UK Acoustics Network+
List of Acoustics Research Priorities 2021
(Draft v4)

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Introduction

The original aim of UKAN+ was set in 2019 to create strategic connections between the Acoustics Challenges (Acoustics Research Priorities) and 4 Grand Challenges (Clean Growth; Healthy Ageing, Future of Mobility; and AI and Data). It was proposed to tackle these challenges, alongside industry, through pilot studies leading to large-scale grant proposals for research projects involving the wider community. UKAN+ promised to support ongoing world-class research in acoustics and to initiate new research, strategically important to the UK.

The first set of Acoustics Research Priorities were identified from the analysis of contributions from 13 UKAN+ Special Interest Groups (SIGs). These contributions were submitted by the SIG Leaders in response to the call for Critical Research Challenges in Acoustics issued in March 2021. The preliminary analysis of the 41 page compiled document has been carried out by Kirill Horoshenkov and Richard Craster in June 2021 who listed 84 SIG-specific Acoustics Research Priorities mapped against the 4 Grand Challenges (see Appendix A).

In March 2021 the UK government decided to revist its Industry Strategy thereby providing our Network with the flexibility to align our Research Priorities with broader EPSRC research Themes rather than with the 4 Grand Challenges related to the Industry Strategy. It was suggested through discussions within the UKAN+ investigators team that these Themes should be: (i) Well-being; (ii) Manufacturing and Transport; (iii) Sustainability (Net-Zero); (iv) AI. These themes were identified from our discussion with the EPSRC which took place in May 2021. The 84 Research Priorities specific to SIGs were mapped by the 4 Grand Challenge Champions and their Early Career representatives through a vote onto these 4 EPSRC Themes in July 2021. Appendix B presents the result of this exercise.

Further analysis of the 84 Research Priorities by Kirill Horoshenkov and Richard Craster suggested that many of them had significant overlaps. This enabled us to distill them further into 21 Higher Order Acoustics Research Priorities which are listed in the next section of this document. These priorities have been also mapped on the 4 EPSRC Themes and then discussed with the 4 Grand Challenge Champions and their Early Career representatives. The inter-relation between the 84 SIG-specific Acoustics Research Priorities, 21 Higher Order Acoustics Research Priorities and 4 EPSRC Themes is shown in the table presented in Appendix B. Appendix C presents 2 Venn diagrams illustrating graphically this inter-relation. The link to the Excel file with this information can be found here.

The 21 Higher Order Acoustics Research Priorities are a key element of this document. It is proposed that these Priorities should guide applications for explorative (pilot) cross-disciplinary research projects between industry, government, third-sector organisations and academia which UKAN+ will support. These are also important to guide full-scale grant applications which will be developed by the research community in the next 10 years.

It is now time to run a consultation among the wider research community to agree on the final draft of this document. Specifically, we would like to ask the community to:

- comment on the list of the 21 Higher Order Priorities to make sure that it is a comprehensive list;
- comment on the proposed inter-relation between these Priorities and the 4 Themes (i) Well-being; (ii) Manufacturing and Transport; (iii) Sustainability (Net-Zero); (iv) AI;
- suggest how urgent each of these Priorities is, e.g. should it be addressed immediately, within the next 5-10 years or in a longer term.

A special Google Form is provided here to facilitate your feedback. The deadline for your comments is the 20th of August 2021.

Acoustics Research Priorities

1. Acoustics for new drugs, healthcare products and therapies.

Special sounds (including ultrasonic), acoustic instrumentation and sensors to support medicine manufacturing and pharmaceutical industry in general. It also refers to sounds for non-invasive, automated imaging, surgery, therapies and delivery of precision medicines (for humans and animals).

2. Acoustics for health screening and diagnostics

Sounds for advanced automated diagnosis and telemedicine, to quantify baseline parameters and their typical variance with demographic factors in healthy populations and to determine the effect size of disease-sensitive changes.

3. Acoustics for space exploration

This priority should include any developments related to acoustic sensing for extra-terrestrial worlds and spacecraft.

4. Acoustics for the understanding of climate change

Sounds for large scale monitoring of environmental effects for better understanding human and eco-system level behaviours in changing environmental conditions, climate change on both the underwater and in-land acoustic environments.

