Fachgebiet Audiokommunikation
Prof. Dr. Stefan Weinzierl

Master Thesis

Empirical validation of a model for the assessment of speech intelligibility considering binaural listening with head movements

In room acoustic evaluation and speech reinforcement with public address systems, speech intelligibility is typically assessed by means of monaural measures like the Speech Transmission Index STI using an omnidirectional microphone. This approach, however, neglects binaural benefits (spatial release from masking, better ear listening), that also depend on the listeners head orientation (HO) relative to the speech source [1]. Up to now, different models have been proposed which can mimic the effects of these aspects. These models typically use binaural room impulse responses (BRIRs) as input, describing the entire transfer path from the source to the ears of the binaural listener. However, to incorporate the effect of HO, BRIRs are required for every HO of interest and simulating or measuring these data is tedious and time consuming. Due to the limited spectral bandwidth of speech, however, approximate representations (termed *pseudo-BRIRs* here) might be sufficient, which can be measured more quickly.

This thesis investigates an existing approach for the assessment of speech perception at different HOs using pseudo-BRIRs generated from spatial impulse responses captured with a first order Ambisonics microphone [2]. In a first step, the prediction error introduced by the non-ideal microphone characteristics of a commercial Ambisonics microphone shall be evaluated. Based on this, appropriate processing parameters for the calculation of the pseudo-BRIRs shall be derived. In a second step, BRIRs (using the FABIAN dummy head [3]) and pseudo-BRIRs (using the Ambisonics microphone) for different HOs shall be measured for different rooms. In a subsequent listening test, the benefit of an optimized head orientation shall be quantified by measuring the speech reception threshold (SRT) at different HOs. The measured benefit of an optimized HO shall be compared to the output of a current prediction model using the same signals as input. Therefor, an existing model [4] with a recent extension for reverberant environments [5] shall be used.

Literature

[1] J. Grange, "The benefit of head orientation to speech intelligibility in noise," *The Journal of the Acoustical Society of America*, vol. 139, no. 2, pp. 703–712, 2016.

[2] S. Tervo, J. Pätynen, A. Kuusinen, and T. Lokki, "Spatial decomposition method for room impulse responses," *Journal of the Audio Engineering Society*, vol. 61, no. 1/2, pp. 17–28, 2013.

[3] A. Lindau, "Ein Instrument zur softwaregestützten Messung binauraler Raumimpulsantworten in mehreren Freiheitsgraden," PhD thesis, Technische Universität Berlin Berlin, 2006.

[4] S. Jelfs, J. F. Culling, and M. Lavandier, "Revision and validation of a binaural model for speech intelligibility in noise," *Hear. Res.*, vol. 275, no. 1, pp. 96–104, 2011.

[5] O. Kokabi, F. Brinkmann, and S. Weinzierl, "Segmentation of binaural room impulse responses for speech intelligibility prediction," *The Journal of the Acoustical Society of America*, vol. 144, no. 5, pp. 2793–2800, Nov. 2018.

Requirements

- Well grounded knowledge of room acoustics, room acoustic simulation, signal processing and speech intelligibility
- Knowledge/ interest in performing listening tests and statistical evaluation (ANOVA etc.)
- Solid MATLAB skills
- A critical view on results and interpretations

Supervisors

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