ACOUSTICS
A SOUND CAREER
2025

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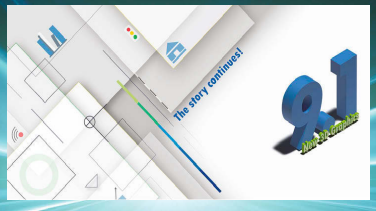

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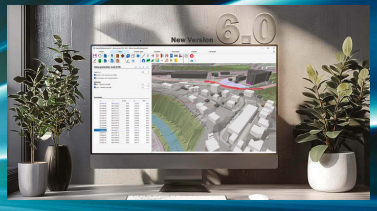

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Welcome to the world of acoustics

Acoustics is involved in just about every aspect of our lives.

'Sound' is a vital component to the quality of our lives, it is how we communicate and it gives us pleasure. **'Noise'**, on the other hand, can irritate us, makes us feel stressed and stops us sleeping. The World Health Organization says that excessive noise seriously harms human health and interferes with people's daily activities at school, work, home and during leisure time. It can cause adverse cardiovascular and psychophysiological effects, reduce performance and provoke changes in social behaviour.

Make a difference

The fascinating science of acoustics is about improving the quality of our lives and making a positive difference to people. From enabling people to hear each other in busy places, designing loudspeakers and microphones, working on speech recognition systems, liaising with architects on the acoustics of theatres and auditoria, helping with the medical applications of ultrasonics, understanding the effects on whales and dolphins of the sound of human activity in the oceans, acoustics offers diverse ways to make your contribution count.

We have created this guide to show you what a career in acoustics can offer you. If you want a career that is varied and challenging, and where you can make a positive and tangible difference to people's lives, consider a career in acoustics.

It makes sound sense.

Allan Chesney
Chief Executive, Institute of Acoustics

Produced by the Institute of Acoustics

Institute of Acoustics
Sound • Noise • Vibration

Contents

A career in acoustics offers challenges, excitement, flexibility and rewards

Acoustics is the interdisciplinary science that deals with the study of all mechanical waves in gases, liquids and solids, including vibration, sound, ultrasound and infrasound.

Many people think that acoustics is strictly musical or architectural in nature. While acoustics does include the study of musical instruments and architectural spaces, it also covers a vast range of topics including noise control, SONAR for submarine navigation, ultrasounds for medical imaging, thermoacoustic refrigeration, seismology, bioacoustics and electroacoustic communication. Something for every skill set!

The acousticians profiled on these pages come from very different backgrounds and took very different routes to the industry. They demonstrate the incredibly diverse nature of acoustics.

Tom Galikowski

"I first became interested in acoustics while studying HND audio and video systems at University of Salford. In my teenage years I was fortunate to work in Polish Radio and was fascinated with recording studios and audio equipment used in the process of making programmes, so I decided to pursue a career in audio production.

"However, life quickly confirmed my talent (or lack thereof) and I realised a career in recording studios was not for me. Luckily, one of the modules, acoustic principles, turned the topic into the most interesting story. It was an introduction to basics of acoustic building design and included examples from BBC and Granada studios. I was hooked.

"I liked the combination of sound, engineering and architecture. Following completion of my HND course I studied for a Bachelor's degree in acoustics in Salford. I completed my student placement with Bickerdike Allen Partners (BAP) the company I have been with ever since, and graduated in 2010.

"While working at BAP I became interested in vibration control and pursued a Master's degree in structural engineering at South Bank University. This allowed me to work on some interesting projects including the British Museum extension and the Royal Opera House refurbishment.

"What I like about acoustics is the blend of science, engineering and creativity. I enjoy combining research, gadgets and creative thinking to solve problems presented by acoustic phenomena (such as structure-borne noise or ways of protecting delicate objects from damage)."

Arshdeep Singh

Arshdeep Singh is a Research Fellow and Sustainability Fellow at the Centre for Vision, Speech, and Signal Processing (CVSSP) at the University of Surrey, working on the project *AI for Sound*. He is also an Early Career Acoustic Champion for AI within UKAN+. Previously, he completed his PhD at IIT Mandi, India.

Arshdeep's research focuses on machine listening, which uses surrounding sounds to interpret and understand environments through machine learning (AI). Everyday sounds carry valuable information that help identify specific activities in various settings, such as distinguishing a restaurant from an office. Identifying sounds plays a critical role in applications like surveillance and activity monitoring. Inspired by the way that the human brain processes information, Arshdeep develops sound-based AI systems to benefit society. For example, sound-based AI can help dementia patients by detecting water taps left running, or monitor traffic noise to analyse vehicle types in specific areas. The abundance of sound data and the potential of machine learning motivate his work in leveraging these technologies for societal impact.

Another key focus of Arshdeep's research is creating energy-efficient machine learning frameworks to address the environmental challenges posed by large-scale systems. These systems consume significant memory and computation, producing substantial carbon footprints. His work aims to reduce this impact, contributing to sustainable and greener AI technologies.

Career that sounds just right

For some, acoustics wasn't the first choice of career. There are many scientific disciplines that lead in that direction though that wouldn't automatically spring to mind, acoustic consultant, Ellen Harrison explains her route:

Ellen Harrison

When thinking about what to study at university, Ellen Harrison, now an Associate Director in the acoustics team at WSP, took inspiration from a diagram like the one page 6 and says that it was instrumental in her choosing to follow a career in acoustics: "A similar image was given to me as a potential student at an open day at Southampton University and it illustrated the wide range of career options available to me, if I decided to study acoustical engineering at university.

"I was originally drawn to engineering when studying maths and physics at school, because I enjoyed the problem-solving nature of the work. I wasn't sure which career to follow at first, but the open day really sparked my interest and the 'wheel' demonstrated the range of career possibilities available to me.

"I've been working in architectural acoustics at WSP, a multi-disciplinary engineering consultancy for more than 14 years now and I love my career. I have worked on a large variety of projects including hospitals, schools and residential developments, helping to assess and control sound and vibration, and provide acoustically comfortable environments for staff, patients and residents. I would highly recommend considering acoustics as a career"

I loved the changing pace of the job – one week testing in north Wales, the next conducting a nightclub noise survey and the week after, creating a noise model of Tower Bridge

Heulwen Peters

When Heulwen was young, acoustics wasn't even on her radar because she first wanted to be a ballerina, then a potter, but around age 11, everything changed. This is the story of her convoluted journey to her satisfying and endlessly varied career in acoustics in her own words:

I settled on the idea of becoming a music teacher after starting to learn the trumpet. Throughout school, I was heavily involved in anything and everything musical, and my life in and out of school revolved around my various orchestras and bands. When I was about 14, my physics teacher encouraged me to do the sound and lighting for the school play, and I changed my mind yet again – deciding that I wanted to do something with music, sound and engineering.

When it came time for my Year 10 work experience placement, I confidently told my careers advisor that I wanted to apply for the placement at the metalwork engineering facility (it was one of the only 'engineering' placements I could find in the list). I was told, "It's not really appropriate for girls – have you thought about journalism?" Never one to be told I couldn't do something, I went home and told my dad, who found me a placement through his work in the RAF Engineering Squadron.

Throughout all the discussions at school around careers and "what do you want to do when you grow up?", acoustics was never mentioned. Even my desire to work with sound and engineering led me to think I might end up as a recording technician or a 'roadie.'

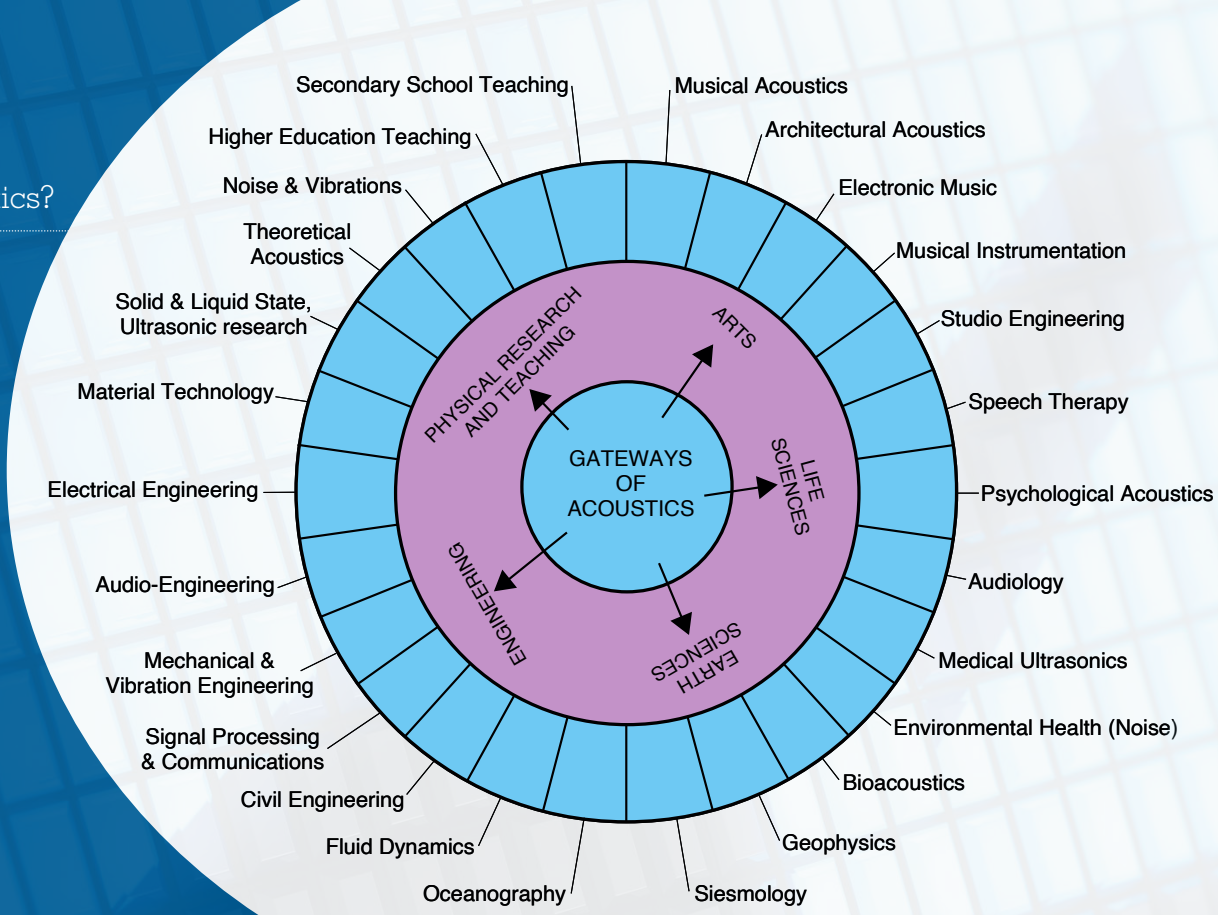
I stayed involved in school plays and sound production both inside and outside school, often with my trumpet in hand. When the time came to apply for university, I scoured the UCAS listings for anything that mentioned music, sound or engineering. After attending some open days and deciding I didn't want to stay too close to home, the acoustical engineering degree at ISVR in Southampton became my top choice. I'd been enamoured with the course from the moment I stepped into their anechoic chamber on the open day. Suddenly, 'acoustics' as a career seemed like an exciting option and possibility.

Then, I 'failed' my A Levels (well, I didn't really fail them, but I got low enough grades that ISVR couldn't accept me onto the course). At the time, it felt like the end of the world. I went through clearing and ended up choosing to attend the University of the West of England to study music systems engineering. By this point, I was convinced that acoustics was now surely out of reach and recording studio engineering was, indeed, my future.

