Rai SATO

291 Daehak-ro, Yuseong-gu
Daejeon 34141, Republic of Korea

s.rai@kaist.ac.kr
https://www.rai.tokyo/

OBJECTIVE

Seeking a PhD Research Internship in Acoustic Data at Dolby Laboratories to contribute expertise in spatial audio, room impulse response analysis, loudspeaker and microphone measurement, acoustic simulation, and perceptual evaluation. Aiming to advance acoustic mapping and next-generation immersive audio systems by combining real-world acoustic experimentation, signal processing, and data-driven analysis.

EDUCATION

Korea Advanced Institute of Science and Technology, Daejeon, South Korea
Integrated master's/doctoral program (Ph.D. Candidate),
Applied and Innovative Research for Immersive Sound (AIRIS) Lab, Graduate School of Culture Technology.

February 2023 – Present

Tokyo University of the Arts, Tokyo, Japan
Bachelor of Music with honors,
Department of Musical Creativity and the Environment, Faculty of Music.

April 2016 – March 2021

WORK EXPERIENCE

Global Research Intern — Sony Corporation
April 2026 – July 2026 — Tokyo, Japan

Laboratory Technician — Okinawa Institute of Science and Technology
May 2022 – February 2023 — Okinawa, Japan

Sound Programmer, Researcher — GATARI Inc.
April 2020 – March 2020 — Tokyo, Japan

International Visiting Research Student — Rochester Institute of Technology
September 2019 – August 2021 — Rochester, New York

TECHNICAL SKILLS

Languages: Matlab, MAX/MSP, Python, C#, R language.

Software: Unity, Wwise, Reaper, Pro tools, Dante (audio network), Ircam Spat.

Hardware: Any kind of sound equipment, EEG measurement device (Brain products, Biosemi, OpenBCI), Prototype making using Arduino, Raspberry Pi, and ESP32.

General: Psychoacoustics experiment design and statistical analysis, Room acoustics measurement, simulation, and design, Sound recording for immersive music, Sound design for AR game and experience, Immersive sound reproduction system design.

AWARDS

Early Career Presentation Awards in Computational Acoustics: At 185th Meeting of the Acoustical Society of America, *December 2023*.

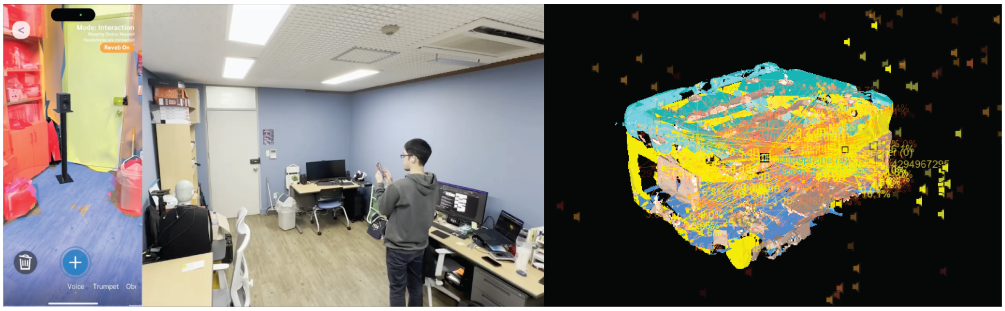
KAIST Global Presidential Scholarship: Highly selective but distinguished scholarship program offered to outstanding admitted students. *February 2023 – February 2025*, Full exemption of tuition and 24M KRW of total stipend.

Japan Public-Private Partnership Student Study Abroad Program: A scholarship for education abroad by Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan, *June 2019 – March 2020*, Amount: 1.85M JPY.

RESEARCH

Real-time Virtual Acoustics for AAR Application

2020 - Present



Developed a plausible and real-time spatial audio rendering system for mobile Auditory Augmented Reality (AAR), addressing the critical challenge of achieving convincing immersion on computationally constrained devices. To overcome prevalent hardware limitations and rendering latency issues, I engineered a novel dynamic processing framework. This framework uniquely integrates a game-audio engine for object-based audio with real-time 3D visual computation for accurate sound source positioning. Furthermore, it incorporates dynamic room acoustic modeling, allowing the virtual sounds to adapt realistically and seamlessly to the user's immediate physical surroundings.

