turn to page 75 to find out more about the new acoustic laboratory at SRL.

Midlands Branch

Living well with tinnitus? A way to prevent or manage tinnitus

By C J Biggs

In March, Colette Bunker, Head of Services at the charity, British Tinnitus Association, delivered a fascinating presentation that was engaging and informative on what was hopefully the last fully virtual Midlands Branch meeting, with future meetings either being planned to be hybrid or held fully in-person.

Colette shared her knowledge on the subject with a step-by-step approach, starting with explaining what tinnitus is and the current research, which subscribes to the belief that everyone may have

it, but, in the main, our brains filter out the electrically generated noise. The causes of tinnitus were also discussed and the practical methods to manage the condition, such as the use of relaxation and noise that is set just below where the tinnitus is audible.

The presentation highlighted that tinnitus is on the rise (due to people using headphones more often for example) and the charity is trying to make the public aware in a drive to prevent it.

The subject of hyperacusis (a condition that makes the person sensitive to

everyday sounds) was also mentioned in the presentation as this can sometimes be linked to tinnitus, but as highlighted by Colette, both hyperacusis and tinnitus need to be researched a lot more. This linked neatly into a discussion on what funding is being given to the topic.

Several questions were asked which covered the way tinnitus works from people who live with it.

The Midlands Branch thanks Colette Bunker for a very well received and informative presentation.

Public address/voice alarm systems for a range of applications

By Aglaia Foteinou

At our first meeting in person after the pandemic, on 27 April, we were delighted to welcome Jim Smith to Birmingham City University. Jim is Associate Director and Electro-Acoustics Lead for AECOM and his presentation was 'Public address and voice alarm systems for a range of applications'.

The recommendations on speech intelligibility (and, in particular, STI values)

were discussed based on standards and codes of practice for both sound systems for emergency purposes (SSEP) and voice alarm systems (VAS). We learned that these are not always achievable due to long reverberation times in spaces and areas with high background noise. Jim discussed ways to optimise early to late sound in different scenarios such as airports, railway stations, arenas

and stadia. Signal-to-noise issues were explained in these spaces and a variety of equipment, as well as their differences (including speakers, platform and emergency microphones), were presented.

Sincere thanks to Jim for sharing his experience and very informative presentation with us, as well as Birmingham City University for hosting the meeting.

Using bioacoustics for field survey and using accelerometers for honeybee colony condition monitoring

By Matt Torjussen

The Midlands Branch was delighted to host Associate Professor, Martin Bencsik, and Senior Lecturer, Carlos Abrahams, of the School of Technology at Nottingham Trent University on 19 May for talks covering 'Honeybee colony condition monitoring' and 'Using bioacoustics for field survey'.

One of Martin's numerous research interests is non-invasive methods for monitoring and predicting the behaviour of beehive colonies. His research has shown that human intervention, such as opening the hive, interferes with important mechanisms within it. Using non-invasive condition monitoring with accelerometers is a way of avoiding disrupting important processes in honeybee colonies. We

learned that honeybees do not hear airborne sound and one of the ways they do communicate is with vibration transmitted via the honeycomb structure. Martin played auralised vibration recordings of queen "toots" and "quacks", which change over the course of a season, this included the depressing sound of vibration transmitted to the colony when the queen knows her days are numbered and there are no virgin queens to replace her; her version of "we're doomed".

Carlos is an ecologist who uses the sound of wildlife to improve ecological surveys. Traditionally, such surveys have relied on an ecologist making visual observations in the field to collect data. There are some

obvious limitations to this; the time an ecologist can physically spend collecting the data, their ability to stay focused for the duration and, potentially, their presence changing the behaviour of the wildlife around them. Carlos presented ways that sound can be used to collect more reliable ecological data because sound can be collected for very long periods of time, over several sites concurrently, and with far less chance of disturbing the environment. Databases of sound recordings allow temporal, spectral and spatial data to be used to identify bat and bird species from their vocalisations, with artificial intelligence commonly employed to improve the identification algorithms.

Southern Branch

Much ADO About Planning

By David Yates (Syntegra Consulting)

On Wednesday 18 May 2022, the Southern Branch welcomed Chris Turner of Adnitt Acoustics to present on the interrelationship between planning, permitted development and overheating.

15 Southern Branch members attended at ISVR in Southampton and, following a general overview of planning policy, permitted development regulations and the new Building Regulations Approved Document O on overheating, heard about a fascinating case study with two applications for the same building.

