SONICOM

YEAR IN REVIEW

2025

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In this edition

FOREWORD

2025, SONICOM's final full year, marked a decisive phase in which many of the project's scientific, technical, and infrastructural strands came together. After several years of foundational research, this was a year focused on consolidation, validation, and deployment, turning ideas, models, and prototypes into further research and more mature tools, datasets, and experiences that are now fully shared through our SONICOM Ecosystem.

Research in 2025 strengthened the methodological foundations of personalised spatial audio. Advances in parametric HRTF modelling, rigorous verification of wave-based simulations, further collection of HRTF data (the Extended SONICOM HRTF dataset) and novel methods in Bayesian perceptual modelling have clarified both the potential and the limits of current approaches, bringing simulated and real acoustic environments into closer alignment.

Integration work reached a new level of maturity. The release of Binaural Rendering Toolbox v2.4.0 significantly expanded rendering capabilities, while the completion of the Selfone self-personalising headphone prototype represents an important project milestone in terms of collaboration between research and industry partners. These developments were complemented by the creation of a custom spatialised teleconferencing application, providing a realistic and flexible platform for upcoming evaluation studies.

In terms of evaluations, we completed the design of several out-of-the-lab experiments, which are currently running, and which will give us relevant data about how what we have proven to work in the lab might ultimately work in real-life settings.

A major milestone of 2025 was the launch of the first public version of the SONICOM Ecosystem. With its web-based interface, DOI-backed datasets, and growing collection of tools and databases, the Ecosystem embodies our commitment to open, reproducible research and will form a lasting hub for personalised binaural audio and spatial hearing research beyond the lifetime of the project.

Alongside these technical achievements, 2025 also saw continued public engagement, artistic collaborations, and a renewed effort to highlight the people behind SONICOM, including the Women of SONICOM initiative.

As we move towards the project's conclusion in June 2026, our focus now turns to final evaluations, long-term sustainability, and new research directions that will allow SONICOM's ideas, tools, and community to continue to grow well beyond the project itself.

Lorenzo Picinali,
SONICOM Lead Investigator,
Imperial College London

HIGHLIGHTS OF 2025

Research theme: Immersion

Improving the immersion of spatial audio rendering in Augmented/Virtual Reality (AR/VR)

Theme lead: Brian FG Katz, Sorbonne University

Work in 2025 on Immersion focused on strengthening the scientific foundations of personalised spatial audio and the consistency between simulated and real acoustic environments. Activities addressed core methodological limitations in HRTF modelling, perceptual evaluation, and acoustic simulation.

Regarding HRTF synthesis and modelling, significant progress was made through parametric descriptions of the human pinna and rigorous verification of wave-based simulations. Parametric Bézier representations demonstrated high geometric accuracy and scalability for data-driven pipelines, while systematic solution verification of FDTD simulations clarified accuracy limits, the role of anatomical complexity, and consequences for localisation predictions.

In HRTF selection, perceptual modelling, and binaural rendering, a comprehensive survey consolidated the state of machine-learning-based HRTF individualisation, identifying common practices, achievements, and open challenges. In parallel, a Bayesian auditory-modelling framework was introduced to support reproducible perceptual modelling and quantitative analysis of sound source localisation.

Finally, in virtual/real world matching and room acoustics, new constrained calibration methods improved the estimation of absorption parameters, enhancing agreement between measured and simulated reverberation and supporting robust calibration of complex room-acoustic models.

Jessica Luo joined the Sorbonne team in 2025

HIGHLIGHTS OF 2025

Research theme: Interaction

Understanding the interactions between the physical, psychological and behavioural

Theme lead: Alessandro Vinciarelli, University of Glasgow

Over the past year, significant progress has been made in the development of new interaction approaches for Audio Augmented Reality (AAR), immersive environments in which sound plays a central role in shaping users' perceptions. The key novelty of these approaches lies in the fact that sound is no longer treated merely as background information, as is common in many immersive applications, but instead becomes the primary medium through which users interact with the environment.

