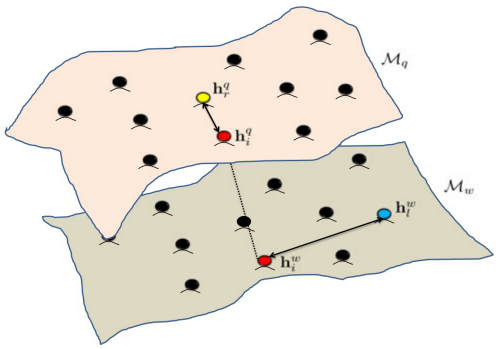
**Lehrstuhl für Multimediakommunikation und Signalverarbeitung**
Universität Erlangen-Nürnberg

# Proposal for a Master Thesis

**Topic:** **Source Localization using Manifold Learning**

**Description:** Acoustic source localization is a precondition for many subsequent signal processing algorithms. It can be accomplished by mapping one or more acoustic features via an analytical mathematical model or a data-driven model, learned by a machine learning approach, to the position of the source. Most acoustic localization algorithms use directional features, e.g., phase differences, time difference of arrivals etc., due to the simplicity of the underlying geometric model. An alternative approach is obtained by the following observation: The spatial information of an acoustic source is embedded in the corresponding room impulse response (RIR) as sources at different positions evoke different reflection patterns in an enclosure. Thus, a feature vector depending on the RIRs corresponding to two observing microphones can be obtained by the relative transfer function (RTF).
However, the RTFs are controlled by only a few parameters, e.g., the position of the source, the reflection patterns of the walls, room volume etc., which gives rise to the assumption that there is an invertible mapping from the space of the high-dimensional RTFs to the low-dimensional parameter space, i.e., the RTFs lie on a manifold. By applying so-called manifold learning techniques, the structure of the RTFs and the mapping to the low-dimensional parameter space can be learned, i.e., observed RTFs with unknown corresponding position can be used to localize the acoustic source by evaluating the learned mapping.
The aim of this thesis is the implementation and evaluation of algorithms for acoustic source localization based on manifold learning, starting with direction of arrival estimation and position estimation based on a single microphone array and continuing with their extension to acoustic sensor networks.

As prerequisites, the student should have MATLAB programming experience and an affinity to math.




[1] Bracha Laufer-Goldshtein, Ronen Talmon, and Sharon Gannot. "Semi-Supervised Source Localization on Multiple Manifolds With Distributed Microphones." IEEE/ACM Transactions on Audio, Speech, and Language Processing 25, no. 7 (July 2017): 1477–91.

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**Available:** Immediately