The first application was for a permitted development of offices to residential use which, under permitted development regulations, required assessment in respect of commercial noise sources only. The second application was a full

planning application for an upwards extension of the same building, for which all noise sources were taken into account, which includes a very busy section of the A4. Naturally, this led to vastly different specifications in terms of noise mitigation and associated ventilation recommendations.

The case study highlighted the dangers of the permitted development regulations as presently written as many conversions to residential use are still in danger of being exposed to an unsuitable noise environment, as there is no requirement to assess transportation noise sources.

Following the talk, a number of attendees continued the discussion whilst enjoying some light refreshment at a nearby bar. 🍷

Quiet Mark certification for Rockfon's acoustic ceilings

Rockfon has been awarded Quiet Mark certification for its Mono Acoustic, Blanka and Color-all acoustic ceiling tile ranges, which will help solve excessive noise issues, and look amazing.

Rockfon Mono Acoustic is a seamless acoustic ceiling, often used discreetly in residential properties, heritage projects or offices where it looks like a smooth plasterboard finish, but it has Class A sound absorption. It allows architects to create big geometric shapes or curves on walls and ceilings and the tiles come in 34 contemporary colours, which come with a matching grid.

Poppy Szkiller, Chief Executive and co-founder of Quiet Mark, said: "Quiet Mark is delighted to approve and certify three acoustic ceiling products by Rockfon, whose selection of edge designs, dimensions, colours and shapes help architects create spaces that people can enjoy."



New battery-operated Nor282 amplifier by Norsonic

Norsonic has designed a new power amplifier for sound insulation testing to meet the requirements of the latest Building Regulations. The Nor282 is paired with the lightweight Norsonic dodecahedron or hemi dodecahedron omni directional speakers to be ultra-portable whilst still producing a reliable and constant 120 dB.

The Nor282 gives the flexibility of an inbuilt lithium battery to give users flexibility to test where mains has not yet been connected (a common issue when testing new buildings). The lightweight battery will power the system for 90 minutes of constant testing and as the amplifier can be controlled via remote control this can provide hours of testing. The charger is built in so users just have to connect to mains to top the battery up.

The Nor282 has Wi-Fi built or it can set it up as a access point for direct control via PC or smartphone. It can be linked to the Norsonic 145 sound analyser which also has built in Wi-Fi meaning that no cables between the instrument and speaker systems are needed giving users full control from the meter. The amplifier has a built-in noise generator with a graphic equalizer for users to adjust the output signal to ensure they meet the 6 and 8 dB rules between adjacent 1/3 octave bands.

See it at Inter-noise 2022.

Sto acoustic ceiling system brings calm

The StoSilent Distance system has been installed in Petersfield Museum, to create a quiet and calm environment.

The Sto system was specified for the building by Hampshire County Council Property Services, as part of a project to create a series of new, welcoming spaces at the museum. Sto's Acoustics Project Manager, James Gosling, said: "This is the latest in a long line of projects where our StoSilent acoustic solutions have been installed in museums – a room's acoustic performance can influence our sense of wellbeing, and if that performance is poor, noise from speech, movement and everyday activity can create an unpleasant environment where sounds are unclear, communication is difficult and concentration is impossible. The need for acoustically absorptive measures is therefore clear and the StoSilent Distance system can provide outstanding acoustic performance and the sort of unobtrusive visual presence which is essential for this type of building."

The StoSilent Distance system can function as a suspended ceiling, or as a wall-covering over a cavity. It features a metal profile sub-construction fitted with



acoustic panels, which are manufactured from expanded glass granulate, making them lightweight and easy to handle,

and allowing them to be adjusted to suit any room shape and create a smooth, seamless surface.

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HBK launches new sound level meter with building acoustics partner

Sound and vibration expert Hottinger Brüel & Kjær (HBK) has designed the HBK 2255 Sound Level Meter, to help those involved in architectural and environmental acoustics.

Weighing just 400 grams, the lightweight sound level meter has a rubberised body for a secure grip and places the measurement controls right under the user's thumb. It has Wi-Fi® and Bluetooth® built in and works with specially created mobile and PC apps, providing an entirely new level of efficiency and control. It can also operate as a stand-alone sound measurement device without an app.

HBK 2255 forms part of a new building acoustics measurement solution from HBK.

The Building Acoustics Partner app provides full workflow support and wireless remote control for sound insulation measurements. The solution is completed with a HBK 2755 Smart Power Amplifier that enables wireless remote control of the sound source in a compact, robust and lightweight package.