5. Adaptive technologies to manipulate sounds

This priority should include research into harnessing emerging technologies (sensors, wearables, AI) to measure noise, understand the relationship with health via new noise metrics, development of adaptive technologies to transform sounds indoors and outdoors, research into improved acoustics for buildings, understanding the effect of the changing acoustic environment including electrification of transport, pandemic effects, wider working from home and virtual reality (VR). It also can include research into our ability to simulate and reproduce any future sounds accurately via VR, voice synthesis, augmented reality and digital twinning, individually tailored methods of active noise control, education and entertainment. Step-change improvements for speech intelligibility in buildings and public places are required.

6. Advocacy and education about noise and acoustics

There is a need for more work into adaptive sound reproduction based on activity and attention of listeners and step-change in education on healthy sound-living among the public and in schools.

7. AI for making sense of sounds

There is a need for new studies into using AI to integrate acoustics sensors with other sensors to improve transportation efficiency, develop automated swarm sonic sensing across scales for infrastructure, machines, processes and agriculture, environment, embedded, wireless self-monitoring acoustic sensor systems and fully automated data analysis and for big data processing from large sensor networks. This research should also include the development of high-fidelity acoustic signal processing and simulations for acoustic detection and classification in challenging conditions with limited data.

8. AI for manufacturing of acoustic products

New research into AI and sounds for manufacture, inspection and decision-making processes are welcome including that on machine learning to support manufacturing of new acoustic materials, process and product design.

9. AI for voice control and artificial speech

This priority refers to new AI methods for audio separation and voice identification, voice synthesis and speech enhancement including that in noisy and reverberant environments.

10. Biologically inspired and intellegent solutions for acoustics

There is a clear need for radically new biologically inspired, 'zero microphone' and quantum sonic sensors, intelligent actuators and other smart and miniturised components for acoustic products.

11. Computer science for acoustics

More efficient solutions in acoustics require new intelligent computational and data analysis algorithms coded to automatically adapt to different special effects, environmental change and mathematical instabilities. This research includes open cloud computing, virtual acoustic prototypes, digital twinning and machine learning for simulating the noise and vibration impact from machines, structures and devices.

12. Hearing aid

We are still far from optimal regarding improvements in experiencing sounds for people with hearing and related problems. This requires the development of individually tailored and hearing-loss friendly sound systems including precision auditory engineering, optimisation of wearable hearing and communication technologies, mobile devices through modelling and AI to remove background noise, improve speech signals, intelligibility and to conserve power. It also requires the development of new pharmacological and genetic solutions to improve hearing health with maximum effectiveness and validated for use in realistic conditions, understanding of context-awareness into acoustic/audio signal processing for communications including hearing aids and transformative treatments for hearing impairment for noisy environments.

13. Hearing and brain

From physiological and psychological points of view we lack understanding of age-related decline in the functioning of the inner ear, ageing brain and their connection with communication problems. There is a need to understand better the link between hearing and brain, auditory and cognitive processing and mechanisms of tinnitus. Research is needed to develop 3D media technology and artificial sound sources for ageing society including the use of positive sounds to support brain function and healthy aging.

14. Impact of noise on mental and physical health

Despite almost a century of research into this topic there is still a lack of understanding of the impact of noise on mental and physical health for diverse age, culture and ethnic groups. There is a clear need to quantify the value of acoustic tranquillity in urban areas and green spaces for health and impact of noise mitigation on wellbeing.

15. Impact of sounds on wildlife

With the increasing auntropogenic activities it is essential to develop enabling technologies for measuring the animal response to sounds and, in particular, to understand the impact of

underwater noise on marine habitat, together with effectiveness of noise abatement technology.

16. Mathematics for acoustics

Mathematics will contrinue to underpin acoustics and there is a need for more work to solve specific mathematical and numerical problems in acoustics using, advanced analysis, machine learning and AI. There is a need to develop a unified mathematical theory for all aspects of acoustic environments at all scales, particularly for the underwater world.

17. More efficient innovation in acosutics

There is still a relatively long time lag between fundamental, applied research in acoustics and non-academic impact from it. There is a particular need to work towards faster adoption of new acoustic technologies by clinicians, industry and policy-makers. This can be done by strengthening the link between pure analysis, applied acoustics research and KT and via the more efficient development of better acoustic standards, practices and legislation.

18. New methods for noise control

New fundamental physics related to noise generation through traditional methods of vehicle propulsion (land and air) is required to develop and adopt novel methods for noise reduction from existing transportation platforms. The focus should also be on novel methods for noise reduction from emerging transportation platforms including electrical cars, UAVs, supersonic planes and high-speed trains without compromising safety, autonomy, speed and efficiency reducing the noise impact of developing Net Zero energy systems on land, air and underwater. Also, it is required to research into mitigation and reduction of impacts of unwanted sounds (noise) from existing anthropologic activities and new infrastructure developments such as manufacturing, agriculture, transportation. A step-change in the prevention of noise induced hearing loss from the young to old is required.