Going through clearing turned out to be the best thing for me. I thrived in what ended up being the right academic environment for me. I learned about electronic engineering, robotics, computer programming, recording studio engineering, mathematics and acoustics. I flourished, finding a natural affinity for the subject material (including Fourier transforms – don't ask me to do one now though, that knowledge has long since left my brain). More importantly, I learned what I liked (variety, maths, acoustics) and what I didn't like (being stuck in an underground recording studio for hours on end).

After two years at university, I applied for a placement year with Acoustic Design Consultants in Suffolk (now part of the H&H Group). After a year in acoustic consultancy, and I knew I was exactly where I wanted to be. I loved the changing pace of the job – one week testing in north Wales, the next conducting a nightclub noise survey and the week after, creating a noise model of Tower Bridge. After finishing the final year of my degree, I returned to Suffolk permanently and have worked as an acoustic consultant ever since, now working for SRL Technical Services Limited.

Working alongside and learning from other experienced consultants over the last 20 years, I continued to grow into the consultant I am today. I have a genuine love for my job and a passion to share the possibilities of acoustic careers so others know it's an option. I feel that acoustic consultancy is a career where you can constantly learn, and no day, week, or year is the same as the last. I feel privileged to work at SRL, and to be able to support my colleagues and peers in return, including through my involvement with the Institute of Acoustics and the Association of Noise Consultants. I'm excited for the next 20 years and look forward to welcoming more new acousticians into our wonderful industry.



The future of acoustics

As we have shown, the acoustics industry occupied by people from a range of educational backgrounds including physics, architecture, engineering, environmental science and music. This means that it attracts a vast range of interesting people, from bedroom DJs to environmentalists, from DIY coders to festival organisers. Robert Marriner, acoustic engineer at WSP continues:

Acoustics is an industry that continuously looks outside of its own field for solutions and inspiration, constantly seeing acoustics as an integrated part of each project and of society. That, in turn helps us to find creative solutions for our clients and to design a world that is ready for the future.

Climate change and specifically, the actions that societies need to take to reverse it, will change the way we all live. However, those actions are also set to change the way we think about sound, particularly in urban environments. With a move away from private cars towards walking, cycling and public transport, and the electrification of the remaining road vehicles, town centres have the potential to become a lot quieter that we are used to at the moment. If we're designing buildings based on today's noise levels, could they have eerily quiet interiors in the future? Could apartments that aren't allowed balconies because today's noise levels are too high, be missing out on sought-after private amenity space further down the line?

Drone noise

Of course, that's ignoring other theories which say that things will get louder, not quieter, because everything will be delivered by drone. Companies interested in using drones are already researching the impact they could have, and developing their expertise.

Drones are already being used, not just by internet giants, but also by engineers, to survey large swathes of land, some even using artificial intelligence to identify certain geological features or the condition of man-made structures. Similar applications could be found in acoustics, but there's one big problem as far as noise measurements are concerned - they are just too noisy…at least for now.

'The future of acoustics promises exciting challenges'

Technological advances

But drones are just one piece of the 21st century technology jigsaw. Back in the office, computer processing power is already opening up opportunities for running bigger, better and more complex noise models simultaneously, as well as improving the accuracy of our work. Technology helps us to design buildings that are resilient to vibration and can be built above rail lines, and even paving the way for virtual reality applications which are revolutionizing the way we talk about acoustics to clients, designers and the public.

Inspiration and innovation

Technology and environmental sustainability are set to change the sound environment in which we live, and the creative acoustician of the future will simultaneously embrace these as sources of societal change and tools of the trade.

The future of acoustics promises exciting challenges that will inspire people with a wide range of skills to think creatively and generate innovative solutions. Who knows – you may have acoustics-related skills that our field hasn't even begun to look for yet.

What's so useful about acoustics?

WHAT'S IT ABOUT?

Acoustics is the interdisciplinary science that deals with the study of all mechanical waves in gases, liquids and solids including vibration, sound, ultrasound and infrasound.

Many people think that acoustics is strictly musical or architectural in nature. While acoustics does include the study of musical instruments and architectural spaces, it also covers a vast range of topics, including: noise control, SONAR for submarine detection, ultrasounds for medical imaging, thermoacoustic refrigeration, seismology, bioacoustics and electroacoustic communication.

Professional acousticians use their expertise to work in a huge variety of fields – from the design of a recording studio or smart phone audio apps to environmental and workplace noise measurement and control and from the assessment of wind farm noise to car and jet engine design to name just a few.

WHO IS THE IOA?

A professional engineering institution founded in 1974, the IOA is the UK's professional body for those working in Acoustics, Noise and Vibration.

THE SCIENCE OF SOUND, ITS PRODUCTION, TRANSMISSION AND EFFECTS

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A career that suits your skills

The specialist field of acoustics mixes people, science and engineering; it impacts everyone's lives, health and wellbeing. It makes a difference to society and how we live, so if you're looking for a fascinating career in which you can exploit your maths and science skills then you should explore the diverse world of acoustics.

Acoustics is all around you – in the voices of your friends and family, in the music you listen to and in the car you drive. Everywhere.

Professional acousticians work in a huge variety of fields – from the design of a recording studio or smart phone audio apps to environmental and workplace noise measurement and control, and from the assessment of wind farm noise to car and jet engine design, to name just a few.

Flexible entry requirements

To work as a recording engineer, higher education qualifications are increasingly expected. If you have, or expect to get, A Levels or an equivalent qualification, such as a BTEC Level 3 National in a relevant subject, you could apply for a degree course. Some courses may require certain A Level subjects such as maths, science or music. For the Tonmeister[1] sandwich degree in Music and Sound Recording at the University of Surrey, normally you need high A Level grades in maths, music and physics and a grade 7 standard in musical performance is desirable.

There are relevant HNC/D and foundation degree courses. These are work-related programmes that normally take two years full time or longer on a part-time basis. Joint Audio Media Education Support (JAMES) accredits relevant courses at around 25 universities and colleges on behalf of organisations such as the Association of Professional Recording Services (APRS), Music Producers Guild (MPG), UK Screen Association, Music Managers' Forum (MMF) and PLASA (a membership body for suppliers of technologies and services to the industry).

Acoustic degrees

For a place on the Southampton Acoustical Engineering courses (and the Acoustics with Music degree course also available at Southampton) you'll need A grades in maths and physics at A Level.

(While there is a lesser entry requirement at Salford (grade C in A Level maths), the mathematical content of their course is equally demanding.)

While graduates from these courses often have successful careers in acoustics-related consultancy, it is possible to practice as an acoustics consultant without needing the level of maths required on these courses.

The IOA Diploma in Acoustics and Noise Control

Those with a degree in engineering or science already can do a postgraduate degree programme in acoustics or study for the Institute of Acoustics' (IOA) Diploma in Acoustics and Noise Control. This requires completion of four modules (general principles of acoustics, laboratory and two specialisms chosen from building acoustics, environmental noise, regulation and assessment of noise and noise and vibration control engineering) and a project. This is the internationally-leading specialist qualification for the professional practitioner in acoustics. In the UK, successful completion of Diploma modules is recognised by the Universities of Derby, Leeds Beckett, London South Bank and Solent for admission to their acoustics-related MSc courses with exemption from the first year.

Diploma candidates study the Diploma programme either through part-time study (typically through day-release) at an IOA-accredited higher education institution (HEI) or through tutored distance learning (DL) depending on individual circumstances. The pattern of study over the year is similar to that of the day-release programme used by many accredited centres. However, DL candidates are required to attend four days of laboratory schools.

Although the normal entry requirement to the IOA Diploma is a relevant degree, the IOA aims for the Diploma to be as accessible as possible and accepts entrants with little more than GCSE-equivalent mathematics and physics, supported by relevant professional experience. In this regard, its entrance requirements are more flexible than those for the courses at Salford and Southampton.

You could be assessing wind farm noise...

...or measuring workplace noise

'Acoustics is all around you!'

Qualities you'll need for a career in acoustics

- **An aptitude for maths and science**
- **Creativity in your approach to solving problems**
- **Curiosity about music, speech and other sounds and how they work**
- **Good written and verbal skills.**

A Moodle-based online classroom on the IOA website gives distance learning candidates access to the resources that normally, would be available only to Centre-based candidates through their HEI library, and enables them to join the tutorials online.

STEM Ambassadorship

Being an acoustician also gives you plenty of ways to get involved in encouraging more young people into the industry.

Teachers and students are really keen to talk to industry professionals that work in STEM (Science, Technology, Engineering and Maths) careers. This can result in acousticians being involved in a wide variety of activities from mentoring and tutoring through to careers and science fairs and school talks and workshops.

The largest organisation that supports individuals that volunteer in school is STEM Learning, the owners of the STEM Ambassadors programme. It is also possible to volunteer through your local education business partnership and other organisations, such as the Royal Institution. You could even contact your old school, your children's school or the nearest school and offer to help.

Not only is working with young people very rewarding and enjoyable, it can also give you some new opportunities to develop presentation and networking skills. Given the shortage of professionals in the industry, the organisation that you work for may be willing to offer you some time to volunteer.

The IOA has a STEM committee that promotes and organises these activities in the acoustics industry.

Ross Latue

"An avid passion for music and science led me to in the direction of acoustics as a potential career.

"I first heard about the post graduate IOA Diploma through careers discussions with my course leader after doing a variety of acoustics modules at university. The IOA course is excellent at equipping its students with the necessary skills needed to work as a consultant; each and every day working within acoustics I apply the knowledge, skills and experience that I gained on the course. The course is particularly good at covering key information about current legislation and guidance – which we constantly refer to as acousticians.

"Just one year into my career and I have been involved in a vast range of projects, from providing suitable mitigation for noise impacting upon a small barn conversion to providing acoustic design advice for a new university building. A cliché but very true, no two projects are ever the same!"

Phil Hainsworth

"Although my undergraduate degree specialised more in audio system electronics for live events, it was the modules in room acoustics and noise control that I found the most interesting.

"During my final year of university, I attended the IOA 'Art of Being a Consultant' conference, which encouraged me to pursue a career as an acoustic consultant. So following my undergraduate degree, I studied the IOA post graduate Diploma in Acoustics and Noise Control at the University of Derby.

"The IOA Diploma gave me all the theoretical background in acoustics and vibration needed for a career in acoustic consultancy, including some of my first practical acoustic measurement experience in the laboratory module.

"The IOA Diploma also counted toward the taught element of the University of Derby MSc in Applied Acoustics, which has set me on the standard route to chartership with the IOA. I thoroughly enjoy my career as a senior acoustician at Atkins, having worked on some of the most exciting large infrastructure projects in the UK and Middle East, and attribute a large part of my underlying theoretical acoustics knowledge to the quality and content of the IOA Diploma."

Reference: 1 A tonmeister is a person who creates recordings or broadcasts of music who is both deeply musically trained (in 'classical' and non-classical genres) and also who has a detailed theoretical and practical knowledge of virtually all aspects of sound recording, music mixing and mastering.

EARLY CAREERS GROUP

The benefits of IOA student membership

The IOA offers **free** student membership to anyone considering a career in acoustics and is interested in learning more about it

By Zach Simcox,
IOA Early Careers Group Chair

The benefits of becoming a student member include:

- great networking opportunities;
- discounted attendance at paying events;
- invitations to free IOA branch meetings in your area;
- monthly IOA e-newsletter;
- online access to IOA's Acoustics Bulletin magazine; and
- access to IOA specialist group and branch videos.

Joining the IOA as a student member is a great way to get involved, make some useful contacts, give yourself the best professional opportunities and make an impact on your future career.

As we open our doors to welcome all new students, we also like to invite them to join the IOA Student Representatives Working Group. This group has been created specifically to offer students an opportunity to get involved with the IOA at an early stage and provide comments, opinions and ideas for developing IOA events and other plans from a students' perspective.