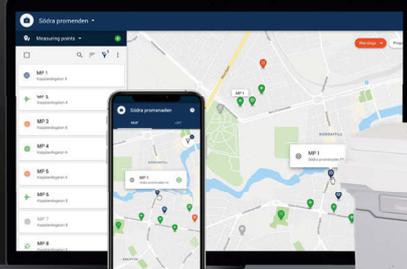
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Pioneering Acoustilay sets the quality standard for soundproofing floors



Manufactured by Sound Reduction Systems, the Acoustilay range of acoustic flooring system products can be laid under a wide variety of floor finishes, including carpets, laminates, solid wood, vinyl and even tiled floors. Available in four different grades, including the new Acoustilay Tilemat product, it remains a widely specified soundproofing treatment due to its quality, versatility and the wealth of technical and acoustic data behind it.

While all Acoustilay products provide excellent impact noise performance resulting from footsteps, dropped items and moving furniture, the heavier grades of Acoustilay 8 and 15 are also able to reduce airborne noise transmission.

Acoustilay can be used to meet the requirements of Part E of the Building Regulations, 'resistance to the passage of sound', in both new build and conversion projects. Installation is simple too, with Acoustilay being easy to cut and shape and a range of accessories to make life simple. An animated installation guide can be viewed on the Sound Reduction Systems website, where all fitting instructions can also be found, and the SRS technical team can be contacted and is always happy to help with any queries.

Acoustilay is sourced and manufactured in the UK using recyclable content. It is supplied in 1,200mm x 1,200mm sheets, in thicknesses of 10mm, 12mm and 15mm to suit a variety of soundproofing objectives.

International naming protocol for acoustic and vibration products

REGUPOL acoustic and vibration products, used in projects such as The Shard and Liverpool's Everyman Theatre and currently going into the 2022 European Athletics Championships tracks in Munich, are now covered by a new international naming convention.

Distributed in the UK by CMS Danskin Acoustics, REGUPOL products are specified worldwide for their noise and vibration reduction properties, chiefly in flooring applications, in construction sectors including sports flooring, residential schemes, hotels, education, health, auditoria, retail and industrial.

A sustainable product, REGUPOL is manufactured in Germany from recycled tyres. Typically, REGUPOL products consist of between 75-95% recycled materials and they are fully recyclable.

The newly named REGUPOL product portfolios, REGUPOL sonus core, REGUPOL sonus multi, REGUPOL sonus eco, REGUPOL sonus curve, REGUPOL sound, REGUPOL comfort, REGUFOAM vibration and REGUPOL sonusfit, include multiple grades of material and can be used in multiple combinations for varied acoustic and anti-vibration applications.

The new uniform referencing across the world will make life easier for specifiers, says UK REGUPOL consultant, Jamie Symons. The new product names and updated product data are now available via CMS Danskin Acoustic's website.



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Sonitus DM30 – noise and dust monitor

Sonitus Systems is a high-tech company dedicated to smart solutions for accurate and highly automated monitoring applications. It was founded by the research department of Trinity College, Dublin.

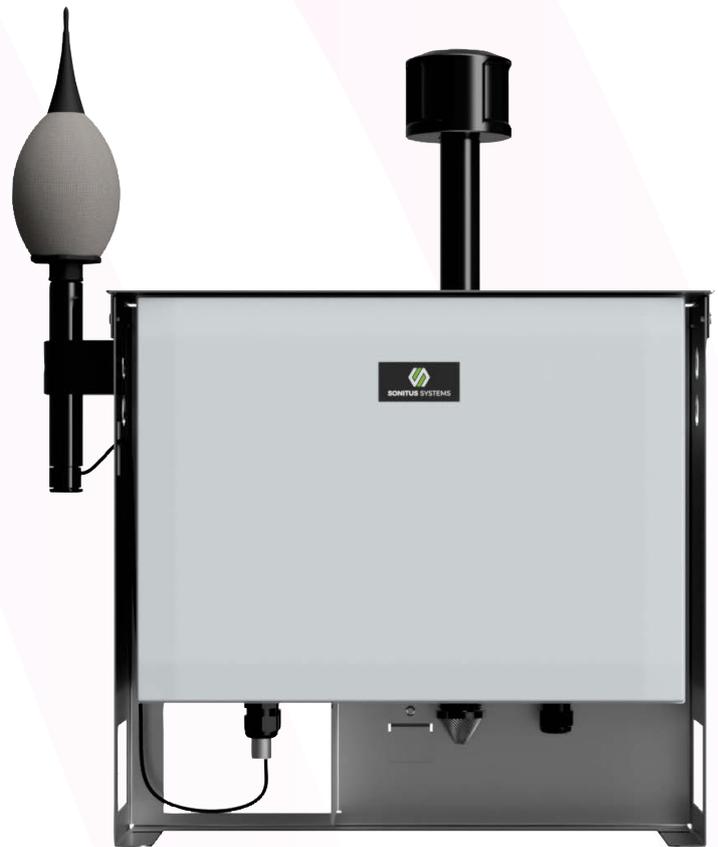
The latest product from Sonitus is the DM30. This new monitor uses communication and processing technology from the established EM2030 noise monitor, which is designed from the bottom up as an automated monitor. The DM30 keeps the noise capability and adds dust/particulate monitoring to run in parallel. This dual function saves considerable cost, as a single monitor can do the job of two. This means a single cabinet, SIM card/ data subscription and a power connector.