19. Quiter marine propulsion technologies

This research should be focused on quieter vessels and drones operating at sea, particularly on novel mechanisms of propulsion which are a step-change in terms of the reduction in their nosie signature.

20. Sustainable acoustic solutions

As a part of the Net-Zero initiative there is a clear need for manufacturing of acoustic materials from sustainable sources and methods, nore efficient use of materials and machines for improved life, safety and functionality and for the adoption of modern methods of construction (MMC) which include sustainable acoustics solutions, e.g. better and more sustainable room acoustics quality and insulation.

21. Understanding of soundscapes

Despite a significant global effort there is still a lack of understanding of the role of soundscapes in the new industrial era and through climate change. Therefore, a better holistic, qualitative research approach to soundscape is required to include climate change, air quality and other societal changes including pandemic. This work should lead to new research into practical implementation of soundscapes.

Appendix A: SIG-specific Research Priorities for Acoustics and their inter-relation with the 4 Grand Challenges

Acoustics for Healthy Ageing

Sounds around us:

1. Understanding of the impact of noise on mental and physical health for diverse age, culture and ethnic groups.
2. Quantifying the value of acoustic tranquillity in urban areas and green spaces for health and impact of noise mitigation on wellbeing.
3. Harnessing emerging technologies (sensors, wearables, AI) to measure noise, understand the relationship with health via new noise metrics.
4. Development of adaptive technologies to transform sounds indoors and outdoors.
5. Research into improved acoustics for health buildings.
6. Understanding of the effect of the changing acoustic environment including electrification of transport, wider working from home and virtual reality (VR).
7. Ability to simulate and reproduce any future sounds accurately via VR, voice synthesis, augmented reality and digital twinning.
8. Development of 3D media technology and artificial sound sources for ageing society.
9. Creative use of positive sounds to support brain function and healthy aging.
10. Research on adaptive sound reproduction based on activity and attention of listeners.
11. Step-change in education on healthy sound-living among the public and in schools.
12. Advocacy for new legislation for much more healthy acoustic environments.

Our hearing:

1. Understanding of age-related decline in the functioning of the inner ear, ageing brain and their connection with communication problems.
2. Understanding of the link between hearing and brain.
3. Understanding of the links between auditory and cognitive processing.
4. Understanding of the mechanisms of tinnitus.
5. Improvements in experiencing sounds for people with hearing and related problems.
6. Development of individually tailored and hearing-loss friendly sound systems including precision auditory engineering.
7. Optimisation of wearable hearing and communication technologies, mobile devices through modelling and AI to remove background noise, improve speech signals, intelligibility and to conserve power.
8. Development of new pharmacological and genetic solutions to improve hearing health with maximum effectiveness and validated for use in realistic conditions.
9. Understanding of context-awareness into acoustic/audio signal processing for communications including hearing aids.
10. Step-change in the prevention of noise induced hearing loss from the young to old.
11. Step-change improvements for speech intelligibility in buildings and public places.

Sounds for health and prosperity:

1. New methods of remote health screening and diagnostics using sonic waves (audio and ultrasonic), smartphones and internet technology.

2. Sounds for non-invasive, automated imaging, surgery, therapies and delivery of precision medicines (for humans and animals).
3. Sounds for medicine manufacturing and pharmaceutic industry.
4. AI support for acoustic related health care applications.
5. Transformative treatments for hearing impairment for noisy environments.
6. New individually tailored methods of active noise control and acoustic virtual reality.
7. Other work towards adoption of new acoustic technologies by clinicians.
8. Developing greater understanding and collaboration at the clinical-research interface.
9. Advancing automated diagnosis and telemedicine with the use of sounds.
10. Use of sounds to quantify baseline parameters and their typical variance with demographic factors in healthy populations and to determine the effect size of disease-sensitive changes.
11. Understanding of pandemic effects on the design of spaces for work and living.

Acoustics for Future of Mobility

Noise and transport:

1. New fundamental physics related to noise generation through vehicle propulsion.
2. Novel methods for noise reduction from existing transportation platforms.
3. Novel methods for noise reduction from emerging transportation platforms including electrical cars, UAVs, supersonic planes and high-speed trains without compromising safety, autonomy, speed and efficiency.
4. Understanding of soundscape in the new industrial era and through climate change.

