Master thesis

Room Impulse Responses to Feedback Delay Networks

Description

Reverberation in room acoustics is an essential part of our human auditory perception: It enriches the spatial impression, characterizes the location, supports musical expression, and, aids sound localization. Room impulse responses (RIRs) are the acoustic transfer functions between source and receiver positions and serve as a practical mean to apply reverberation to sound signals. Typically, RIRs are measured in physical spaces or are simulated from elaborate physical models. Alternatively, RIRs can be artificially generated with parametric filters such as feedback delay networks (FDNs). Especially FDNs remain popular for their efficiency and flexibility. In this master thesis, we attempt to approximate measured RIRs with FDNs such that they are perceptually similar. Such a conversion to FDNs has many applications in music and movie post-production as well as virtual and augmented reality. To achieve the goal of the thesis, the following three subtasks are proposed: estimation, synthesis, and, evaluation.

- Various perceptually relevant room acoustics features are estimated from the RIRs including reverberation time, spectral energy distribution, and early reflections.
- The estimated parameters from the measured RIRs are matched by an FDN by advanced filter design methods. Early reflections are implemented by various input-output paradigms which require in-depth investigation to identify suitable solutions.
- The result of the FDN approximation is compared to the original RIR. The approximation error may be evaluated with various objective measures as well as subjective testing.

Prerequisites

The proposed master thesis addresses current research questions in the field of acoustic and audio signal processing and includes various challenging investigations. Therefore, it is particularly suited to students interested in pursuing a future career in this field. Six months of full-time work are expected to complete this thesis. Further helpful prerequisites are

- Strong digital signal processing and filter design understanding
- Strong mathematical competence especially linear algebra and calculus
- Programming in MATLAB
- Interest in room acoustics and audio signal processing

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