The dust monitor provides accurate data, which has been certified to MCERTS requirements for both PM10 and PM2.5 and the system logs these channels simultaneously. PM10 is the primary channel for construction dust monitoring but PM2.5 is now often asked for by local authorities on large-scale projects.

The DM30 has a built-in heater to dry the air sample before it goes through the particle counter. This ensures accurate measurements even in high humidity environments such as fog. Even with the heated inlet, efficient electronics make it possible to run the monitor on a 12v battery pack for a week or more. It also can be powered by solar and hydrogen generating systems.

The system is modular and can be ordered as a dust monitor or as a combined noise and dust monitor, and customers can also integrate an anemometer for wind speed and direction. The DM30 automatically sends the data to Sonitus cloud for reporting, alerting and administration of your projects in an easy to manage platform.

Typically, noise and dust monitoring are required at the same location for construction projects and the DM30 saves space, money, and time.



HEAD acoustics MDAQS: A milestone in instrumental audio quality assessment

MDAQS (Multi-Dimensional Audio Quality Score) is the world's first binaural perception-based software tool that replaces human evaluation with novel metrics in the audio device development process. This allows manufacturers to quickly and efficiently evaluate the audio quality of all types of playback devices, such as speakers, headphones, smart speakers, headsets, etc. in a scientific and quantifiable way.

MDAQS runs as an option in the test software ACQUA, the speech and audio quality measurement and analysis software from HEAD acoustics.

HEAD acoustics has conducted numerous intensive listening tests with carefully selected, untrained listeners. These “naïve” listeners have evaluated a variety of different audio devices with music of various genres based on several parameters. The results of these extensive listening tests serve as the basis for developing the algorithms and the training of MDAQS.

The comprehensive package of ACQUA and MDAQS, together with labCORE and an artificial head such as the HMS II.3, can easily



replace previously used measurement hardware and software solutions. The interaction of the faithfully recorded sound signal and the unique MDAQS metrics models human perception so well that time-consuming and cost-intensive tests with test subjects become obsolete.

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SRL's rain noise test facility

Laboratory testing facilities

SRL Technical Services Limited recently completed the construction, fit-out and qualification of additional test facilities, doubling their previous testing capacity.

With the facility hired by the day or half day clients can do several tests in a day, a unique and valuable aspect of the service.

The new East Laboratory comprises five test rooms and an area for sample preparation and build. The Lower North receiving room has a large sample test aperture, ideal for walls, partitions, curtain walling, cladding systems and large windows and doors. The Lower South receiving room has a bespoke smaller sample test aperture for double and single door sets, windows and smaller panels. Access to the ground floor middle room is via a large wide opening door. The Lower Ground floor receiving rooms also have large access doors at each end.

The Lower North and South are also receiving rooms for the two horizontal test apertures which work with the Upper North and South source rooms.

The Upper North source room has an open aperture that is designed for floor and roof systems to be built and tested in. There is also an in-built crane system to aid the installation of samples into the test aperture.

The other horizontal test suite has a permanent 140mm thick concrete floor, which has been designed for testing impact improvement of floor coverings on concrete floors. This floor can also be built onto as well as ceiling systems added below for airborne and impact sound insulation testing.

Adjacent to the testing facilities are private client viewing rooms which overlook the test suites and conference room facilities.

This new test suites complement the existing test suites and reverberation room which are in an adjacent building.

The bespoke rain noise testing facility measures the noise levels that rain produce when landing on a particular roof construction. Rain noise testing is often required for buildings where the occupiers need low internal noise levels to study and concentrate or use video conferencing facilities.