Noise and marine environment:

1. New quiet vessels and drones.
2. Development of new sensors, tools and maps for the spatial, temporal and spectral distribution of underwater noise sources including anthropogenic sources.
3. Development of high-fidelity acoustic signal processing and simulations for acoustic detection and classification in challenging conditions with limited data.
4. Development of enabling technologies for measuring the animal response to sound.
5. Understanding of the behaviour response of marine mammals, and the impact of underwater noise on marine mammals, together with effectiveness of noise abatement technology.
6. Understanding the effects of climate change on the underwater acoustic environment.
7. Development of a unified mathematical theory for all aspects of the underwater acoustic environment at all scales.

AI and Data

Voice control and artificial speech:

1. New AI methods for audio separation and voice identification.
2. Context-aware adaptation of sounds using AI.
3. New AI methods for voice synthesis and speech enhancement.
4. AI for speech enhancement in noisy and reverberant environments.
5. AI for sound adaptation to individual context.

Making sense of sounds and sound control:

1. Intelligent computational and data analysis algorithms coded to automatically adapt to different special effects, environmental change and mathematical instabilities.
2. AI-based environment monitoring, detection and classification of sounds mimicking the brain (human and wildlife).
3. AI-based adaptive noise control.
4. AI decision support for industrial and environmental monitoring applications.
5. AI for big data processing from large sensor networks.
6. AI for solving specific mathematical and numerical problems in acoustics.
7. AI and sounds for manufacture, inspection and decision-making processes.
8. Machine learning for new acoustic material design.
9. AI sound detection in public spaces for surveillance and emergency response.
10. Enhanced acoustic modelling comparable to optical models in video games and VR.
11. Development of new, open cloud computing solutions for hi-fi acoustic modelling.

Acoustics for Clean Growth

Reducing noise impact:

1. Mitigation and reduction of impacts of unwanted sounds (noise) on wildlife and humans from existing anthropologic activities and new infrastructure developments such as manufacturing, agriculture, transportation.
2. Holistic research approach to soundscape to include climate change, air quality and societal changes including pandemic.
3. Research in practical implementation of soundscapes.
4. Reducing the noise impact of developing Net Zero energy systems on land, air and underwater.
5. Understanding and mitigating the impacts noise from unmanned or electrical transportation.

Acoustic sensing:

1. Fusing acoustics sensors with other sensors to improve transportation efficiency.
2. Large scale monitoring of environmental effects of sounds for better understanding human and eco-system level behaviours in changing environmental conditions.
3. Automated swarm sonic sensing across scales for infrastructure, machines, processes and agriculture.
4. Acoustic sensor miniaturisation.
5. Embedded, wireless sonic (acoustic and ultrasonic) sensors and deep learning framework, self-monitoring systems and fully automated data analysis.
6. Biologically inspired, ‘zero microphone’ and quantum sonic sensors.
7. Development of acoustic sensing for non-terrestrial worlds.

Acoustic software, materials, devices and practices:

1. Manufacturing of acoustic materials from sustainable sources and methods.
2. Efficient use of materials and machines for improved life, safety and functionality.
3. Intelligent acoustic actuators and smart components.
4. Active acoustic with in-built acoustic sensors and intelligence.
5. Development of virtual acoustic prototypes, digital twinning and machine learning for simulating the noise and vibration impact from machines, structures and devices.
6. Full integration of inspection modelling with materials and integrity engineering.
7. New solutions for better sound reinforcement, education and entertainment.

8. High-fidelity, intelligent simulation algorithms integrating acoustic sensors and information with industry and national databases.
9. Acoustics for Modern Methods of Construction (MMC).
10. Strengthening the link between pure analysis, applied acoustics research and KT.
11. Development of better acoustic standards, practices and legislation.