What you could be involved in

Earlier this year two Student Representatives, Ellen Crockett and George Mackenzie (University of Salford) hosted an event called *Engaging undergraduate students in professional development*. It allowed participants to gain insights from both academic and industry professionals, and the lineup of speakers included representatives from the IOA and UKAN+, who shared valuable perspectives on the various benefits of involvement with these organisations, along with speakers from industry and research. It was such a successful, well attended event, that we hope to organise many more like this in the coming year, and we are always open to ideas for topics to tackle.

The more the merrier

The IOA Student Representatives Working Group is dedicated to encouraging greater engagement between university students and the wider UK acoustics community. The group meets throughout the year (in-person or online) to discuss acoustics and explore opportunities for networking and cooperation, as well as developments in the IOA as an organisation. So if you are a student and this sounds like something you would like to get involved with – please contact us at **earlycareers@ioa.org.uk**

Join the IOA as a student member here: **https://www.ioa.org.uk/membership/student-membership**





REMOTE LEARNING OPTIONS AVAILABLE

Want a qualification that assures you of good job prospects?

The one year IOA Diploma in Acoustics and Noise Control includes the General Principles of Acoustics, Laboratory and Experimental Methods, a project and two specialist modules chosen from:

- Building Acoustics
- Regulation and Assessment of Noise
- Environmental Noise: Measurement, Prediction & Control
- Noise and Vibration Control Engineering

Established for more than 50 years, the Institute provides graduates and those with a proven interest in acoustics, the chance to become a recognised member of a vibrant and active global network with regular UK meetings and CPD.

The Diploma is taught to candidates in centres across the UK and via distance learning tutorials, also facilitating candidates abroad – find out more at:
www.ioa.org.uk/education-training

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Enhance your career prospects in acoustics

The IOA runs a range of certified short courses nationwide, assessing competence in the areas shown on the right. 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 more about any of these courses visit:
https://www.ioa.org.uk/education-training
and contact the appropriate centre directly.

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Workplace Noise Risk Assessment

Environmental Noise Measurement

Building Acoustics Measurement

Occupational Exposure to Hand Arm Vibration

Anti-Social Behaviour (Scotland) Act 2004 - Noise Measurements

Courtesy Luis Gomez-Agustina

#ExploreAcoustics sounds out career choices in acoustics

Which career is all about sound, yet few have heard of it?

The answer is acoustics – and now there's the chance to hear much more about it following the launch of an initiative from the Association of Noise Consultants (ANC), designed to attract more students into the industry.

The ANC's '#ExploreAcoustics' initiative demonstrates the wide range of opportunities available to students interested in a career in science, technology, engineering and mathematics (STEM). It includes video interviews and in-depth case studies featuring students, graduates, professionals and academics in the industry.

There's also a brochure, full of facts about careers and study routes into the industry, with QR codes for additional content.

ANC is the professional body representing consultants in acoustics, noise and vibration in the UK – and many of their members are reporting a shortage of graduates.

ANC chair, Louise Beamish, said: "There are few other careers that can offer the financial rewards, opportunities for travel and such diverse work opportunities than acoustics.

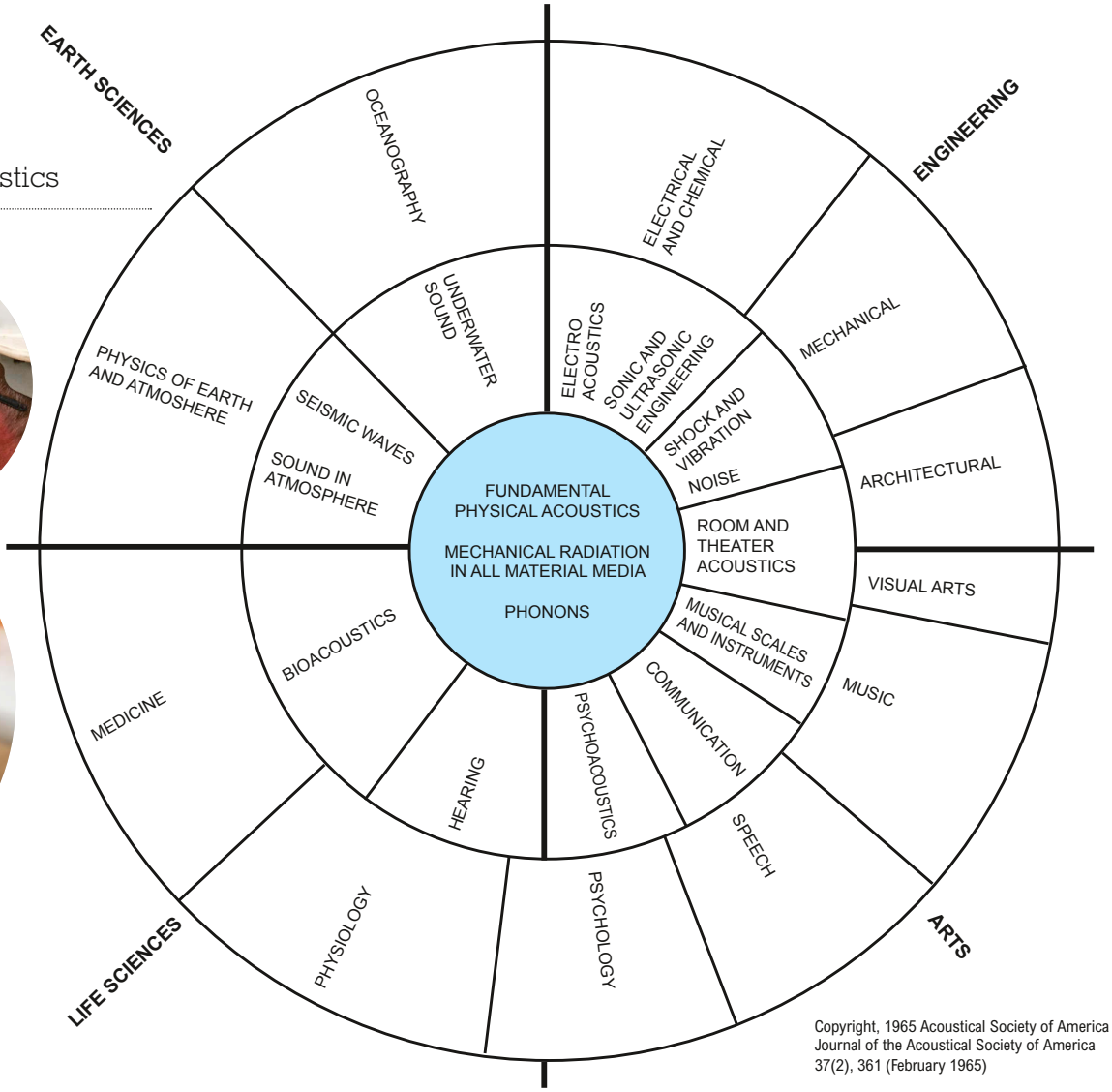
"Roles in the industry include openings in architectural and building acoustics, environmental noise, product design, cinema sound, even sonar and ultrasound."

As well as the graduate route, an apprenticeship is being developed, to give another option to work in the sector.

Keep in touch with all the information, including apprenticeships, at the #ExploreAcoustics site at **www.association-of-noise-consultants.co.uk/explore-acoustics**

Louise added: "It's a great industry to be in and we hope **#ExploreAcoustics** gives an insight into the many opportunities offered."

Physical acoustics



LINDSAY'S WHEEL OF ACOUSTICS

Designing better products

The way sound propagates, scatters, attenuates and interacts with structures and measurement equipment should concern us all – physical acoustics is the fundamental science that underpins the acoustics we work with every day.

Having a basic knowledge of physical acoustics enables us to make better decisions, design better products, make better measurements and write more accurate reports.

The study of physical acoustics is also developing new ways of interpreting acoustical data including medical ultrasound and imaging, the use of advanced materials for sound absorbers and noise barriers, and many more applications for now and in the future.

Most employers will expect you to have a degree in:

- **Acoustics**
- **Maths**
- **Physics, or**
- **Engineering.**

You could also do a degree in music technology or environmental science then take further training, like the IOA Diploma in Acoustics and Noise Control.

Your day-to-day duties could include:

- **Carrying out noise assessments on buildings to make sure they meet building regulations**
- **Checking noise levels are within legal limits**
- **Testing how changes to a building's design affects sound levels and quality**
- **Using computers to find ways of reducing machinery noise and vibration in the workplace**
- **Giving specialist advice in legal cases**
- **Exploring how sound vibrations affect machinery and structures**
- **Designing and working with recording studio and broadcast sound equipment**
- **Designing medical equipment (like ultrasound) to help doctors diagnose and treat patients**
- **Producing reports, sharing your findings and making recommendations for action.**

'The study of physical acoustics is also developing new ways of interpreting acoustical data.'

Upgrading your career with Engineering Council registration

The IOA is licensed by the Engineering Council to register members as professional engineers.

Through the IOA Engineering Division, suitably qualified and experienced engineers may gain this internationally-recognised award. For Chartered Engineer (CEng) and Incorporated Engineer (IEng) registration, there are two routes:

- The standard route for those holding an accredited engineering degree, and as listed on the Engineering Council website (**https://www.engc.org.uk/professional-registration/**)
- The individual asssessment route for those holding degrees in related subjects such as physics, or unaccredited engineering degree, the IOA diploma, or who are submitting work experience in lieu of qualifications.

Because of the nature of the acoustical engineering profession, the Institute recognises that some members seeking CEng or IEng registration will need guidance and assistance in developing the evidence to demonstrate that they satisfy both the educational and the professional development requirements. If you need advice or more information, email the IOA at **acousticsengineering@ioa.org.uk**

Step up

Whether you are an engineering apprentice, studying engineering at college or university, or recently graduated, professional registration will be an important future step on your career ladder.

The first stage in becoming registered is to join a professional engineering institution such as the IOA. There are many advantages to joining while still studying, and these institutions offer resources that might help you in your studies, such as libraries, journals, specialist interest groups, networking opportunities and careers advice.

Professionally registered status shows employers that you have (and are) committed to maintaining and enhancing the knowledge, skills and competence required to meet the engineering and technological needs of today. The prestige of your title will improve your CV and may lead to wider employment options, career progression and promotion.

Professional registration also shows employers, peers and the pubic that you have spent a number of years developing your skills, knowledge and understanding in your field and have clearly demonstrated your competence and commitment.

Rachel Bennett

Rachel studied for her BSc (Hons) in Music Technology & Audio Systems at the University of Huddersfield, and completed her MSc in Environmental Acoustics at the University of Salford, in 2011.

Because CEng registration is a recognised standard across all engineering disciplines, qualification had been a goal of hers for a few years and she was encouraged by her employer.

Rachel said: "I started preparing evidence for CEng registration a few years ago, I have always been encouraged to keep a CPD record at work, and it is also a requirement of IOA membership, so this was the most straightforward piece of evidence to compile.

"I also had to provide an initial professional development report, which expanded the relevant areas of my MSc studies and CPD whilst at work.

"I found that writing the professional review interview (PRI) report took the most time – selecting a variety of projects to cover the different UK SPEC criteria, describing them in the required way, it took considerable time and numerous revisions.

"I was supported by the IOA through the process, they reviewed my evidence and provided feedback until they felt it was suitable for submission. Finding time to compile and revise all the evidence and prepare for the interview, along with work and family life, proved challenging.

"The interview mainly focused on the PRI report and I was asked questions to clarify my statements, expand on them, and to make sure that all the relevant criteria had been covered. I was also given the opportunity to discuss CPD and other aspects of work I am involved in, such as STEM outreach.

"The IOA was especially helpful in arranging an interview so that I had the opportunity to complete the process before my own personal deadline – I was due to have a baby at the end of January! I was very glad of this otherwise I would have had to postpone and re-visit the application after 12 months of maternity leave."

Looking to the future, she said: "I hope that being chartered will provide extra confidence in my work to clients and my employer. This will be especially important when bidding for new projects.