- **Rai Sato** and Sungyoung Kim, "An approach to real-time late reverberation generation for six-degrees-of-freedom Auditory Augmented Reality," in *189th Meeting of ASA*, Dec. 2025. (invited talk)
- **Rai Sato** *et al.*, "Automatic Acoustical Material Estimation for Room-Specific Early Reflections in Auditory Augmented Reality (AAR) Application," 2024 AES 6th International Conference on Audio for Games. April 2024.
- **Rai Sato** and Sungyoung Kim, "Subjective Evaluation on the Sense of "Being There" using Augmented reality Room Acoustic Estimator (ARAE) Platform," 22nd IEEE ISMAR-Adjunct. October 2023.
- Shunichi Takeshita and **Rai Sato**, "information processing system, information processing method and program," Japanese Patent No. 7637412, February 2025.

Aural Heritage Project

2023 - Present

Spearheaded a pioneering project to revitalize endangered aural heritage, moving beyond static archiving to create interactive, dynamic sonic reconstructions. I designed and implemented a comprehensive end-to-end workflow—from on-site capture using high-order ambisonic arrays to post-processing and real-time rendering in a VR engine. This culminated in fully navigable six-degrees-of-freedom (6DoF) environments, allowing users to physically explore historical soundscapes with profound spatial realism and presence.

- Sungjoon Kim, **Rai Sato**, Kyung Taek Oh, Pooseung Koh, and Sungyoung Kim, "Virtual Reconstruction of Historical Heritage: A 6DoF Immersive Audio Reproduction of Magoksa Temple," *2025 Immersive and 3D Audio: from Architecture to Automotive (I3DA)*, IEEE, 2025.
- Kyung Taek Oh, **Rai Sato,** Sungjoon Kim, Pooseung Koh, Sungyoung Kim, and Hyeseung Shim, "Place-based Virtual Reconstruction of Heritage Soundscape: A Case Study of Magoksa Temple, UNESCO World Heritage Sites of Korea," *The 30th ICOMOS CIPA International Symposium 2025*, ICOMOS, 2025.

Quantitative Assessment of Acoustical Attributes and Listener Preferences in Binaural Renderers 2023 - Present

Conducted an in-depth investigation into the perceptual factors that govern listener preference for head-tracked binaural audio, addressing the industry-wide challenge of inconsistent and subjective evaluation of rendering software. I designed and executed formal subjective listening tests to systematically evaluate a range of commercial and academic renderers. Through rigorous statistical analysis of listener feedback, I quantified the distinct perceptual profiles of each renderer based on key attributes such as spatial accuracy, timbral coloration, and degree of externalization. This research provides creators with a clear, objective framework for selecting the most suitable rendering tool for their artistic goals. Concurrently, by analyzing the complex trade-offs and listener-dependent weighting of perceptual attributes, the study produced a comprehensive guide for developers to achieve an "optimal perceptual balance," bridging the gap between subjective user experience and underlying signal processing.

- **Rai Sato**, and Sungyoung Kim, "Regional differences in listener preferences for head-tracked binaural audio," *npj Acoustics*. 2, 23 (2026).
- **Rai Sato**, and Sungyoung Kim, "Perceptual Factors Influencing Listener Preferences in Head-tracked Binaural Renderers," *2025 Immersive and 3D Audio: from Architecture to Automotive (I3DA)*, IEEE, 2025.
- **Rai Sato**, Palavat Komkris, Sungjoon Kim, Yiduen Park, and Sungyoung Kim, "Quantitative Assessment of Acoustical Attributes and Listener Preferences in Binaural Renderers with Head-Tracking Function," *Audio Engineering Society 157th Convention*, Audio Engineering Society, 2024.