The first advancement concerns the development of sonic controls, that is, the use of sound as a means of controlling events within the environment. Game playing was chosen as the experimental application domain, and the investigated scenarios cover the three most common gaming paradigms: combat (the player fights against an opponent), story (the user progresses through a narrative), and search (the player looks for items). The experiments compare sonic actions, such as speech, music, and non-speech sounds (e.g., finger snapping), with more established interaction modalities, including physical movement, gestures, and game controllers. The results demonstrate that sound can serve as an effective alternative to these traditional interaction channels.

The second major advancement is the definition and development of sonic linking, which involves using real-world sounds in the user's surroundings to drive interactions within AAR experiences. Two scenarios were explored: a game in which entities are spawned based on real-world sounds, and a music player featuring sound-reactive filtering and volume adjustment. Multiple design variations were evaluated to address different AAR scenarios, types of sonic links, and comparisons with equivalent applications lacking such links. The results indicate that sonic linking can create more augmented and engaging AAR experiences

Publications from this research theme

Sonomancer: Exploring Sonic Control Schemes for Audio Augmented Reality Games

Learn more

Birds of a Feather Augment Together: Exploring Sonic Links Between Real and Virtual Worlds in Audio Augmented Reality

Learn more

HIGHLIGHTS OF 2025

Research theme: Integration

Integrating SONICOM's various research tools and outputs into an accessible framework

Theme lead: Arcadio Reyes-Lecuona, University of Malaga

In 2025, SONICOM's WP3 Integration work package delivered major advances across tools, hardware, and applications.

The Binaural Rendering Toolbox v2.4.0 was released by UMA, including directional source models, geometric-acoustics environments (SDN and ISM), and hybrid reverberation workflows. Binaural rendering now supports real-time HRTF interpolation, dynamic HRTF switching, Ambisonic encoding, and BRIR-based room simulation. New bilateral post-binaural filters enable simulations of hearing protection or headphone compensation, while multi-listener rendering and output-level calibration expand experimental flexibility.

The Selfone hardware (a multi-speaker/multi-microphone headphone prototype) has been completed by USound and installed in the laboratory of the Acoustics Research Institute (ÖAW). As the first step, a measurement protocol has been created and extensive tests have been done. Then, collection of data has begun. We have individually measured head-related transfer functions (HRTFs) and the Selfone impulse responses (SIRs), both with the same in-ear microphone, for over 100 persons.

Finally, a spatialised teleconferencing application powered by BRT was developed by UMIL to support upcoming evaluation studies, providing a realistic testbed for SONICOM's integrated technologies.

Open-access research tools

SONICOM has a variety of openly accessible tools for the research community, from datasets to MatLab toolkits.

- The SONICOM HRTF Dataset
- SOFA (Spatially Oriented Format for Acoustics)
- Binaural Rendering Toolbox (BRT)

HIGHLIGHTS OF 2025

Research theme: Experience

Evaluating our results in an ecologically valid manner

Theme lead: Areti Andreopoulou, National and Kapodistrian University of Athens

2025 has been a very productive year for WP4-Experience. The consortium has developed several evaluation scenarios and put them into use to assess user immersive experience in VR/AR in an ecologically valid manner. To name a few, an immersive sound installation was presented at the 2025 Great Exhibition Road Festival in London, demonstrating how high-quality rendering of virtual sound-sources can make them indistinguishable from real ones.

The application of spatial audio in teleconferencing was also examined. Studies investigated how positioning remote participants in a 3D soundscape can improve immersion and user experience, as well as whether interactions in AR teleconferencing remain natural when each participant experiences different acoustic conditions. Immersive VR environments for remote musical training were also studied, assessing how HRTF, source directivity, and acoustic accuracy can significantly benefit users and serve as effective training tools.

Finally, a new cellphone-based technology for indoor navigation for visually impaired and blind individuals, based on the spatialization of auditory cues, has been developed and is being assessed by different user groups. As we approach the end of the project, WP4 will conclude the evaluation of all immersive sound experiences developed within SONICOM, and we foresee that these immersive experiences will be made available to a wider audience through several public and scientific outreach events.