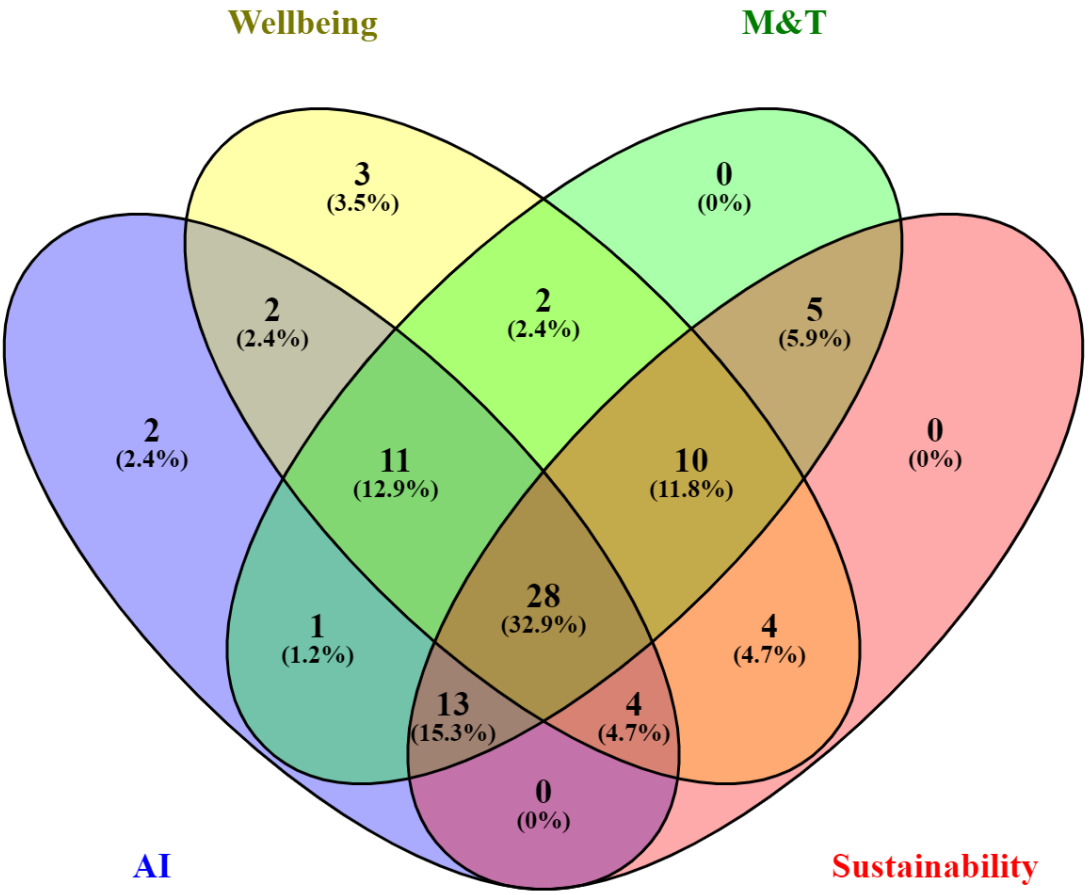
Appendix B: Inter-relation between the SIG-related Research Priorities in Acoustics, Higher Order Research Priorities and 4 EPSRC Themes.