Next-Generation In-Vehicle Active Acoustic System (Joint Research with Hyundai Motor Company) 2024 - Present

Engaged in a collaborative research project with Hyundai Motor Company to revolutionize the auditory experience in Purpose-Built Vehicles (PBV). The project focuses on developing an adaptive acoustic control system that dynamically modifies the cabin's sound field based on user context. As a project leader, I designed a real-time signal processing framework using Max/MSP and a multi-channel array to generate active reverberation while mitigating acoustic feedback. This research explores the intersection of psychoacoustics and automotive engineering to enhance spatial immersion in constrained environments.

- Sungjoon Kim, **Rai Sato**, Ju In Kim, and Sungyoung Kim, "Design of Adaptive In-Cabin Sound Fields for Purpose-Built Vehicles via Multichannel Immersive Audio," abstract submitted to *32nd International Congress on Sound and Vibration (ICSV32)*, July 2026.

REFERENCES Available upon request.

PUBLICATIONS

Journal Articles

- R. Sato and S. Kim, "Regional differences in listener preferences for head-tracked binaural audio," *npj Acoustics*. 2, 23 (2026).
- S. Kim, R. Sato, P. Koh, and S. Kim, "Interplay of auditory cue optimization and gaming proficiency to reduce reaction times in a first-person shooter game," *The Journal of the Acoustical Society of Korea*, vol. 44, no. 2, pp. 153–159, Mar. 2025.
- S. Estelle, K. Uhlig, L. Zapata-Fonseca, S. L'erique, B. Morrissey, R. Sato, and T. Froese, "An open-source perceptual crossing device for investigating brain dynamics during human interaction," *PloS one*, vol. 19, no. 6, p. e0305283, 2024.
- R. Sato, A. Marui, T. Kamekawa, and S. Kim, "Variation in the temporal window of integration with changing the sound pressure level of a sound stimulus," *Acoustical Science and Technology*, vol. 43, no. 2, Mar. 2022.

Conference Proceedings (International)

- S.Kim, R. Sato, J. Kim and S.Kim, "Design of Adaptive In-Cabin Sound Fields for Purpose-Built Vehicles via Multichannel Immersive Audio," abstract submitted to *32nd International Congress on Sound and Vibration (ICSV32)*, July 2026.
- S. Kim, R. Sato, K. T. Oh, P. Koh, and S. Kim, "Acoustical Characteristics of Korean Traditional Architecture for Virtual Heritage Reconstruction: A Case Study of Magoksa Temple, UNESCO World Heritage," in *189th Meeting of the Acoustical Society of America*, Dec. 2025.
- R. Sato and S. Kim, "An approach to real-time late reverberation generation for six-degrees-of-freedom Auditory Augmented Reality," in *189th Meeting of the Acoustical Society of America*, Dec. 2025.
- H. Kim, R. Sato, S. Kim, and K. M. Lee, "Neural Correlates of Immersive Audio Experience: An EEG Study with TRF and ISC in Naturalistic Listening," in *189th Meeting of the Acoustical Society of America*, Dec. 2025.
- S. Kim, R. Sato, K. T. Oh, P. Koh, and S. Kim, "Virtual Reconstruction of Historical Heritage: A 6DoF Immersive Audio-Visual Reproduction of Magoksa Temple," in *Int. Conf. on Immersive and 3D Audio (I3DA)*, Sep. 2025.
- R. Sato and S. Kim, "Perceptual Factors Influencing Listener Preferences in Head-tracked Binaural Renderers," in *Int. Conf. on Immersive and 3D Audio (I3DA)*, Sep. 2025.
- K. T. Oh, R. Sato, S. Kim, P. Koh, S. Kim, and H. Shim, "Place-based Virtual Reconstruction of Heritage Soundscape: A Case Study of Magoksa Temple, UNESCO World Heritage Sites of Korea," in *The 30th ICOMOS CIPA International Symposium 2025*, Aug. 2025.
- S. Kim, R. Sato, P. Koh, K. Lee, and S. Kim, "Investigating the Role of Customized Interaural Time Differences on First-Person Shooter Gaming Performance," in *Audio Engineering Society 157th Convention*, Oct. 2024.
- R. Sato, P. Komkris, S. Kim, Y. Park, and S. Kim, "Quantitative Assessment of Acoustical Attributes and Listener Preferences in Binaural Renderers with Head-Tracking Function," in *Audio Engineering Society 157th Convention*, Oct. 2024.
- R. Sato, K. Lee, Y. Izumi, and S. Kim, "Automatic Acoustical Material Estimation for Room-Specific Early Reflections in Auditory Augmented Reality (AAR)

Application," in *2024 AES 6th International Conference on Audio for Games*, Apr. 2024.

