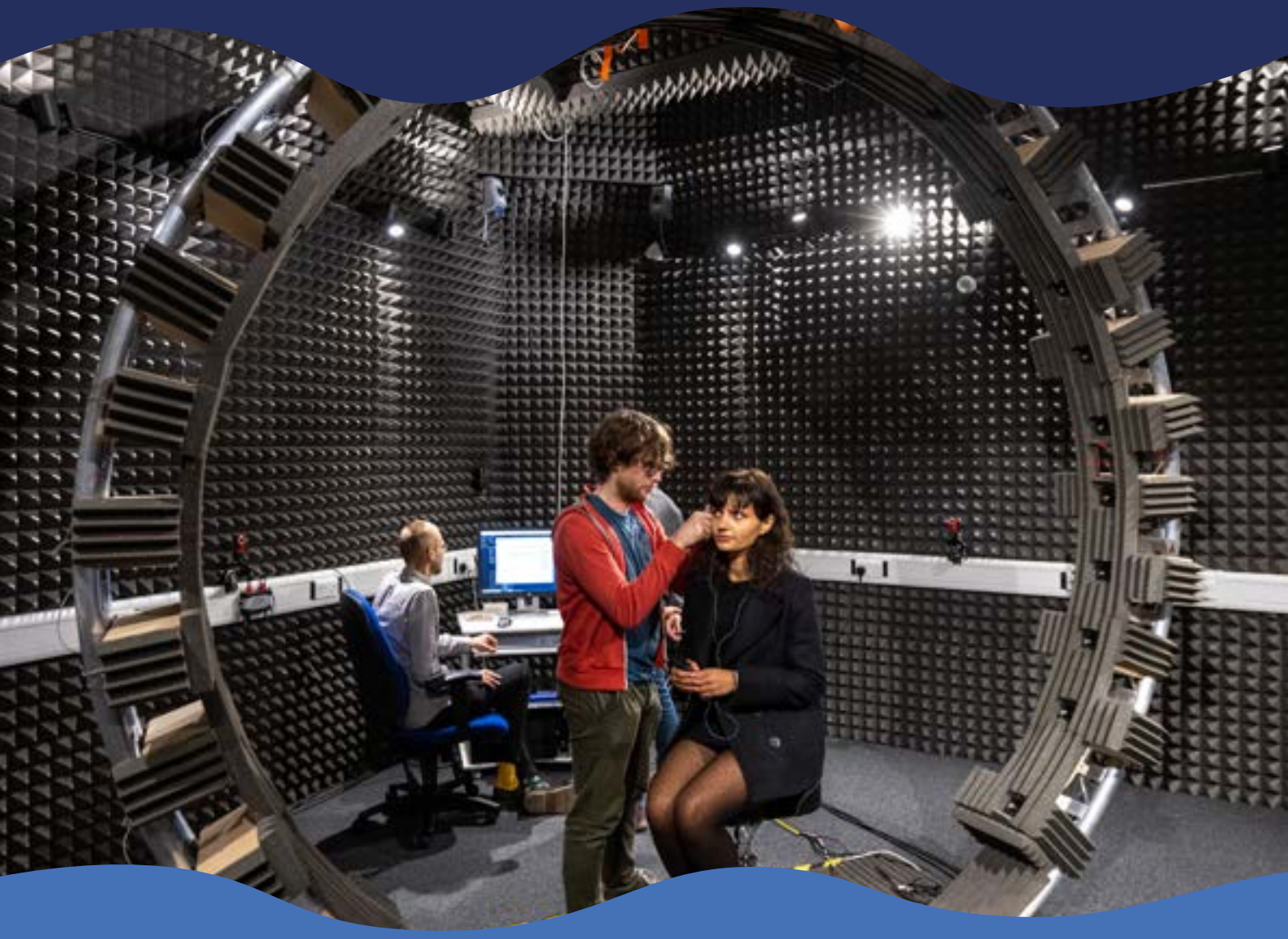
SONICOM

YEAR IN REVIEW 2023



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101017743.

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FOREWORD

The third year of the SONICOM project has been the busiest and most exciting so far!

In just three years, SONICOM has already substantially contributed to the design and evaluation of novel immersive audio technologies and techniques, as well as to the overall advancement of knowledge and understanding in the spatial acoustics and immersive audio research domains. Our works on parametric pinna models will move forward aiming at consolidating practices across the consortium and outputting results from perceptual validation studies. Similarly, work on perceptual- and numerical-based HRTF selection frameworks has already mapped existing approaches across the research community and will contribute to consolidating their use within and beyond SONICOM.

Explorative work has been completed and will soon be published looking at the interactions between HRTF choices and speech intelligibility, which has the potential to generate major impact on our understanding of immersive audio communication and interaction within AR/VR. Considering specifically the AR context, SONICOM's work focussed on three studies looking at matching the reverberation of the real environment with the virtual one, and at exploring which computational/rendering choices (including machine-learning based ones) and parameters are relevant from a perceptual point of view. Results from these and other experiments will soon be published and will allow us to achieve a seamless blend between the real and virtual auditory domains.