		Themes					
		AI	Wellbeing	Manufacturing and transport	Sustainability		
Priority number	SIG-specific Research Priorities	Count of votes by investigators				Higher Order Research Priorities	Priority number
1	Sounds for medicine manufacturing and pharmaceutic industry.	0	7	9	3	Acoustics for new drugs, healthcare products and therapies.	1
2	Sounds for non-invasive, automated imaging, surgery, therapies and delivery of precision medicines (for humans and animals).	3	9	4	0	Acoustics for new drugs, healthcare products and therapies.	1
3	AI support for acoustic related health care applications.	9	6	3	0	Acoustics for new drugs, healthcare products and therapies.	1
4	New methods of remote health screening and diagnostics using sonic waves (audio and ultrasonic), smartphones and internet technology.	6	9	2	0	Acoustics for health screening and diagnostics	2
5	Advancing automated diagnosis and telemedicine with the use of sounds.	5	9	1	3	Acoustics for health screening and diagnostics	2
6	Use of sounds to quantify baseline parameters and their typical variance with demographic factors in healthy populations and to determine the effect size of disease-sensitive changes.	2	9	1	1	Acoustics for health screening and diagnostics	2
7	Development of acoustic sensing for non-terrestrial worlds.	2	0	3	0	Acoustics for space exploration	3
8	Large scale monitoring of environmental effects of sounds for better understanding human and eco-system level behaviours in changing environmental conditions.	3	4	3	7	Acoustics for understanding of climate change	4
9	Understanding the effects of climate change on the underwater acoustic environment.	1	3	1	7	Acoustics for understanding of climate change	4
10	Harnessing emerging technologies (sensors, wearables, AI) to measure noise, understand the relationship with health via new noise metrics.	9	6	2	1	Adaptive technologies to manipulate sounds	5
11	Development of adaptive technologies to transform sounds indoors and outdoors.	5	9	4	2	Adaptive technologies to manipulate sounds	5
12	Research into improved acoustics for health buildings.	1	9	2	7	Adaptive technologies to manipulate sounds	5
13	Understanding of the effect of the changing acoustic environment including electrification of transport, wider working from home and virtual reality (VR).	3	9	9	4	Adaptive technologies to manipulate sounds	5
14	Ability to simulate and reproduce any future sounds accurately via VR, voice synthesis, augmented reality and digital twinning.	6	7	1	0	Adaptive technologies to manipulate sounds	5
15	New individually tailored methods of active noise control and acoustic virtual reality.	6	7	6	0	Adaptive technologies to manipulate sounds	5
16	Understanding of pandemic effects on the design of spaces for work and living.	0	6	4	9	Adaptive technologies to manipulate sounds	5
17	Context-aware adaptation of sounds using AI.	7	0	0	0	Adaptive technologies to manipulate sounds	5
18	AI for sound adaptation to individual context.	7	4	0	0	Adaptive technologies to manipulate sounds	5
19	Enhanced acoustic modelling comparable to optical models in video games and VR.	7	5	1	0	Adaptive technologies to manipulate sounds	5
20	New solutions for better sound reinforcement, education and entertainment.	0	4	1	6	Adaptive technologies to manipulate sounds	5
21	AI for big data processing from large sensor networks.	0	9	7	5	Adaptive technologies to manipulate sounds	5
22	Research on adaptive sound reproduction based on activity and attention of listeners.	4	9	2	0	Advocacy and education about noise and acoustics	6
23	Step-change in education on healthy sound-living among the public and in schools.	0	9	0	6	Advocacy and education about noise and acoustics	6
24	Advocacy for new legislation for much more healthy acoustic environments.	0	9	0	6	Advocacy and education about noise and acoustics	6
25	Fusing acoustics sensors with other sensors to improve transportation efficiency.	4	0	6	5	AI for making sense of sounds	7
26	Automated swarm sonic sensing across scales for infrastructure, machines, processes and agriculture.	2	0	7	5	AI for making sense of sounds	7
27	Embedded, wireless sonic (acoustic and ultrasonic) sensors and deep learning framework, well-monitoring systems and fully automated data analysis.	6	0	7	4	AI for making sense of sounds	7
28	Active acoustic with in-built acoustic sensors and intelligence.	5	3	5	5	AI for making sense of sounds	7
29	AI for big data processing from large sensor networks.	7	1	6	1	AI for making sense of sounds	7
30	Development of new sensors, tools and maps for the spatial, temporal and spectral distribution of underwater noise sources including anthropogenic sources.	4	0	6	6	AI for making sense of sounds	7
31	AI-based environment monitoring, detection and classification of sounds mimicking the brain (human and wildlife).	7	3	0	5	AI for making sense of sounds	7
32	AI-based adaptive noise control.	7	3	5	5	AI for making sense of sounds	7
33	AI decision support for industrial and environmental monitoring applications.	7		7	5	AI for making sense of sounds	7
34	AI sound detection in public spaces for surveillance and emergency response.	7	5	0	2	AI for making sense of sounds	7
35	Development of high-fidelity acoustic signal processing and simulations for acoustic detection and classification in challenging conditions with limited data.	7	0	6	4	AI for making sense of sounds	7
36	AI and sounds for manufacture, inspection and decision-making processes.	7	0	7	3	AI for manufacturing of acoustic products	8
37	Machine learning for new acoustic material design.	7	0	4	4	AI for manufacturing of acoustic products	8
38	New AI methods for audio separation and voice identification.	7	0	0	0	AI for voice control and artificial speech	9
39	New AI methods for voice synthesis and speech enhancement.	7	6	0	0	AI for voice control and artificial speech	9
40	AI for speech enhancement in noisy and reverberant environments.	7	5	4		AI for voice control and artificial speech	9
41	Biologically inspired, 'zero microphone' and quantum sonic sensors.	1	0	3	4	Biologically inspired and intelligent solutions for acoustics	10
42	Intelligent acoustic actuators and smart components.	4	0	5	5	Biologically inspired and intelligent solutions for acoustics	10