"It will also be a welcome boost to my confidence when I return to work after maternity leave.

"CEng registration has not necessarily always been 'expected' of acoustic consultants as much as it is of other engineering disciplines, however, I think this is starting to change."

Will Kerr

Having excelled in maths and music at school, Will Kerr felt that he was in a prime position to start a career in acoustics by studying at the ISVR at the University of Southampton. Fast forward four years, including a summer placement at Hoare Lea and the attainment of an of MEng in Acoustical Engineering, Will was offered a graduate position at Mott MacDonald and he has worked there ever since as part of their acoustics team.

He has worked on major road and rail infrastructure schemes – gaining valuable experience in environmental noise. His most notable contributions have included improving efficiencies in modelling, and presenting a paper on the subject in Japan.

Will said: "It took me a while to understand how to present my evidence for my CEng qualification, but fortunately, I had some great support.

"I would say to anyone going through the CEng process that they should make sure they have a mentor who understands exactly what is needed to present the evidence to demonstrate that they satisfy the educational and professional development requirements."

Engineering Council

More Engineering Council information www.engc.org.uk

Acoustic measurement and instrumentation offers a career with immense variety

John Shelton, Secretary of the IOA Measurement and Instrumentation Group, asked members of his group why they chose a career in this specialist field of acoustics.

The older members, who started their careers when acoustics was not really a 'thing', were originally electronic engineers with a mechanical bias, who were designated by their employers to take on the responsibility of doing noise and vibration measurements, as no-one else could or would do it!

This led to one member ending up having a successful career in instrument sales, another spearheading the development of new acoustic measurement products and another, heading up an instrumentation company.

Younger members have more commonly come from a local authority, or an acoustic education and are now involved in instrumentation development, sales and standardisation, with a strong focus on applications.

Take your pick

The beauty of acoustics is that it covers many fields, which can include:

- automotive;
- aerospace;
- electroacoustics;
- R&D;
- environmental; and
- telecoms etc

While there are specialist groups in the IOA which address all of these disciplines, no single other group has a toe in them all, so the acoustic measurement and instrumentation area allows a lot of variety in careers.

For example, in any given week, you could be at a building acoustics laboratory:

- measuring insulation;
- measuring noise and vibration in the latest secret car prototype;
- measuring the human vibration in a military tank; or
- measuring the performance if hi-fi headphones.

How to specialise

It's fair to say that most graduates from acoustics courses tend to gravitate towards a career as an acoustic consultant, it's a great career in which you can end up heading your own consultancy. But if you like variety, another good place to start is in sales or development of instrumentation and all the instrumentation manufacturers are looking for well qualified people.

Another area is to work in an acoustics laboratory, for example, taking measurements on new machine prototypes. One of my first jobs was measuring the noise from a prototype leisure hovercraft – I spent many happy hours driving it around Portsmouth harbour in the name of development!

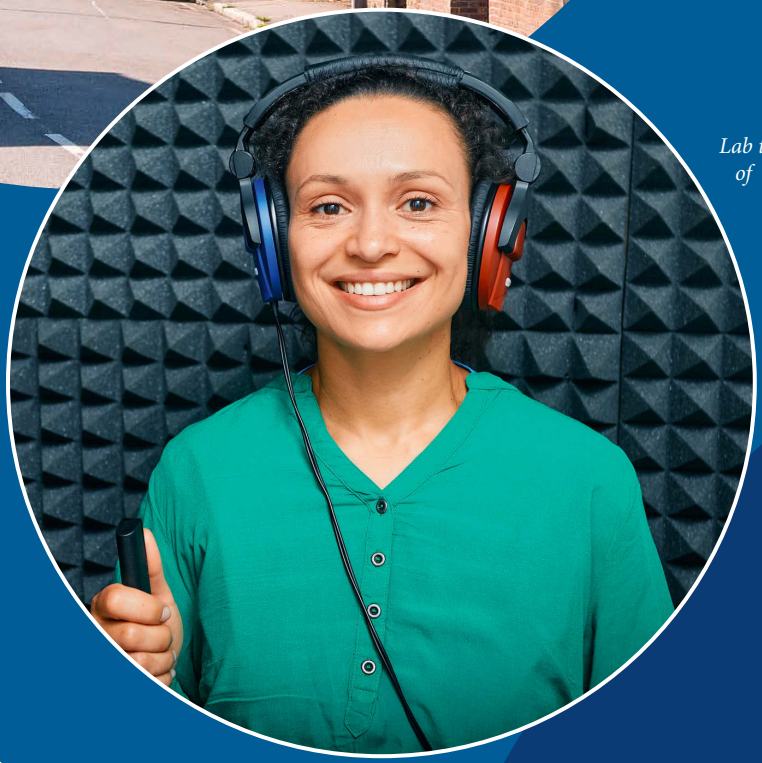
An interest in 'gizmology' also helps, I've always enjoyed tinkering with software and computers, as well as any kind of noise and vibration measurement, and I am always looking for different ways of characterizing noise and vibration parameters to allow us to better understand the world around us.

So for measurement and instrumentation, the buzzwords are:

- variety;
- curiosity; and
- a desire to make the best measurement possible, while understanding the limitations and possible errors.

Acoustics covers many fields including the aerospace industry so you could make this your speciality

How does measuring the human vibration in a military tank grab you?



Lab testing the performance of hi-fi headphones

"An interest in 'gizmology' helps steer a career in acoustic measurement and instrumentation"

IOA support for student members

To join the IOA as a student costs you nothing, but it gives you an initial level of access to the Institute's resources. You can join now if you are studying acoustics or are on an acoustic-related course.

One of the main benefits of becoming a Student Member is the opportunity for networking – it's quite likely that you could meet your first (or next) potential employer simply by attending the IOA's regular meetings and events.

Aside from having access to branch and group meetings and getting to know the Institute better, you will also receive the IOA's monthly newsletter, which lists upcoming events and meetings and provides you with much deeper insights into what the IOA provides its members.

Professional competency

Membership of the IOA is often seen as a prerequisite for demonstrating one's professional competency in the field. Student members will get to know what's required to obtain full membership of the IOA in future, a process that requires you to provide evidence of a sufficient level of knowledge and experience.

Full membership is open to those who satisfy Council as being suitably qualified educationally and who have a minimum of three years' experience of responsible work in acoustics.

Students usually progress from Student Membership to Associate Membership once they are suitably qualified educationally in acoustics, or when they have an appropriate period of experience in acoustics instead. Associate Membership is for those who have obtained the appropriate academic qualifications for the grade of Member but who do not (yet) have the relevant period of experience in the profession.

To join the IOA as a student costs you nothing, but it gives you an initial level of access to the Institute's resources

‘Members range from university students through to qualified professionals in all disciplines’

The Institute of Acoustics has a fascinating and diverse membership working in a variety of research, educational, environmental, governmental and industrial organisations. Its members range from university students through to qualified professionals in all disciplines.

The Institute is a very active professional body. It has nine specialist interest groups, some of which are featured in this publication. These groups organise meetings throughout the year and the IOA also holds regional events through its Branch network.

TAKE A LOOK

If you would like to become a Student Member, email **membership@ioa.org.uk**

We look forward to supporting you right at the very start of your career.

The Institute of Acoustics has a fascinating and diverse membership working in a variety of research, education, environmental, governmental and industrial organisations. Its members range from university students through to qualified professionals in all disciplines.

Join here: **https://www.ioa.org.uk/membership/joining**

Definition – *electroacoustics is a branch of acoustics which is concerned with the development and use of devices such as speakers, headphones and microphones that convert electrical signals into sound or visa-versa.*

Electroacoustics: the world of audio system design, transducers and reproduced sound

The science of electroacoustics can be thought of being a vast galaxy that sits within the acoustic universe, where many famous stars shine brightly in the hearts and minds of thousands of passionate professionals. Some of their most critically important goals are to guide people to develop both advanced technologies and brilliant, useful products.

Many jobs and skills in electroacoustics are related to what is called a signal chain, this term is derived from:

- **signal:** The event, phenomenon, or electrical quantity, that conveys information from one point to another; and
- **chain:** Any series of items linked together, so pertaining to a routine consisting of segments which are run through the computer in tandem, only one segment being within the computer at any one time and each segment using the output from the previous programme as its input.

The goal of any *signal chain* is to process a variety of *signals* to sense, process, monitor or control an analogue, digital, or analogue-digital system.

In simple words, a signal chain consists of sensors (e.g. microphones), processors, algorithms, converters, amplifiers and eventually actuators (e.g. loudspeakers) to reproduce sound and vibrations of all kinds. Every day, electroacoustic professionals deal with speech and music, both vital and indispensable components of our lives.

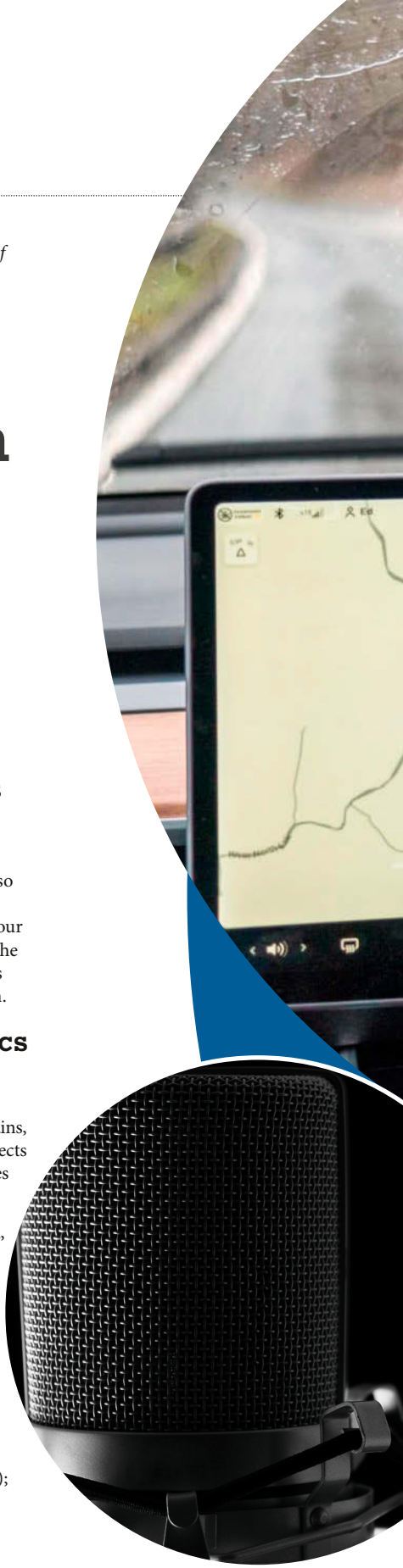
Skilled and curious acousticians working in this field might start their careers as microphone or loudspeaker designers, balancing performance with the tough physical constraints of materials and technical solutions – not to mention the products' eventual cost. Maybe after a few years of working they might find themselves in the fast-paced world of digital signal processing and audio system design, which has been revolutionised by the advent of digital audio protocols and the use of networks to distribute signals and acoustic information.

In fact, electroacoustics and signal chains are also familiar concepts in the world of their design, reproduction and amplification, so if music is your thing, remember that for each famous artist in the charts there is an army of engineers, technicians and designers who help make the magic happen.

Careers in electroacoustics

The range of potential careers in the field is continuously evolving, together with the technologies involved with signals and signal chains, so a complete list of all the possible jobs and projects is almost impossible to compile, but the industries open to electroacousticians today include:

- audio systems design, entertainment (cinema, television, radio, live performance and AI);
- communications and speech intelligibility (mobile phones, public address, emergency announcements);
- automotive (car infotainment, active noise control and personal audio);
- noise vibration and harshness (NVH) and their sensing, control and active attenuation (building acoustics and automotive acoustics);
- psychoacoustics (combines the physiology of sound – how our bodies receive sound – with the psychology of sound, or how our brains interpret sound);
- transducer design (microphones and loudspeakers); and
- musical instruments and amplification systems (guitars, pickups, amplifiers, audio mixing desks, electronic instruments, effects, processors, keyboards).