Partner spotlight

Learn more about the SMEs in SONICOM working across the Experience research theme

Reactify

Creative technology company building immersive experiences

Dreamwaves

The world's first spatial audio navigation app

HIGHLIGHTS OF 2025

Research theme: beyond

Ensuring that SONICOM's outputs remain available beyond the project

Theme lead: Piotr Majdak, Austrian Academy of Sciences

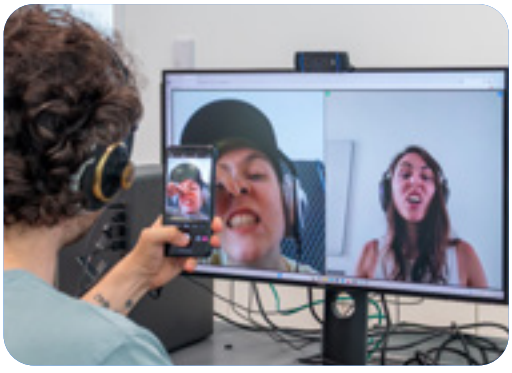
In 2025, Beyond was in the light of finishing the SONICOM Ecosystem. The Ecosystem is a web-based data repository designed to store auditory data linked with auditory models and tools for binaural rendering. The key objectives for the Ecosystem are:

- Focusing on personalized binaural audio and spatial hearing research.
- Providing automatic and research-specific data visualization.
- Being open-accessible and citable via DOIs.
- Being documented and searchable by metadata through a web frontend.
- Providing an interface for machinable download of partial data.
- Integrating the output of SONICOM and enabling other researchers to contribute.
- Promoting reproducible research.

To this end, we have programmed the software, installed new server hardware, and finished negotiations with the Datathek, a general-purpose repository serving as the backbone of our Ecosystem.

In July, the first version of the Ecosystem went "live" and became available to all anonymous visitors for browsing and downloading the content.
The Ecosystem is also available to all ORCID-approved researchers who wish to contribute new content and interact with the Ecosystem. The interaction is facilitated by an easy-to-use commenting function on each database and tool of the Ecosystem.

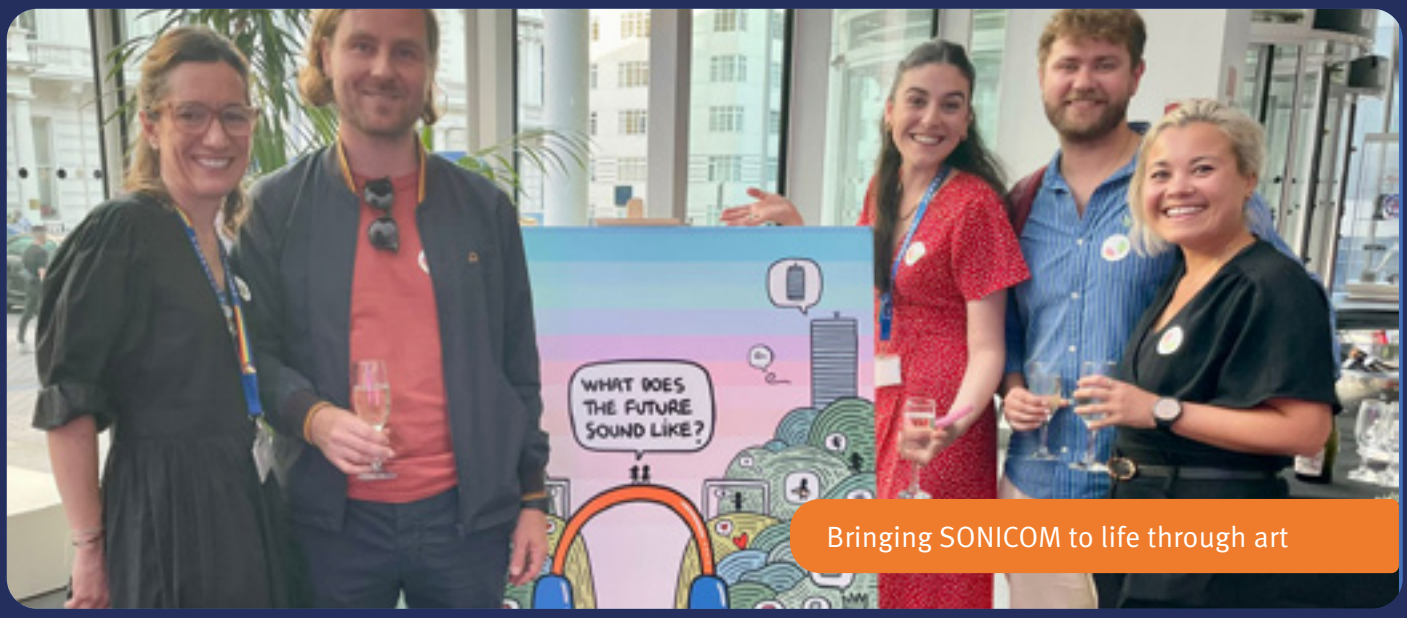
With its initial content coming from the SONICOM researchers, the Ecosystem grew to contain over 20 databases and tools within a few months. While we are still working on tiny details, the future focus will be on promoting the Ecosystem within the auditory community. By providing functionality to interact with and commenting on the data, we hope that the Ecosystem will be a place of thriving interaction, creating a supportive environment for the spatial-hearing and binaural-audio research community.