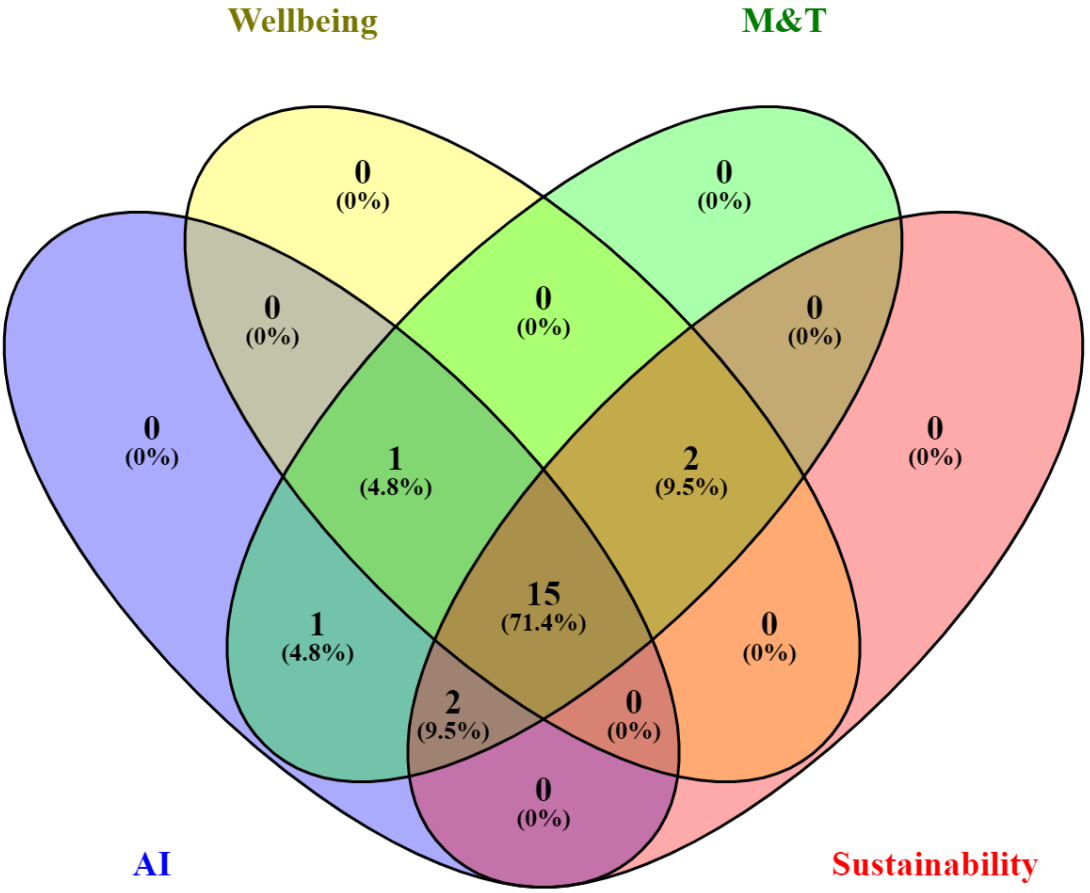
d3	Acoustic sensor miniaturisation.	1	3	7	6	Biologically inspired and intelligent solutions for acoustics	10
d4	Intelligent computational and data analysis algorithms coded to automatically adapt to different special effects, environmental change and mathematical instabilities.	7	3	3	d	Computer science for acoustics	11
d5	Development of new, open cloud computing solutions for hi-fi acoustic modelling.	7	3	3	3	Computer science for acoustics	11
d6	Development of virtual acoustic prototypes, digital twinning and machine learning for simulating the noise and vibration impact from machines, structures and devices.	7	6	7	5	Computer science for acoustics	11
d7	Full integration of inspection modelling with materials and integrity engineering.	6	6	7	5	Computer science for acoustics	11
d8	High-fidelity, intelligent simulation algorithms integrating acoustic sensors and information with industry and national databases.	5	6	7	5	Computer science for acoustics	11
d9	Improvements in experiencing sounds for people with hearing and related problems.	1	9	3	1	Hearing aid	12
50	Development of individually tailored and hearing-loss friendly sound systems including precision auditory engineering.	3	9	8	1	Hearing aid	12
51	Optimization of wearable hearing and communication technologies, mobile devices through modelling and AI to remove background noise, improve speech signals, intelligibility and to conserve power.	9	7	3	5	Hearing aid	12
52	Development of new pharmacological and genetic solutions to improve hearing health with maximum effectiveness and validated for use in realistic conditions.	6	9	3	6	Hearing aid	12
53	Understanding of context-awareness into acoustic/audio signal processing for communications including hearing aids.	3	9	1	6	Hearing aid	12
5d	Transformative treatments for hearing impairment for noisy environments.	1	9	d	8	Hearing aid	12
55	Understanding of age-related decline in the functioning of the inner ear, ageing brain and their connection with communication problems.	6	9	6	3	Hearing and brain	13
56	Understanding of the link between hearing and brain.	6	9	6	6	Hearing and brain	13
57	Understanding of the links between auditory and cognitive processing.	6	9	6	6	Hearing and brain	13
58	Understanding of the mechanisms of tinnitus.		9	6	6	Hearing and brain	13
59	Development of 3D media technology and artificial sound sources for ageing society.	5	9	d	6	Hearing and brain	13
60	Creative use of positive sounds to support brain function and healthy aging.	1	9	6	3	Hearing and brain	13
61	Understanding of the impact of noise on mental and physical health for diverse age, culture and ethnic groups.	1	9	6	3	Impact of noise on mental and physical health	14
62	Quantifying the value of acoustic tranquillity in urban areas and green spaces for health and impact of noise mitigation on wellbeing.	1	9	1	7	Impact of noise on mental and physical health	14
63	Development of enabling technologies for measuring the animal response to sound.	6	d	1	8	Impact of sounds on wildlife	15
6d	Understanding of the behaviour response of marine mammals, and the impact of underwater noise on marine mammals, together with effectiveness of noise abatement technology.	6	d	3	7	Impact of sounds on wildlife	15