The range of careers in electroacoustics is wide and includes the design and manufacture of microphones

‘Industries that require electroacoustic technology include radio and live performance.’

How the IOA can help your electroacoustics career

Joining a professional body such as the IOA is a great way to make some useful contacts, give yourself the best professional opportunities and make an impact on your career.

Its Electroacoustics Group is the home for specialists in all aspects of sound equipment and sound systems design. The Group holds an annual conference (Reproduced Sound) usually in late November (**www.reproducedsound.co.uk**)

Forensic speech science

By Dr Jessica Wormald, Lecturer and BIEI Research Fellow, Department of Language and Linguistic Science, University of York

Ever wondered how the analysis of voices could help to solve crime? That's where forensic speech science comes in.

Specialists in this field support law enforcement by carrying out a range of speech and audio tasks, producing evidential reports which can form part of legal proceedings.

Further, with the increase in AI-based voice technologies and growing concerns around deepfakes, skills acquired in this field are increasingly valuable across sectors.

What is forensic speech science?

Forensic speech science is the analysis of speech and audio to support law enforcement. Tasks include transcription of indistinct audio, speaker profiling, enhancement of unclear recordings and, most commonly, speaker comparison. In a speaker comparison, practitioners will be instructed to compare the voice of an unknown speaker in an evidential recording (e.g. a threatening voice note), with the voice of a known speaker, usually in a police interview recording.

Forensic practitioners apply a range of skills to analyse and characterise the voice in each recording. Practitioners typically have a background in linguistics and phonetics and will analyse a range of auditory and acoustic features in a given comparison. All aspects of the voice could be examined, from individual vowels and consonants, to the overall quality of a speaker's voice. Practitioners use specialist software and training to provide an overall picture of each of the voices in a comparison. The findings are compared and the practitioner then assesses how likely it is that the two voices came from the same or different speakers.

Increasingly for speaker comparison, testing and use is being made of automatic speaker recognition software. State of the art methods use deep neural networks to create speaker embeddings or 'models' from a given recording. Comparisons based on automatic speaker recognition software are usually carried out alongside more traditional auditory and acoustic analysis.

"Although a niche forensic discipline, skills in forensic speech science are increasingly valuable"

Skills development

Those working in forensic speech science develop a range of skills which are key for forensic analysis, these include:

- an exceptional knowledge of phonetics, including a diverse range of auditory and acoustic approaches to analysing and measuring speech;
- the capacity to acquire new skills and knowledge as the field and associated methods develop (e.g. increase in value of automatic speaker recognition);
- an understanding of what makes speech and audio vary, including speaker factors (e.g. speaking style, accent) and technical variation (e.g. covertly recorded low-quality audio in a moving vehicle);
- a keen attention to detail to ensure comprehensive analyses are undertaken and evidential conclusions are appropriate;
- an ability to communicate complex analytical findings to non-experts (e.g. lawyers, police officers); and
- understanding how forensic speech science, an applied field of linguistics, fits within wider regulatory frameworks (e.g. the UK Forensic Regulator).

Beyond forensics

Although a niche forensic discipline, skills in forensic speech science are increasingly valuable. With the proliferation of recorded speech and the growing use of our voice as a form of identification, the ability to understand, analyse and distinguish between voices, both real and fake, is of huge importance. Additionally, skills in forensic speech science can be a complement to skills in computational linguistics or data engineering. Understanding the nuances of human voices and how people vary their speech can facilitate the development of better quality speech technologies. This is of particular importance within the forensic field, where the application of automatic speaker recognition software needs to be assessed relative to individual speaker variability, in addition to generalised performance and error metrics.

Skills in forensic speech science can be a complement to skills in computational linguistics or data engineering

Routes into the field

The University of York offers a range of options for those wishing to find out more about forensic speech science. As part of the Language and Linguistic Science department we offer the only dedicated forensic speech science masters programme[1] in the world. This is a one year programme, in person at the University of York - the learning experience integrates scholarly and professional contexts, allowing you to develop expert witness communication skills and gain hands-on experience of the latest generation of automatic speaker recognition technology, made available through the Department's partnership with the leading speech technology companies.

Additionally, we offer shorter courses for those wanting to find out more without committing to a full year's academic study. On Thursday 24th and Friday 25th April 2025 we are hosting our latest two-day in person course 'Using Speech and Audio as Evidence[2] '. This course will enable participants to better understand the process of speech and audio analysis for law enforcement. As well as discussing methodological processes, this course will also explore how analysis is translated into an evidential conclusion, and the role of regulation in forensic speech science.

Alumni from our Masters programme have gone onto work in diverse areas across a range of sectors, highlighting how skills and knowledge acquired through study in forensic speech science have a wide range of applications. Law enforcement employers include police and security forces in the UK and internationally (e.g. US Department of Homeland Security, Bundeskriminalamt). We also have alumni who are now based in private forensic speech and audio labs, industry roles, or as part of government institutions (e.g. European parliament, civil service). Several students have gone on to complete a PhD and have taken up academic teaching and research posts in the UK and internationally.

References:
1 https://www.york.ac.uk/study/postgraduate-taught/courses/msc-forensic-speech-science/
2 https://www.york.ac.uk/business/cpd/sector-specific-courses/using-speech-and-audio-as-evidence/

The importance of acoustics in healthcare

By David Sproston, Associate Director at Noise Consultants Ltd

In medical settings, particularly hospitals, sound and vibration should be an integral element in the design process. For patients, restful sleep and privacy are essential to recovery, yet noise from alarms, voices and equipment can disrupt both.

Studies have highlighted that poor acoustic environments can lead to increased stress and slower healing times. For healthcare providers, noise can impact communication and focus, sometimes even compromising patient safety. As acousticians, understanding the distinct challenges of healthcare settings and how to address them is key to creating environments that support both health and healing.

Understanding noise and vibration in healthcare settings

Hospitals present a unique soundscape with sources ranging from HVAC systems and medical alarms to footsteps in corridors, conversations and poorly maintained equipment. We categorise noise sources into:

- airborne (like voices and equipment alarms); and
- structure-borne (like vibrations from machinery or even nearby transport).

Vibration, too, poses unique challenges in healthcare: imagine the sensitivity required in MRI suites, or operating rooms. Recognising and controlling these variables is vital to minimising disruptions in patient care and ensuring staff concentration in critical environments.

Applicable UK guidance and standards

The UK has developed specific guidance for healthcare acoustics to ensure a supportive environment. Health Technical Memoranda (HTM), particularly HTM 08-01, outline acoustic criteria for patient rooms, corridors and operating theatres. Additionally, Building Standards like BS 8233 offer benchmarks for sound insulation, while HTM 08-02 addresses noise and vibration from lifts. As a UK-based acoustician, familiarity with these standards is your first step in designing compliant, comfortable spaces.

Design solutions and strategies

Healthcare acoustics require a thoughtful blend of materials, spatial planning and noise control measures. Sound insulation solutions vary from high-performance walls and floors to sound-absorbing ceilings. Strategically placing high-activity areas away from high-sensitivity areas, using sound-absorbing materials, and isolating noisy equipment are proven strategies to manage noise effectively. For vibration-sensitive areas, anti-vibration mounts and careful site planning are key measures that might need to be considered at an early stage of a building design to create an environment that enhances patient recovery and staff effectiveness.

The human element

Good acoustics is more than just numbers and materials – acoustics impacts people. Studies show that lower noise levels in hospitals help patients sleep better, reduce stress and even improve healing outcomes. For staff, reduced noise means improved focus and wellbeing. As acousticians, our work touches lives by making challenging times a bit easier for both patients and healthcare workers, with each decision we make, from sound insulation to equipment dampening, contributing to a more supportive and care-led experience for the building occupiers.

"Early-career acousticians are well-positioned to create spaces that are both future-ready and in tune with patient and staff needs"

For patients, restful sleep and privacy are essential to recovery

Future trends and challenges

As healthcare evolves, so too do its acoustic needs. The move toward sustainable building design is one significant emerging trend, where acoustic solutions use eco-friendly materials and solutions without sacrificing performance. Flexible acoustic designs that adapt to changing healthcare layouts are also becoming more important. Technological advances such as AI-driven noise monitoring, promise to help manage acoustics in real-time. Early-career acousticians are well-positioned to bring fresh perspectives to these challenges, creating spaces that are both future-ready and in tune with patient and staff needs.

Conclusion: the way forward for acousticians

In healthcare acoustics, every project is a chance to positively impact lives. Mastering the technical standards and embracing the role of sound in patient care and staff wellbeing will make you an invaluable asset to the field. Remember to keep learning, remain curious, and don't hesitate to question established practices. Each room you help design, each vibration you dampen, brings us closer to the ideal healthcare environment—one where both healing and quality of life are truly supported.

Vibration poses unique challenges in healthcare: imagine the sensitivity required in MRI suites

For hospital staff, reduced noise means improved focus and wellbeing

How the IOA can help your medical acoustics career

Joining a professional body such as the IOA is a great way to make some useful contacts, give yourself the best professional opportunities and make an impact on your career.
Sign up for FREE to become a student member here: **https://tinyurl.com/IOAstudent**

Careers in audiology

If you like a challenge and enjoy working with people of all ages then audiology may well be the career for you.

Audiology is a challenging and expanding field involving the study of hearing and balance. The British Academy of Audiology states that audiology professionals perform a wide range of activities, which include the assessment and rehabilitation of people of all ages with hearing loss or balance disorders.

Audiologists can work in a variety of settings including hospitals, private practice, research and development and with instrumentation ranging from audiometric measurement equipment to sophisticated signal processing hearing aids.

New and exciting opportunities exist in this fast-evolving and varied discipline. Individuals with an interest in acoustics, biological sciences, psychology, physics, and electronics, as well as speech and language development, may find that audiology has a lot to offer them.

There are also opportunities for those with an interest in signal analysis and signal processing, particularly in diagnostic instrumentation and hearing aids.

