Faculty of Electrical Engineering & Computer Science
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Passive Acoustic Source Localisation using Machine Learning.

ABSTRACT - Masterthesis

Locating the position of static or dynamic sources based on measurements obtained from sensors is an important research area since many years. Acoustic Source Localization with microphone arrays is key to many applications such as 3-D audio capture, speech enhancement for hearing aids in medical applications, vehicle and gunshot localization for military use, automatic camera steering for event broadcasting or video conferencing, and video games. The estimation of wave and signal parameters is an important topic in sensor array signal processing. Knowing the location of a given source enables the enhancement of its associated acquired signals, thus providing higher signal-to-noise ratio (SNR).

In recent years, Deep Neural Networks have played a pivotal role as the state- of-the-art for several identification and recognition tasks. Deep learning can be defined as neural networks with a large number of parameters and layers in one of the four fundamental network architectures- Unsupervised Pre- trained Networks, Convolutional Neural Networks, Recurrent Neural Networks and Recursive Neural Net-works.

Beamforming is a robust method for source localization, which aims at estimating the source position by maximizing the steered response power (SRP) output of the spatial filter in the source direction. This thesis explores the alternative approach rather than the traditional Match-field processing to the source localization problem. Sensor system of uniform linear array is considered. The array manifold vectors of these sensors are used to calculate the covariance matrices. Since, the covariance matrices are created by simulation, the bearing angle and the number of snapshots are already known. This corresponding detail is associated with the nomenclature of the covariance matrices. These matrices are used as the input for Feed-forward neural network.

The popular and well-supported open-source machine learning framework tool TensorFlow is used to implement neural network. The data is divided into training, validation and testing. After the training, the network designed is tested on validation dataset for examining the performance of the training. After necessary modifications and optimizations of the trained network, testing dataset is evaluated. The trained network parameters obtained are implemented on the testing dataset to predict the bearing angle. Furthermore, the quality metrics of the network designed are evaluated and optimized to achieve better performance.