Achieving a particular rain noise specification is particularly important in schools and hospitals where the roof must achieve rain noise criteria set out in BB93 Acoustic design for schools: performance standards and health technical memorandum 08-01: Acoustics. Where previous guidance only required designers to consider rain noise in their roof designs, they must now demonstrate the roof and

ceiling can achieve specific rain noise criteria within the rooms of the school or hospital.

The way rain noise moves through the different layers of the roof construction is extremely complex. By measuring the rain noise on the rig, SRL can quantify this quickly and accurately, which avoids costly and time-consuming predictions. Roof systems can easily be over-designed when there is inaccurate or missing rain noise data which can lead to unnecessary upgrades to improve the rain noise performance.

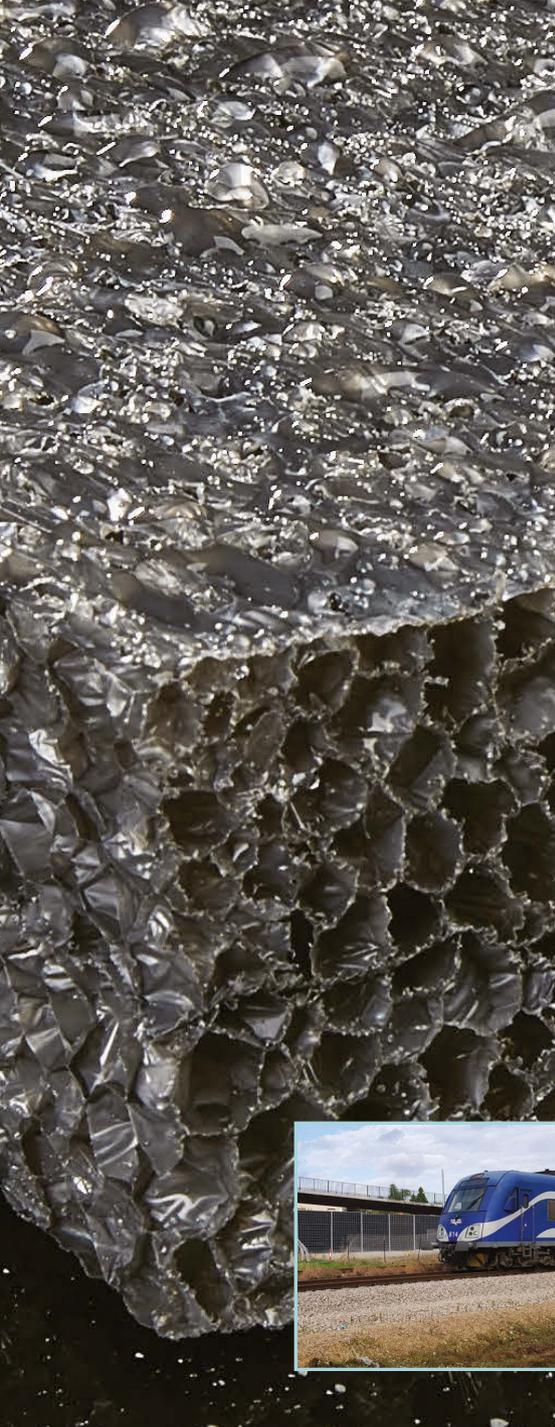
SRL's rain noise test facility is UKAS accredited for testing the sound generated by rain fall onto building elements, including roof and skylight systems, fully in accordance with BS EN ISO 140-18:2006

The ducted Attenuator test rig is a UKAS accredited facility for testing to BS EN ISO 7235:2009 'Laboratory Measurement for ducted silencers and air terminal units. Insertion loss, flow noise and total pressure loss'. SRL is the only independent UKAS accredited laboratory that holds this standard. Using a significantly different approach to earlier test standards, the latest standard now includes a 'modal filter' to create a predominantly 'plane wave' sound field. 📍



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Acoustic Properties Whisper® NBO

Sound absorption street DL_{α}	EN 1793-1	dB	9 dB without steel post cladding; 9 dB with steel post cladding
Sound absorption rail DL_{α}	EN 16272-1	dB	11 dB without steel post cladding; 12 dB with steel post cladding
Sound reflection DL_{Ri} in-situ street	EN 1793-5	dB	5
Sound reflection DL_{Ri} in-situ rail	EN 16272-3-2	dB	6

Mechanical Properties

Resistance to frost and de-icing salt	EN 14474	-	Fulfilled
Fire resistance	EN 1794-2	-	Class 1
Notch test	EN 1794-2	-	Class 2
Impact of stones	EN 1794-1	-	Fulfilled