65	Development of a unified mathematical theory for all aspects of the underwater acoustic environment at all scales.	6	6	5	8	Mathematics for acoustics	16
66	AI for solving specific mathematical and numerical problems in acoustics.	7		1		Mathematics for acoustics	16
67	Other work towards adoption of new acoustic technologies by clinicians.	3	9	1	3	More efficient innovation in acoustics	17
68	Developing greater understanding and collaboration at the clinical-research interface.		9	1		More efficient innovation in acoustics	17
69	Strengthening the link between pure analysis, applied acoustics research and KT.	3	3	5	d	More efficient innovation in acoustics	17
70	11. Development of better acoustic standards, practices and legislation.	3	d	8	8	More efficient innovation in acoustics	17
71	New fundamental physics related to noise generation through vehicle propulsion.			8	3	New methods for noise control	18
72	Novel methods for noise reduction from existing transportation platforms.	d	3	8	d	New methods for noise control	18
73	Novel methods for noise reduction from emerging transportation platforms including electrical cars, UAVs, supersonic planes and high-speed trains without compromising safety, autonomy, speed and efficiency.	d	3	8	7	New methods for noise control	18
7d	Reducing the noise impact of developing Net Zero energy systems on land, air and underwater.	6	3	8	7	New methods for noise control	18
75	Understanding and mitigating the impacts noise from unmanned or electrical transportation.	6	5	7	8	New methods for noise control	18
76	Step-change in the prevention of noise induced hearing loss from the young to old.	6	9	6	3	New methods for noise control	18
77	Mitigation and reduction of impacts of unwanted sounds (noise) on wildlife and humans from existing anthropologic activities and new infrastructure developments such as manufacturing, aviculture, transportation.	3	5	8	7	New methods for noise control.	18
78	New quiet vessels and drones.	3	3	8	7	Quiter propulsion technologies	19
79	Manufacturing of acoustic materials from sustainable sources and methods.	6		7	7	Sustainable acoustic solutions	20
80	Efficient use of materials and machines for improved life, safety and functionality.	6	5	8	7	Sustainable acoustic solutions	20
81	Acoustics for Modern Methods of Construction (MMC).	6	6	8	8	Sustainable acoustic solutions	20
82	Understanding of soundscape in the new industrial era and through climate change.	1	3	8	d	Understanding of soundscapes	21
83	Holistic research approach to soundscape to include climate change, air quality and societal changes including pandemic.	6	d	d	7	Understanding of soundscapes	21
8d	Research in practical implementation of soundscapes.	1	5	3	5	Understanding of soundscapes	21

This table is also available to view as an Excel file via this link.

Appendix C: Venn diagrams illustrating the relations between the acoustics Research Priorities and EPSRC Themes.



SIG-related Acoustics Research Priorities and 4 EPSRC Themes



Higher Order Acoustics Research Priorities and 4 EPSRC Themes