Significant work has also been done mapping, planning, and executing activities aiming at exploring and modelling how the physical characteristics of spatialised auditory stimuli can influence observable behavioural, physiological, kinematic, and psychophysical reactions of listeners within AR/VR-based social interaction scenarios. When released, the SONICOM 3D Speaker Personality Corpus will hopefully become a standard tool within the academic community for exploring interactions between the simulated distance/position of speakers and the traits that listeners attribute to them. Furthermore, our study on proxemics will soon be published, showing how AI-based models can be trained to infer socially and psychologically relevant perceptions of a user from the widest possible array of measurable aspects in an AR/VR environment.

The impact of the work carried out so far has already been evidenced by the contribution of SONICOM in the release and update of tools and datasets widely used within the immersive audio research community and plans for more substantial impact will involve the mid-project sandpit event and the Listener Acoustic Personalisation challenge.

Lorenzo Picinali,
SONICOM Lead Investigator,
Imperial College London

RESEARCH OVERVIEW

SONICOM INVESTIGATORS UPDATE ON BEHALF OF THE PROJECT'S RESEARCH THEMES

Immersion: Brian FG Katz, Sorbonne University

2023 has seen progress across the three main strands of our research in SONICOM.

HRTF modelling advances our understanding of HRTFs in spatial audio perception. This year we enhanced HRTF databases, developed perceptual model frameworks, and created auditory modelling tools. Completing two parametric pinna models, we compared auditory models, analysed Bayesian sound localization, and proposed probabilistic frameworks.

Our advances in spatial hearing perception showcased spatial audio research advancements in HRTF selection, user-system adaptation, head-mounted display effects, and Bayesian models. The studies combine theory and practical applications to improve spatial audio quality.

Finally, we also worked on integrating real and virtual acoustics in Audio Augmented Reality. We advanced towards optimized late reverberation algorithms, simulated dynamic scenarios, and explored factors affecting auditory perception, aiming to create seamless, immersive audio experiences for augmented reality applications.

Interaction: Alessandro Vinciarelli, University of Glasgow

During 2023, we made progress across all our activities in SONICOM, including experiments to test whether auditory accommodation to altered HRTFs in an acoustically dry room generalizes to a more reverberant room.

We also gained new insights on the impact of 3D audio spatialization on users' ability to detect rotation gains within a virtual environment, with indications that dynamic active listening has a positive influence on sound localisation and findings showing that accurate monaural cues are not required for the dynamic part of the sound localization process. We also measured the interplay between physical distance and attribution of personality traits in virtual immersive audio environments.

We performed experiments showing that Late Reverberation has limited influence on co-immersion in Audio Augmented Virtuality and results about the relationship between the plausibility of room impulse responses and varying levels of spatial resolution and spectral bandwidth.

Finally, we also included a new SOFA convention (AnnotatedReceiverAudio) and completed the SONICOM 3D Speaker Personality Corpus.

Integration: Arcadio Reyes-Lecuona, University of Malaga

Much of our work this year has focused on the development of the Binaural Rendering Toolbox (BRT). The BRT is a software tool which functions as a virtual laboratory designed for psychoacoustic experimentation, comprising libraries, applications, and definitions. Developed within SONICOM, the BRT integrates algorithms from the 3D Tune-In Toolkit into a new open and extensible architecture, also including new algorithms for binaural rendering.

At its core, the BRT consists of a library with C++ implementations of listener models, source models, and environment models. Additionally, the BRT includes an application that is controlled through the Open Sound Control (OSC) protocol.

Short term plans include the implementation of a listener model based on Ambisonics and several environment models, as Scattering delay Networks (SDN) and convolution with Binaural Room Impulse Responses (BRIR).

Experience: Areti Andreopoulou, National and Kapodistrian University of Athens

Our work focuses on ecologically valid assessments of the outcomes derived from other parts of the project. This approach is necessary, as audition is a multimodal experience affected on a cognitive level by motion, visual feedback, context etc. Consequently, our core research is based on the design of real-life evaluation scenarios, predominantly where audio is either the most important component, or the only component, such as for blind or visually impaired individuals.

This area of research only commenced earlier this year. Yet, even during this short period of time significant progress has been made towards the identification of the evaluation scenarios, which our partners will use to assess SONICOM related work. These scenarios so far include: i) remote music education enhanced by XR technologies, ii) network music performance practices, iii) teleconferencing with integrated spatial audio, iv) navigation tools for VIB individuals, and v) virtual musical training.

Beyond: Piotr Majdak, Austrian Academy of Sciences

We've seen great progress in our development of tools for the audio research community, meaning several of them are now nearly complete. Tools we have released new versions of this year aim to help researchers to share spatially oriented data, model auditory processing, and calculate personalised acoustic filters. Find out more about these tools later in this Review.

As well as this, we started the implementation of the SONICOM Ecosystem as an online data repository, and the planning of the Listener Acoustic Personalisation (LAP) Challenge to integrate the research community – keep an eye out for updates on these next year!

