Fachgebiet Audiokommunikation

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Masterarbeit

Spatial resolution for early reflections in binaural synthesis

The spatial resolution of binaural impulse responses (BRIRs) required for perceptually transparent dynamic binaural synthesis has been shown to be about 2° for every degree of freedom of head movement (Lindau & Weinzierl 2009). Since this would entail high requirements in memory and computational effort for auralizations in six degrees of freedom (6DOF), it is one approach to simulate the direct sound, early reflections and the later reverberation tail in separate threads, and to adapt the spatial resolution of each component to the perceptual threshold of detection.

In this project, a perceptual threshold for the spatial resolution of early reflections, i.e. of early order reflections arriving at the listener before the perceptual mixing time (Lindau et al. 2012). By reducing the resolution for these reflections, a double calculation for the new angle and for the old one would have to be performed less often, which might be important to applications with limited computational resources such as mobile applications of for 6DOF auralizations on large listening areas.

To determine such as threshold, BRIRs would be calculated using the software RAVEN (Schroeder & Vorländer 2011) without the direct and late part of the reverberation. Then, the direct component and early reflections can be rendered with different grid resolutions in Pure Data or possibly in Unity using the VAS Library (Resch et al. 2019), in order to determine whether an audible loss of quality is perceptible. It shall also be investigated whether rendering the early reflections is possible with a shortened HRTF, reducing the usual length of 128 or 256 samples.

Literature

T. Resch, C. Böhm, & S. Weinzierl (2019). VAS – A cross platform C-library for efficient dynamic binaural synthesis on mobile devices. In: AES International Conference on Headphone Technology, San Francisco.

T. Resch, Git Repository VAS Library, https://github.com/funkerresch/vas_library

A. Lindau, H-J. Maempel & S. Weinzierl (2008). Minimum BRIR grid resolution for dynamic binaural synthesis. In Acoustics 08 Paris.

A. Lindau, & S. Weinzierl (2009). On the spatial resolution of virtual acoustic environments for head movements in horizontal, vertical, and lateral direction. http://dx.doi.org/10.14279/depositonce-8668.

A. Lindau, L. Kosanke, & S. Weinzierl (2012). Perceptual evaluation of model- and signal-based predictors of the mixing time in binaural room impulse responses. J. Audio Eng. Soc. 60 (11), 887–898.

D. Schröder, & M. Vorländer (2011). RAVEN: A real-time framework for the auralization of interactive virtual environments. In Forum acusticum (pp. 1541-1546). Denmark: Aalborg.

T. Lübeck, C. Pörschmann, & J.M. Arend (2020). Perception of direct sound, early reflections, and reverberation in auralizations of sparsely measured binaural room impulse responses. In: 2020 AES International Conference on Audio for Virtual and Augmented Reality.

Requirements

Knowledge of room acoustics and binaural technology; interest in learning room acoustic simulation using Sketchup and RAVEN. Basic skills in Pure Data or Unity. Programming knowledge in C (for Pure Data) or C# (for Unity) can be helpful to adapt the respective test environment to personal preferences.

Betreuung

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