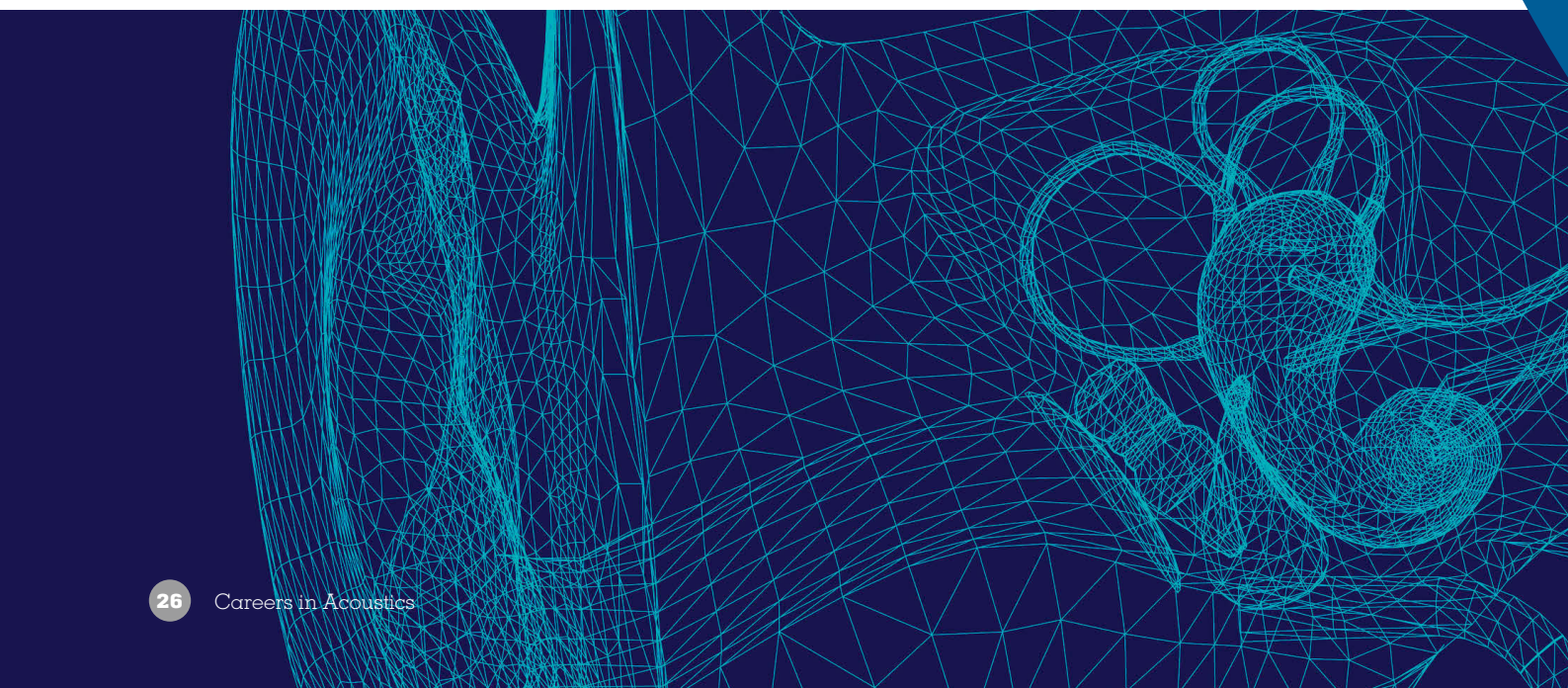
Many audiologists work in multidisciplinary teams, frequently liaising with medical, education and research professionals.

Qualities of an audiologist

If you can tick these boxes, a career in audiology could be right up your street:

- ☐ **Ability to communicate well with all types of people**
- ☐ **Good problem solving skills**
- ☐ **Ability to work as part of a team**
- ☐ **A caring and understanding attitude**
- ☐ **Good manual dexterity; and**
- ☐ **Analytical skills.**

In addition you should have evidence of ability to effectively work with people of all ages, particularly elderly people and young children.



‘New and exciting opportunities exist in this fast-evolving and varied discipline’

How the IOA can help your audiology career

The IOA Speech and Hearing Group provides a forum for members with an interest in acoustic aspects of speech and hearing. These include speech intelligibility, perception and production, hearing protection, audiology, assistive and other technologies for speech and hearing, and speech and language therapy.

The Speech and Hearing Group committee organises meetings to raise awareness of the subject and advancing technical development through the sharing of knowledge and experience. The group acts as a point of contact for individuals and organisations from all backgrounds that share the common interest, and welcomes their involvement.

Tomorrow belongs to those who can hear it coming

By Ruth Moslin

Ruth Moslin recently achieved a first class degree in audio engineering from the University of the Highlands and Islands in Scotland. For her research she wrote a paper on soundscapes and how they affect our creative, mental and ecological worlds. This is a shortened version (complete with sound effects), which helps to show how Ruth's interests have influenced her degree and the direction of her future career.

Tomorrow belongs to those who can hear it coming – is a phrase used by David Bowie to promote his 1977 album *Heroes*.

Although Bowie was most likely referring to the fluctuating political and fashionable trends prevalent at the time, the phrase has since been used in discussions relating to the earth's sonic landscape and it's ever-changing biophonic, geophonic and anthrophonic soundscapes.

The first known audio recording of a biophonic non-human source was captured on the earliest available commercial recording device, the wax phonograph cylinder. Frankfurt born, Ludwig Koch, caught the song of a captive shama bird in 1889 and while this is an impressive achievement alone, Koch was only eight years-old at the time. Since then, birdsong has been used in extraordinary ways as both artwork and in healing practices. (Listen here **https://www.bbc.co.uk/sounds/play/b00jn4m2**)

Birdsong

Combining human sound and the environment in 2015, Robin Perkins released the album *A guide to the birdsong of South America* which contains calls from endangered birds across the continent to raise money for non-profit organisations. While birdcalls vary through species, they are known to be beneficial to mental health, but setting aside the pig-like grunt from the Atlantic puffin, why do humans find birdsong so calming?

Birdsong falls within the frequencies known as the 'sweet spot range for human hearing' (1,000Hz-8,000Hz). Electroencephalography (EEG) measures brain waves and is broken up in to gamma, beta, alpha, delta and theta frequency bands, which fall within our sweet spot range. Theta waves have been shown to be strongly present during internal focus activities, such as meditation and relaxation – possibly providing the insight into why birdsong is used so widely for therapeutic uses.

These days recorded birdsong is not just found in relaxing Spotify playlists or BBC's Springwatch. Alder Hey Children's Hospital in Liverpool has played birdsong in its corridors since 2010, the recordings, which were captured at a nearby park, are seen to uplift spirits and boost relaxation. A similar concept can be found in Amsterdam's Schiphol Airport where birdsong recordings are used in lounges to promote relaxation before flights. (Listen to birdsong therapy here **https://www.birdnote.org/podcasts/birdnote-daily/birdsong-therapy**)

However, unlike Ludwig Koch's shama recording, the most mesmerising bird song will not be recorded from those in captivity - so what is the best way to capture these sounds? Paying homage to the Heinrich Hertz 1888 parabolic antenna, the parabolic shield has its uses for birdcall recording, its concave design, which gathers sound into a focal point can be paired with an omni-directional microphone that provides the ability to capture the very best of dawn choruses. In his book, *The Singing Life of Birds*, ornithologist Donald Kroodsma compares the parabolic shield and shotgun microphone for their qualities in bird call recording. Kroodsma suggests that the parabolic microphone is far more capable of capturing soft and distant sounds, however, it doesn't capture the birds as heard by the human ear, such as that of a quasi-binaural microphone set up. Although the parabolic microphone covers a much larger area than that of a shotgun, the shotgun manages to capture more echo and uncertain sounds – making birdsong sound a little 'smudgy'. Despite the disadvantages they pose on recording birdsong, shotgun mic's are better at capturing low frequency sounds and are used for recording outdoor sounds such as psithurism (the sound of wind blowing through trees), which brings us neatly to the next sonic attribute – geophony.

Setting aside the 'pig-like grunt' of the Atlantic puffin, humans find birdsong calming

Geophony

Geophonic sounds describe any sound created by nature, reminding us how powerful the earth can be and how it is continuously on the move. In 2020, the sounds of the melting Kongsvegan glacier in Norwegian archipelago, Svalbard, were recorded by researcher, Ugo Nanni[1], using a seismometer, where the frequencies recorded fell between 1-100hz. These infrasonic recordings were processed to be audible and contained the constant sound of cracking ice around the melting glacier, despite its visual stillness.

According a 2021 study by Noise & Health[2], low frequency sounds can be dangerous to humans. The study concluded that within one hour of exposure to infrasonic sounds of more than 100 dB, there is interference with the human cardiac muscle, increased nausea and sleep disorders in participants.

London's Gatwick airport is home to the largest soundscape installation that incorporates geophonic sounds – *A Living River*. Using over 60,000 meters of speaker cable, the installation contains a series of hydrophone recordings captured along China's Yangtze river that plays to those walking along Skybridge, the 180m-long airport corridor. The installation is supported by WWF who also promote alternative methods of travel over aeroplanes to cut aviation pollution and aircraft noise. Listen here: **https://www.dandad.org/awards/professional/2016/branding/25407/living-river/**

References:
1 https://edm.com/lifestyle/ambient-glacier-sounds-climate-change-effects

2 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8411947/#:~:text=Exposure%20to%20high%20levels%20of,as%20one%20hour%20after%20exposure

Under water

In 1490, Leonardo Di Vinci was credited for the first noted evidence that sound travels under water. One of the most influential uses of a piezoelectric hydrophone dates back as far as World War I when Canadian inventor, Reginald Fessenden, used a hydrophone in 1914 to detect an iceberg in the hope of avoiding a repeat of the Titanic disaster two years prior. Further developments using hydrophones include arrays where several are placed across the ocean floor to record data. This method has uses for recording the position of marine life and has been modernised by the US navy who tow a hydrophone line array behind ships to locate enemy submarine positions.

Forming a creative use, the muti-platinum album, *Songs of the Humpback Whale (1970)* by Roger Payne showed that whales could sing and communicate in rhythm. Payne's album is the most successful nature recording of all time and kick-started the *Save the Whales* movement, which eventually led to the banning of commercial whale hunting in 1986. More recently in 2023, James Crutchfield developed a hydroambiphone – a 3D underwater audio recorder which he used to record humpback whales in Alaska.

Continuous research into anthropocene soundscapes on marine life has been studied due to the qualities of hydrophones' recording. The EU set limits on underwater noise pollution, so since March 2024, no more than 20% of a marine area can be exposed to continuous underwater noise during a given year and no more than 20% of a marine habitat can be exposed to impulsive noise over one day – an incredible step forward given the EU's continuous and expanding shipping traffic.

Archeoacoustics

The combination of archaeology and acoustics (archaeoacoustics) uncovered large granite rocks known as gong rocks in the Serengeti National Park in Tanzania, believed to date back as far as the middle-ages. Similarly, 'The Ringing Stone' in Tiree, Scotland is thought to have arrived from the Isle of Rùm during the last ice age. These carved and decorated rocks are lithophones and when hit with a stone produce sounds believed to have been a form of communication for gathering people, warning signals and rituals. Listen to the gong rocks here **https://tinyurl.com/gongrock**

Songs of the Humpback Whale (1970) by Roger Payne showed that whales could sing and communicate in rhythm

Sound anthropologist, Iégor Reznikoff, studied sound within painted caves and rocks and found that areas with a higher resonation rate generally contained more paintings dating back to the palaeolithic period, providing evidence that they were used as very early amphitheatres. Today, a more contemporary use of these resonating caves is found inside the Luray Caverns in Virginia, USA. An organ is fixed in place to vibrate the caves' stalactites and is now known as the largest musical instrument in the world. Listen here: **https://www.sonicwonders.org/great-stalacpipe-organ-usa/**

Urban landscapes

The best example of an anthrophonic soundscape is, of course, a city. In 1928, The Daily Mail recorded the urban soundscapes of London with the specific aim to highlight traffic noise. Five of those recordings were published on gramophone, played on BBC radio and almost instantly, officials in London took immediate action to minimise traffic noise by placing limitations on the use of car horns. Fast forward to 2020, these recordings were made available to visitors at the Museum of London[3] alongside updated recordings from the same locations to allow listeners to compare (recognising that because of the pandemic the streets of London were significantly quieter at that time).

Lead by R Murray Schafer, the World Soundscape Project aimed to bring together research on the scientific, sociological and aesthetic aspects of the acoustic environment. *The Vancouver Soundscape* was one of the group's first releases in 1973 where listeners could be re-cast to late 1970's Vancouver with the recordings capturing the reality of a working industrial city. Two of the group's members, Barry Truax and Hildegard Westerkamp were involved in the 1996 re-issue of the project aiming to highlight the changes in Vancouver's soundscape over the years and provided an audible difference from the stereo Nagra analogue recorder used by the group for the first recordings.