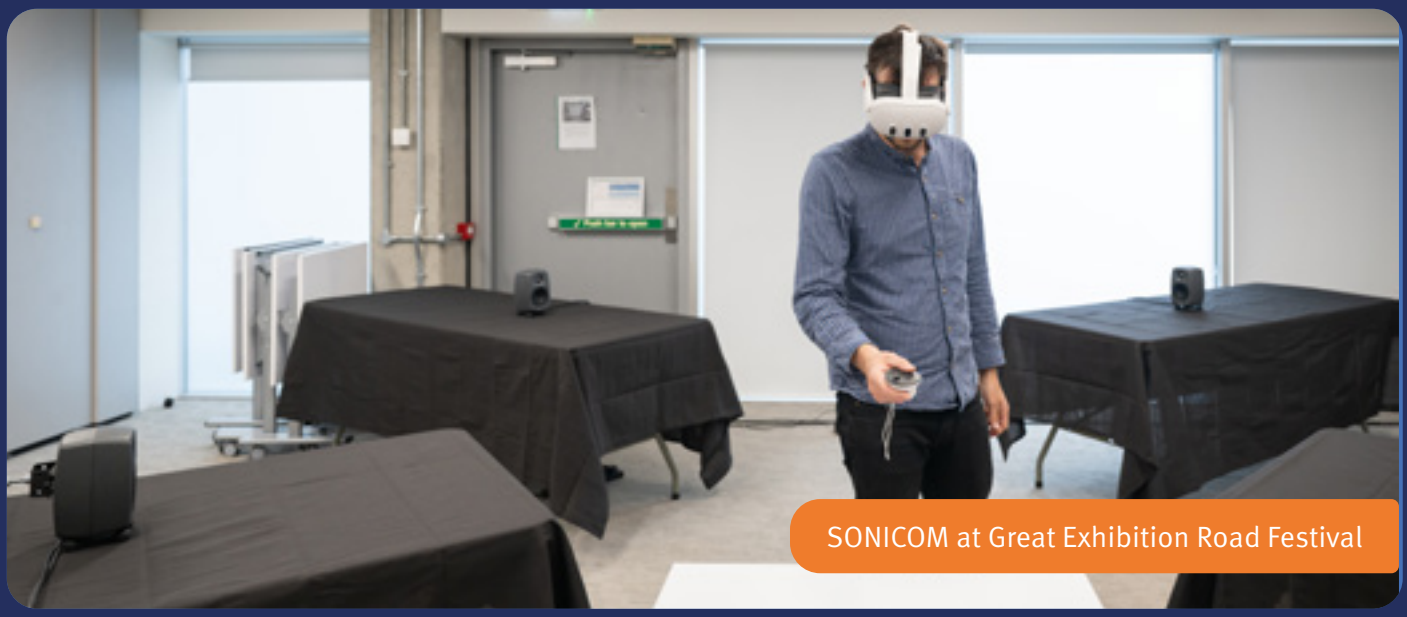
HIGHLIGHTS OF 2025

Engagement

The SONICOM team continues to engage with a variety of audiences at public events



Bringing SONICOM to life through art



SONICOM at Great Exhibition Road Festival

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Our partners

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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 2025 Annual Meeting hosted by Milan University