Sustainability	EN 14389-1-2		Acoustic and non-acoustic properties 50 years EPD on request
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Committee meetings 2022

DAY	DATE	TIME	MEETING
Wednesday	13 July	09.30	CCBAM
Wednesday	13 July	10.30	CCENM Examiners
Wednesday	13 July	13.30	CCENM Committee
Tuesday	26 July	10.30	Engineering
Wednesday	27 July	10.30	Engineering
Thursday	28 July	10.30	Meetings
Thursday	4 August	10.30	Diploma Moderators Meeting
Thursday	11 August	10.30	Membership
Thursday	25 August	11:00	Publications
Wednesday	7 September	10.30	Executive
Thursday	15 September	10.30	Council
Tuesday	27 September	11.00	CPD Committee
Tuesday	25 October	10.30	Engineering
Wednesday	26 October	10.30	Engineering
Thursday	27 October	11.00	Publications
Tuesday	1 November	10.30	Research Co-ordination(London)
Thursday	3 November	10.30	Meetings
Wednesday	9 November	10.30	CCBAM Examiners
Thursday	10 November	10.30	Diploma Tutors and Examiners
Thursday	10 November	13.30	Education
Thursday	17 November	10.30	Membership
Monday	21 November	10.30	CCWPNA Examiners
Monday	21 November	13.30	CCWPNA Committee
Tuesday	22 November	10.30	ASBA Examiners (Edinburgh)
Tuesday	22 November	13.30	ASBA Committee (Edinburgh)
Wednesday	23 November	10.30	Executive
Thursday	24 November	13.30	CCENM Examiners
Thursday	24 November	13.30	CCENM Committee
Wednesday	7 December	10.30	Council

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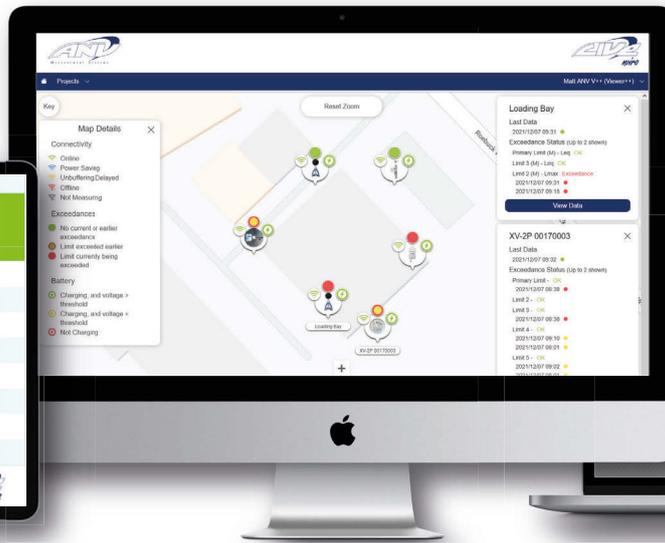
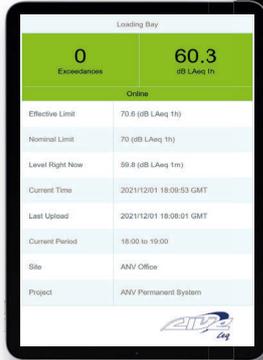
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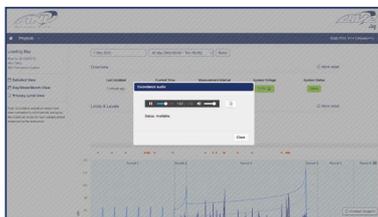
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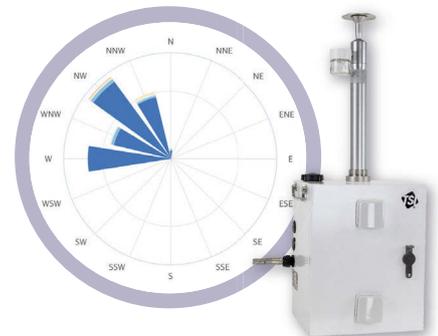


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- Control .wav recording on the meter remotely



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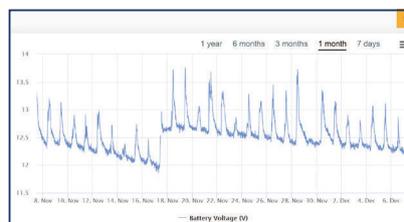


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