Reference:
3 https://www.londonmuseum.org.uk/blog/recording-londons-soundscapes-past-present/

The World Soundscape Project brought together research on the scientific, sociological and aesthetic aspects of the acoustic environment of Vancouver

Infrasonic sounds

Of course, another way to identify sound is to visually inspect the frequencies in audio signals from spectrogram software. By using spectrograms, bioacousticians have been able to research a range of mammals' infrasonic sounds, particularly those of elephants. Researchers at Cornell University's *Elephant Listening Project* estimate that because of elephants' infrasonic range humans can only hear around 40% of the animals' sounds. But by using acoustic arrays to record elephant calling, researchers have discovered that elephants have a four-octave frequency range, reaching between 27Hz and 470Hz – pretty handy when you are trying to reach your friend over six miles away. Creatively, spectrograms are also used as an artform. In late 90s a trend of artists 'hiding' spectrogram artwork in their music began, one of these was Cornish artist, Aphex Twin, whose track *Equation* was hiding his own face at the end of the track using a spectrum of frequencies, of course it could be argued that animal calls are a lot more pleasing to listen to! Listen here: **https://archive.org/details/spectrogramaphextwinmi1n1ndinjcifjin1fextin11**

Biophilia

There is now evidence that humans find that biophonic and geophonic sounds more relaxing than anthropogenic sound. Naturalist Dr Edward Wilson, used the term 'biophilia' to describe the tendency that humanity as a whole has to be drawn towards nature.

Supporting his theory is the trend of shinrin-yoku (forest bathing) – a Japanese practice of surrounding oneself in nature. To test this, researchers for BBC series, *Forest 404*, immersed participants in sounds of rainforests, woodlands and coastal areas to record the psychological impact it had on them. Results recorded from the study in those who practiced it included lowered blood pressure, lower heart rate and a decrease in the stress hormone, cortisol – assisting the stress recovery and the attention restoration theories. In 2017, the University of Sussex exposed 17 participants to a series of natural and artificial sounds. During listening, functional magnetic resonance imaging (fMRI) scans were produced, allowing the researchers to have a visualised demonstration on the effects of natural sounds. The results showed improved internal focus, lowered blood pressure, decrease in the body's sympathetic response (flight or flight mode) and an increase in the body's parasympathetic response (relaxation).

Given that every soundscape has its own unique elements which create its sonic characteristics, it would be challenging to provide only one explanation as to why they provide us with the affects they do. Without a doubt one aspect is for certain – as urbanisation grows rapidly and our natural surroundings change, this could well be an opportune time to capture our sonic landscape and map the continuous changes in our rapidly changing world.

The inventiveness of noise and vibration engineers

The entitlement to be free from adverse noise and vibration could be considered as a basic human right.

We travel in aircraft, trains, cars and ships, our factories are filled with the machines that produce consumer goods and industrial products, homes have vacuum cleaners, washing machines and fridges. We expect that our vehicles and the equipment we use will be quiet and unobtrusive and that the workers producing them will not suffer harm. We expect that their manufacture and use will not disturb our sleep or leisure.

Noise and vibration control can involve increased weight, loss of operational efficiency and higher costs, all of which affects the sustainability of products. Hence a large engineering design effort is invested to reduce the unwanted noise and vibration without these negative impacts.

So given the rightful drive for sustainable engineering solutions, how can noise and vibration engineers contribute? The answer is not always obvious. Opportunities become apparent when the entire lifecycle of an engineering programme is considered; the best noise and vibration solutions are those that are invisible to the consumer of the technology. Take the car for example; the basic principles of car design remain the same now as they were 40 years ago, but to put the vehicles of the 1970s in context, it was only just becoming common that heaters were a standard item rather than a luxury add-on and most mass-market cars were utilitarian and noisy.

Can cars be too quiet?

Since then, we have developed much more complex noise-reduction strategies for cars. The main structures are now studied in the early phases of design to minimise acoustic impact on the passengers. Damping and absorption materials located in the most effective places have resulted in quiet and comfortable vehicles. In a similar way to crash modelling, the dynamics of the bodyshell and power train can be studied and optimised in detail by computer modelling.

Some of the changes in vehicle design have offered great challenges to quiet and comfortable products. A challenge that continues today is the downsizing of engines, often coupled with intensive pressure to improve fuel economy, so that the weight penalty of noise control treatments becomes more significant. In the other direction we see a growth in the adoption of various forms of hybrid systems. Although the use of electric motors is usually viewed as a noise reduction route, the results in many cases are a new set of challenges presented by the gear drives and other mechanisms that are required.

Most of the acoustic advances in car design have been achieved through improvements in our understanding that have led to better engineering designs, but the future has to include a **reverse** of what we have been trying to achieve for many years – **generation** of external vehicle noise. It will soon be a requirement that hybrid cars broadcast some kind of noise signal to allow those nearby to be aware that the vehicle is active and moving.

"Electric cars need invented engine noise to ensure pedestrian safety"

Noise and vibration engineers specialise in:

- **Engineering noise control**
- **Vibration control**
- **Assessment and control of workplace noise and vibration**
- **Noise, vibration, and harshness sound quality assessments**
- **Low noise design**
- **Noise source mechanisms**
- **Measurement methods for source identification**
- **Noise and vibration prediction methods.**

They are likely to have other related interests such as: vibro-acoustics, underwater acoustics, aero-acoustics, the physical effect of noise on humans, measurement methods and standards, noise or vibration induced fatigue, engineering design methods, etc.

Noise and vibration engineers often work closely with people outside the field of acoustics (mechanical, marine or aeronautical engineers, designers and architects, safety officers, etc).

CHALLENGE

The e-sound challenge
What sort of noise would you 'invent' for an electric or hybrid car to satisfy the driver and to alert pedestrians? Would you replicate the sound of a combustion engine? Or would you go for an entirely different noise that people would have to learn?

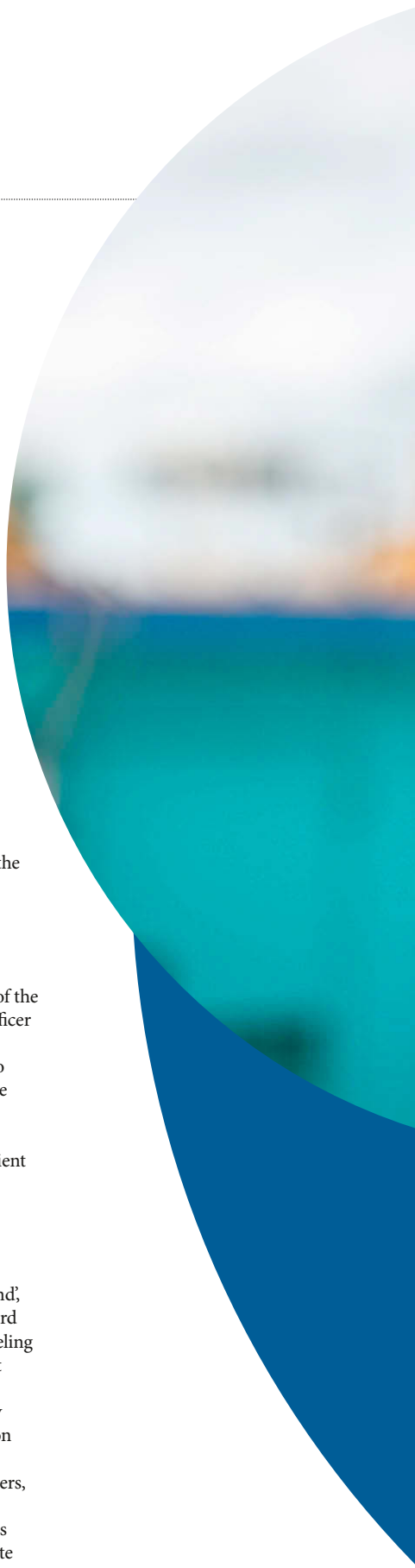
How the IOA can help your industrial noise career

The IOA Noise and Vibration Engineering Group comprises members of the Institute with a particular interest in assessment and control of noise and vibration. The aim of the group is to provide a forum for members to exchange information and discuss developments within this general field of interest, including engineering methods for noise and vibration control, workplace noise or NVH assessment, low noise design, source identification methods, source mechanisms and prediction methods.

‘Sound’ is good. ‘Noise’ is not

By Steve Mitchell, Mitchell Environmental Ltd

Noise is all around us, it’s a fact of life, and we just have to put up with it don’t we? Well not necessarily! Did you know noise can have a direct effect on your health?



The European Environment Agency estimates that across Europe, long-term exposure to transport noise causes about 11,000 premature deaths and 40,000 new cases of ischaemic heart disease each year[1]. Apart from causing deaths, noise annoys people and affects sleep. This is why environment noise is heavily regulated, and around a half of the IOA membership (more than 1,000 professional acousticians) get involved in managing environmental noise to help reduce these effects.

Road traffic is the most common noise source, then there are railways, airports, industrial and commercial facilities. We can predict noise from these sources and model how it spreads across residential and other areas like schools that are sensitive to noise. We can predict this noise before it happens, pre-empt problems and take steps to design to minimise the health effects. So, acousticians work a lot in the realm of planning and design.

Noise assessments and predictions

If a new housing estate is to be built, a noise assessment is often required to predict the levels of environmental noise that would affect the new residents, and to change the design to minimise the health effects of noise, before the local planning authority will consent the development. For new sources of noise like road widening schemes, railways or airport expansions, environmental impact assessments must be carried out, following strict planning processes and stakeholder consultation to report the noise effects, and to take design measures to minimise them in accordance with planning guidelines. The health effects of the additional noise can be calculated and monetised so they can be considered in the overall economic cost benefits of the project.

The actual construction of buildings and facilities can also create significant noise effects, such as disturbance to work and sleep etc. Acousticians predict this construction noise and assess these effects before they happen, then work with construction companies to measure and mitigate the noise they create.

Investigatory work

Noise also causes problems for some existing operations. People may complain to the operator of the facility or to the local authority. Local authority officer members of the IOA investigate these complaints through surveys and site visits, and have powers to serve noise abatement notices if the noise levels are not adequately reduced. As a noise consultant you might investigate a noise problem by measuring it and assessing its effect, before working with the client to design a solution to reduce the noise and solve the problem.

‘Sound’ is good!

Environmental noise is not all bad! We call it ‘sound’, as opposed to noise when it has positive effects. Bird song, running water and natural sounds, or the feeling of tranquility positively affect our health. In recent years the value of a good sound environment (or ‘soundscape’ as we call it) has become increasingly appreciated, and it is now becoming more common to design the built environment for a good quality soundscape. IOA members work with town planners, architects and landscape designers etc on all sorts of projects such as designing parks, housing estates and built-up areas, with good soundscapes to create positive and healthy places to live.

Reference:
1 https://www.eea.europa.eu/en/analysis/indicators/exposure-of-europe-population-to-noise

If a new housing estate is to be built, a noise assessment is often required to predict the levels of environmental noise that would affect the new residents

Natural sounds like bird song positively affect our health

"We can predict this noise before it happens, pre-empt problems and take steps to design to minimise the health effects"

Noise consultants might investigate a noise problem by measuring it, and assessing its effect, and then work with the client to design a solution to reduce the noise and solve the problem

The IOA has a mix of acousticians trained in predicting measuring and assessment environmental sound using computer software to model sound and sound level meters to measure it. The Institute supports careers in environmental sound by facilitating learning and continued professional development – there is a wealth of policy and guidance that acousticians have to understand and follow. Our engineers help design solutions to reduce unwanted sound, and our contribution to manage environmental sound overall helps reduce its harmful effects and make the world a quieter, healthier place.

Embracing the wonky pathway: from GCSE uncertainty to PhD achievement

By Dr Helen Whitehead, Lecturer in Environment and Sustainability, University of Salford

If you are struggling to decide what path your career might take, don't worry. Helen's story is a fine example of how many people only discover what they really want to do when their first choice simply doesn't work out.

