Abstract

Acoustic Scene Analysis using Distributed Microphone Arrays

Christian Schörkhuber

Microphone arrays (MA) have gained a lot of popularity for audio acquisition as they can exploit the spatial diversity of an acoustic scene. They allow for localizing and extracting a given sound source or cancelling out interfering sources. Traditional microphone arrays, however, sample the sound field only locally. This often means that distances between sources and the MA are large, resulting in a low signal-to-noise ratio (SNR).
Distributed microphone arrays (DMA) consist of several, usually rather small, microphone arrays that are randomly placed in the area of interest. That is, MA processing algorithms can be applied to the individual compact arrays and the acquired data can be jointly processed at the fusion centre.
When distances between the nodes are large or wired connections between the nodes and the fusion centre are infeasible, wireless DMA are preferred. The main challenges in wireless DMA processing arise from the limited bandwidth, clock synchronization issues and limited energy resources. As transmission of raw audio data from all sensor nodes to a fusion sensor is frequently impossible, each sensor node performs local processing of its sensor signals and reports only metadata or compressed data to the fusion centre or neighbouring nodes.
The aim of this thesis is to enhance existing, and develop new methods for tasks like sensor self-calibration, room geometry inference, signal estimation and 3D soundfield acquisition using both wired and wireless distributed microphone arrays with a strong focus on real-world applications, i.e. considering the influence of room reflections in unknown enclosures and sound sources emitting unknown arbitrary signals.