- R. Sato, Y. Izumi, and S. Kim, "Room-aware Portable Auditory Augmented Reality: Real-time Spatial Audio Generation with Geometric Data Analysis," in *185th Meeting of the Acoustical Society of America*, Dec. 2023.
- R. Sato, A. Takeuchi, H. Shim, and S. Kim, "Quantitative Assessment of Acoustical Attributes and Listener Preferences in Binaural Renderers," in *Audio Engineering Society 155th Convention*, Oct. 2023.
- R. Sato and S. Kim, "Subjective Evaluation on the Sense of 'Being There' using Augmented reality Room Acoustic Estimator (ARAE) Platform," in *22nd IEEE International Symposium on Mixed and Augmented Reality (ISMAR-Adjunct)*, Oct. 2023.
- S. Kim, J. Cozzarin, and R. Sato, "A novel ear training game and the training influence on auditory selective attention," in *24th International Congress on Acoustics*, Oct. 2022.
- R. Sato, T. Ito, and S. Kim, "Real-Time Spatial Sound Rendering System Using LiDAR Sensor For Audio Augmented Reality Application," in *24th International Congress on Acoustics*, Oct. 2022.
- R. Sato, S. Kim, and A. Marui, "Investigating perceptual tolerance of audio-tactile synchrony," in *Audio Engineering Society 148th Convention*, May 2020, Engineering Brief 574.

Conference Proceedings (Domestic: Japan & South Korea)

- R. Sato and S. Kim, "Impact of Perceptual Attributes on Listener Acoustic Preferences in Head-Tracked Binaural Audio," in *The 2025 Autumn meeting of the Acoustical Society of Japan*, Sep. 2025.
- K. T. Oh, R. Sato, S. Kim, P. Koh, and S. Kim, "Preserving Aural Heritage through 6DoF Virtual Reality Reproduction of Traditional Korean Architecture: A Case Study at Magoksa Temple, a UNESCO World Heritage Site," in *Proc. Acoustical Society of Korea 2025 Spring Meeting*, May 2025.
- S. Kim, R. Sato, P. Koh, and S. Kim, "Investigating the Role of Customized Interaural Time Differences on First-Person Shooter Gaming Performance," in *Proc. Acoustical Society of Korea 2024 Fall Meeting*, Oct. 2024.
- R. Sato, P. Komkris, S. Kim, Y. Park, and S. Kim, "Quantitative Assessment of Acoustical Attributes and Listener Preferences in Binaural Renderers with Head-tracking Function," in *Proc. Acoustical Society of Korea 2024 Fall Meeting*, Oct. 2024.
- P. Komkris, R. Sato, and S. Kim, "Characteristic comparison of binauralizers with head tracking and their impact on headphone listening experience," in *Proc. Acoustical Society of Korea 2024 Spring Meeting*, May 2024.
- R. Sato and S. Kim, "Implementation of Six-degree-of-freedom sound experience in Auditory Augmented Reality: Augmented reality Room Acoustic Estimator (ARAE)," in *2024 Spring meeting of the Acoustical Society of Japan*, Mar. 2024.
- S. Kim and R. Sato, "Influence of technical ear training on auditory spatial attention," in *FY 2021 RIEC Annual Meeting on Cooperative Research Projects "Compass for Next-Gen ICT" Program*, Feb. 2022.
- R. Sato, A. Marui, T. Kamekawa, and S. Kim, "Variation of perceptual tolerance for audio-tactile synchrony about the frequency separation of both modal stimuli," in *Technical Committee on Musical Acoustics, Acoustical Society of Japan*, vol. 39, no. 4, Jul. 2020.

Patents

- S. Takeshita and R. Sato, "information processing system, information processing method and program," Japanese Patent No. 7637412, February 2025.