Helen Whitehead

It's rare to wake up one day and decide all of a sudden to become a train driver, a surgeon or a teacher and never waver. Most of us need time and advice before we land on a career for life. In this article, Dr Helen Whitehead writes about her convoluted journey that took her from GCSEs to eventually become a university lecturer (with a stint at Chornobyl on the way). In other words, sometimes, indecision is nothing to worry about. Changing your mind can be all part of the journey and there is no right or wrong way to achieve the same, brilliant and rewarding career. Here is her story:

When I chose my GCSE options, I'll be honest: I had no idea what career I wanted to pursue. I bounced between dreams of becoming a vet, a doctor, or a journalist. At 14, making such a significant decision felt overwhelming as if it was final and I'd never be able to change my path.

After passing all my GCSEs, I chose to do A Levels because it seemed like the expected route. However, I quickly realised they weren't for me, so I dropped out and decided to pursue a career in hairdressing. I became a fully qualified hairdresser, completing two apprenticeships, and started working at L'Oreal. Yet, as I sat at my desk at L'Oreal, I felt unfulfilled. I wanted to make a difference and have a sense of purpose. Without A Levels, I researched how to get into university and started an Access to Higher Education Diploma in Medical and Health Science at The Manchester College. Initially, I thought I wanted to be a midwife, but that changed again. It wasn't until I attended an open day at the University of Salford and heard about their wildlife programmes that everything clicked. My childhood passion for nature resurfaced, and I knew this was my path.

Follow your passion

In 2015, shortly after turning 22, I began my BSc (Hons) in Wildlife and Practical Conservation. I loved every moment of my undergraduate degree and during my final year dissertation, I discovered my passion for research. As I neared the end of my degree, I explored my options and, after a conversation with Professor Mike Wood at the University of Salford, decided to pursue a PhD in Environmental Studies.

Birds have fascinated me for as long as I can remember, and my connection with nature has been strong since childhood. We fed birds daily and visited local nature reserves. Professor Wood mentioned they had been collecting acoustic data in the Chornobyl Exclusion Zone (CEZ) in Ukraine as part of the TREE project (TREE | UK Centre for Ecology & Hydrology), and no one had analysed it yet. Combining my passion for wildlife and interest in Chornobyl, my PhD research focused on using ecoacoustics to study the avifauna in the CEZ, employing methods like acoustic indices and machine learning. My research was the first to use acoustics to monitor biodiversity in the CEZ.

Opportunities, grit and hard work

My PhD journey, like many others, had its ups and downs. Transitioning from ecology to acoustics was daunting, but I grew to love it. PhDs offer opportunities to network with other students and experts and provide access to affordable memberships and conferences. I have been able to take on roles within organisations including the UK Acoustics Network (UKAN) and Society for Radiological Protection (SRP), which have enhanced my skills and created networks with a diverse range of people.

Whilst completing my PhD, my home life carried on. I bought a house in 2018 and got married in 2022. I was also a self-funded PhD student, which resulted in me having to work quite a few jobs to ensure I could pay my bills and put food on the table. I'm not going to lie; this was challenging sometimes. For some time, I worked a 04:00-08:00 shift at a supermarket and then went straight to university from there. Although reflecting now on the challenge of this, it made me a resilient and determined person. Sometimes in life, you just have to make it work.

The Chornobyl nuclear plant in Ukraine where Helen's PhD research focused on using ecoacoustics to study the avifauna

If hairdressing doesn't work for you, try something else

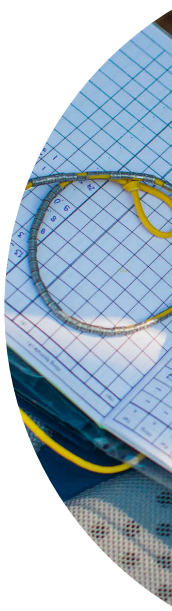
Your career, your decisions

In the final year of my PhD, I was appointed as a Lecturer in Environment and Sustainability at the University of Salford. I had been an hourly paid academic at the University of Salford during my PhD where I had the opportunity to develop my teaching skills. I've now been a lecturer for two years. Alongside my teaching responsibilities, I conduct research and collaborate with others around the world. Although my journey has been 'wonky', it's what made my journey mine and I made all the decisions. Starting university at 22 was the best decision I made as working for a few years opened my eyes to the importance of a career that you love. It is okay to not have all the answers when picking your GCSEs and not to go to university straight from college. There is no 'correct' route as you are the maker of your path, and you don't have to do it the 'right' way.

Acoustic biodiversity monitoring with hopping robots

By Sarab S. Sethi, Lecturer in Ecosystem Sensing, Department of Life Sciences / I-X, Imperial College London

Science never stands still, that's why we continue to evolve as a species and although we don't always get it right, acknowledging that we need to protect (rather than damage) what we have is a step in the right direction. Researchers are critical for our survival and the science of acoustics contributes in ways you'd never imagine. This is where 'hopping robots' can come in handy.



Understanding how animals are distributed cross our planet, how they move and how they behave is essential if we are to protect biodiversity in the face of increasing human pressures. However, in practice, collecting insightful monitoring data at meaningful scales and resolutions remains extremely challenging.

Traditional approaches to collecting biodiversity data rely on manual surveys conducted by trained experts. For example, in a bird point count an ornithologist will stand at a site of interest and record every single bird that they see or hear over a fixed period. Whilst data quality can be exceptional (e.g. identifying sex, age, or breeding stage is possible), the slow speed and high cost of surveys very quickly becomes a major barrier to scalability.

Acoustic monitoring has recently seen a surge in popularity as a scalable alternative to surveying animals in the wild. Inexpensive audio recorders are deployed to capture natural soundscapes from sites of interest over weeks and months. Audio is then analysed with machine learning algorithms to identify species from their vocalisations (e.g. birds by their calls and songs) or other unique acoustic cues (e.g. mosquitos by their buzzing frequencies).

Still, whilst recorders themselves can be cheap, deploying, maintaining and retrieving them can become prohibitively expensive and time-consuming when species need to be monitored on landscape scales or over extended time periods.

Drones on the hop

In a pilot project funded by the UK Acoustics Network (UKAN+), Dr Peggy Bevan led explorations into whether autonomous robots (e.g. drones) carrying acoustic sensors might be able to transform the scale at which we can monitor biodiversity.

Using a vast dataset of audio recorded from ~300 sites across tropical rainforests and agricultural lands on the Osa Peninsula, Costa Rica, we simulated autonomous drones hopping between sampling sites recording an hour of audio at a time. Whilst the original dataset had complete temporal data coverage at each site, our simulated drones could only record short snippets of audio while they briefly landed at a sampling site.

We found that even when simulating very lightweight sampling networks (e.g. one drone per five-10 sites), we could reconstruct previously published patterns in bird biodiversity and spider monkey occupancy across the region. We also found that adaptive sampling – using real-time data to inform which site the drone visited next – improved the reliability of our downstream biodiversity data.

Reducing costs and increasing scalability

In other research from our group at Imperial (the Ecosystem Sensing group) and collaborators across Europe, we are developing technologies that will make autonomous biodiversity sensing systems of this type a reality. For example, Mili Ostojic is developing an autonomous drone that can navigate through complex natural environments and Dr Clementine Boutry and Javad Bathaei at TU Delft are developing fully biodegradable sensors that could be deployed from robotic platforms of this kind.

More engineering research and development work certainly remains before robotic sampling systems reach full maturity and are available at reasonable price points. Nevertheless, our research has paved a clear pathway for autonomous robotic platforms to deliver reliable and impactful data whilst reducing costs and increasing scalability of biodiversity surveys in the future.

Drones carrying acoustic sensors might be able to transform the scale at which we can monitor biodiversity

An ornithologist will record every single bird that they see or hear over a fixed period. Whilst data quality can be exceptional the slow speed and high cost of surveys becomes a major barrier to scalability

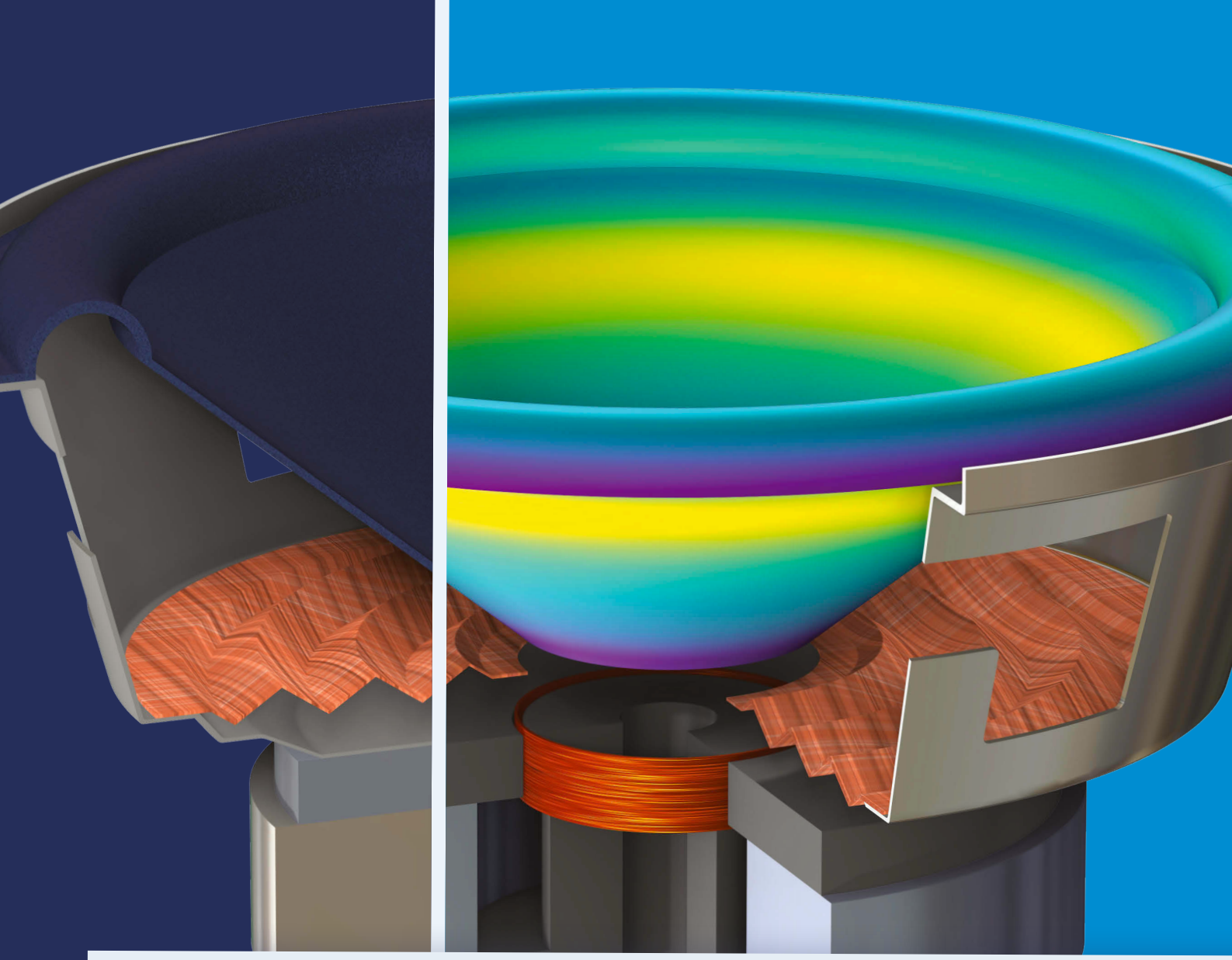
Bringing together the UK's acoustic research community

The vision of the UK Acoustics Network Plus (UKAN+) is to:

- **promote acoustics related research in the UK both nationally and internationally;**
- **provide a coherent single point of access to the acoustics research community for industry and governmental agencies; and**
- **support pilot/explorative projects that can be developed into competitive full-scale proposals to initiate research areas which are new to UK or strategically important.**

Find out more here: https://acoustics.ac.uk/

Collaborators throughout Europe are developing technologies that will make autonomous biodiversity sensing systems a reality



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