HIGHLIGHTS OF 2023

RESEARCH ACHIEVEMENTS

SONICOM HRTF Dataset

2023 saw the launch of the SONICOM HRTF dataset, designed to facilitate reproducible research in immersive audio, this dataset contains the HRTFs of 120 subjects, as well as headphone transfer functions; 3D scans of ears, heads, and torsos; and depth pictures at different angles around subjects' heads.

Access the dataset and other open access tools on our website

Updated tools for the acoustic research community

SOFA Toolbox version 2.2

The toolbox enables researchers to share spatially oriented acoustic data, facilitating their work on personalisation of audio.

Learn more

The Auditory Modeling Toolbox (AMT) version 1.5.0

The AMT enables modeling of auditory processing and behavioural data, expanding our understanding of the human hearing. Within SONICOM it has importance to evaluate the degree of personalisation of binaural systems.

Learn more

Mesh2HRTF version 1.1.1

Mesh2HRTF enables researchers and companies to calculate personalized acoustic filters for improved spatial perception of sound presented via headphones.

Learn more

The Binaural Rendering Toolbox (BRT) version 1.2

BRT library enables real-time binaural rendering of point sources simulating both the directivity of the source and the HRTF of the listener (Both in SOFA format).

Learn more

Forum Acusticum 2023

Team members from across the SONICOM consortium presented a variety of work being undertaken as part the project at Forum Acusticum 2023.

This included the new Spatially Oriented Format for Acoustics (SOFA) release, as well as research on HRTF individualisation, accommodation and upsampling.

Read more about the SONICOM research presented at the conference

BAS2023 Conference

SONICOM co-funded the 2023 Basic Auditory Science conference and hosted the event at Imperial College London. The two-day meeting offered those involved in hearing, acoustics and audiology research to meet and exchange ideas, with presentations on a range of topics including spatial hearing and immersive audio rendering, psychoacoustics, and hearing-assistive technologies.

Read the full agenda of what was covered

SONICOM publications

The SONICOM consortium has continued to publish their research outputs across 2023, and we look forward to keeping up the momentum next year.

View our publications on our website

HIGHLIGHTS OF 2023

ENGAGING AUDIENCES WITH SONICOM

Royal Society Summer Science Exhibition

From 4-9 July 2023, SONICOM exhibited at the Royal Society Summer Science Exhibition – one of the most prestigious science-engagement festivals in the UK.

As the Royal Society's flagship event, the Summer Science Exhibition attracts thousands of visitors every year, from families with 4-year-olds to school groups to eminent Fellows of the Royal Society.

Taking part in the 'Virtual Audio: Illusion or Reality?' exhibit, one of nine chosen from teams across the UK, members of the SONICOM consortium engaged these audiences through conversation and hands-on activities, including having their own ears 3D scanned to learn about how morphology needs to be taken into account when personalising audio.

Read more about the Exhibition

Highlighting the women of SONICOM

For International Day of Women and Girls in Science, we shone a spotlight on some of the amazing female scientists within the SONICOM consortium.

Through a series of interviews, they shared their stories about becoming a researcher and their thoughts on what it's like to be a woman in science.

Read the full interviews

Celebrating European Collaboration

SONICOM exhivited at a reception hosted by Imperial College to celebrate the UK's reassocation to Horizon Europe.

The evening brought together over 200 members of the European science and policy community, including the UK Amabassador the EU and the Head of the Horizon Europe Association Unit.

Learn more about the evening

Engaging audiences across Europe

SONICOM members from across the consortium have been engaging with members of the public this year, including:

- Showcasing different SONICOM technologies at the University of Malaga;
- Discussing immersive audio in the pub for Pint of Science in London;
- Demonstrating digital tools for choristers at European Researchers Night in Athens.

HIGHLIGHTS OF 2023

CATALYSING COLLABORATION

SONICOM Research Sandpit

Representatives from across the SONICOM consortium gathered at the University of Glasgow to take part in the SONICOM Research Sandpit – a chance to exchange knowledge and experiences between the project consortium and external researchers and stakeholders.

Read more about the discussions that took place

Supporting Early Career Researchers

SONICOM hosted sister projects from the “Artificial Intelligence for Extended Social Interaction” funding call for a one-day workshop for early career researchers to network, present work and exchange ideas.

Learn more about the workshop

OUR PARTNERS

Imperial College London

SCIENCES SORBONNE UNIVERSITÉ

L A M Institut Jean le Rond d'Alembert

ÖAW AUSTRIAN ACADEMY OF SCIENCES

UNIVERSITAS MALACITANA UNIVERSIDAD DE MÁLAGA

UNIVERSITÀ DEGLI STUDI DI MILANO DIPARTIMENTO DI INFORMATICA

Laboratorio di Informatica Musicale

HELLENIC REPUBLIC National and Kapodistrian University of Athens

LabMAT

University of Glasgow

Reactify ADDING NEW DIMENSIONS TO MUSIC

Dreamwaves

U SOUND

SONICOM consortium at the 2023 Annual Meeting at the University of Malaga