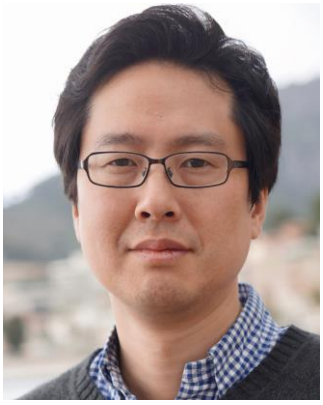
Title: Psychoacoustic Engineering in Spatial and Immersive Audio



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Abstract

With the advances of multichannel, object-based and binaural audio technologies, spatial audio and immersive audio become buzzwords in the audio industry over the recent years. New multichannel and object-based audio formats typically employ the so-called height loudspeakers as well as rear/side ones to provide the listener with a more realistic and enveloping auditory experience. However, simply adding more loudspeakers to physically surround the listener does not guarantee an immersive audio "experience". Furthermore, although binaural rendering is now widely used to deliver 3D audio over headphones, delivering a convincing sense of "being there" without compromising perceived sound quality is a challenging task. For an ultimate immersive audio experience, we need to consider psychoacoustic and other contextual factors in audio engineering. This lecture will first discuss a conceptual framework of immersive audio experience, which audio engineers must understand when developing an immersive audio system. It will then overview some of the key psychoacoustic principles of 3D sound localisation, the perception of spatial impression and binaural externalisation, with examples of psychoacoustic engineering in spatial audio recording, panning and reproduction introduced.

Bio-sketch

Hyunkook Lee, PhD, is Associate Professor in Music Technology and the Director of the Applied Psychoacoustics Laboratory (APL) / Centre for Audio and Psychoacoustic Engineering (CAPE), University of Huddersfield, United Kingdom. He received a bachelor's degree in music and sound recording (Tonmeister) from the University of Surrey, UK, in 2002, and a PhD in spatial audio from the Institute of Sound Recording at the same University in 2006. From 2006 to 2010, he was a Senior Research Engineer in audio R&D with LG Electronics in South Korea, where he participated in the standardizations of MPEG audio codecs and led the development of spatial audio algorithms for LG mobile devices.

Since he joined the University of Huddersfield in 2010, he has conducted a number of funded research projects related to 3D audio perception, recording and reproduction. His research on 3D audio has significantly advanced the fundamental understanding about the perception of height in 3D audio recording and reproduction, and led to the development of various new 3D microphone arrays, virtual elevation panning and 2D-to-3D upmixing techniques. His current research topics include the six-degrees-of-freedom perception and rendering of virtual acoustics, perceptual optimisation of virtual room acoustics, binaural audio rendering techniques and the subjective and neurological measurement of multimodal immersive experience for extended reality applications.

He was awarded the Fellowship of the Audio Engineering Society (AES) in 2018, and was elected as a Governor of the AES in 2021. He also serves as Vice Chair of the High-Resolution Audio Technical Committee of the AES, and Associate Technical Editor of the AES journal.