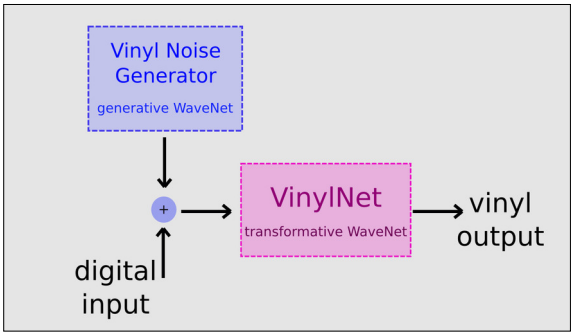
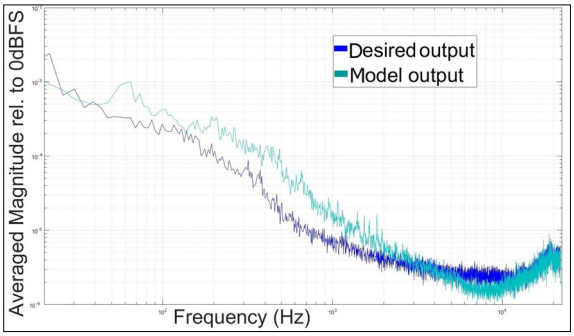
Graduate Candidate	Isabelle Kernhof
Examiner	Prof. Dr. Guido Schuster
Co-Examiner	Fabian Riesen, Schaffhausen, SH
Subject Area	Sensor, Actuator and Communication Systems

Design of a Vinyl Sound Emulation

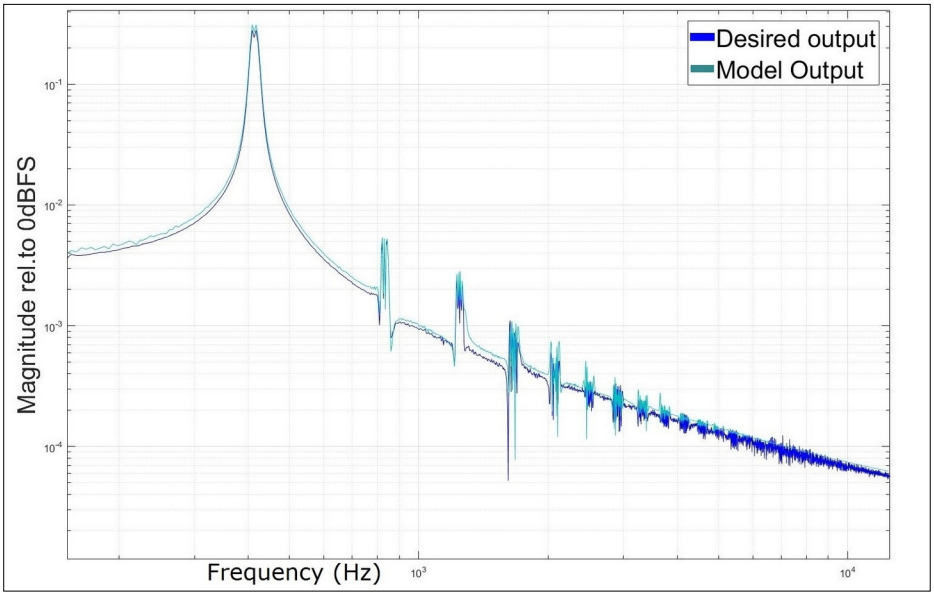
utilizing the WaveNet architecture



Proposed model structure of the vinyl sound emulation: combination of a generative and a transformative Wavenet.
Own presentment



Frequency analysis of desired vinyl noise and output of the Vinyl Noise Generator based on the generative WavNet.
Own presentment



Frequency analysis of a sine wave signal of vinyl recordings and model output of the proposed model based on a generative and a transformative WaveNet.
Own presentment

Objective: Nowadays, the individualization of playlists is a popular feature of streaming applications. Why should the user not be able to personalize the sound of the playback - for example like their favourite vinyl record player? When taking a look at the market of physical sound storage mediums only the segment of vinyl records is increasing, although the segment of streaming music is the most demanded. The goal of this thesis is to investigate possibilities to digitally create 'authentic analogue vinyl sound'.

Approach: To reach this objective the presented work utilizes state-of-the-art machine learning methods. Based on a detailed literature review of the field of digital audio effects, the so called WaveNet architecture could be identified to be the most popular design for such applications. Two types of learning data have been created and used to accomplish the goal of a vinyl emulation - synthetic data and recordings of vinyl records. These data consist of either chirp signals or accordion recordings. An iterative model building of the proposed neural network design is evolving from a simplified version, which is easy to validate, to its enhanced final system.

Conclusion: Two main network concepts have been investigated - a generative and a transformative architecture. The proposed final design merges the benefits of the generative and the transformative WaveNet. With the generative structure a Vinyl Noise Generator was developed. This generator creates high frequency vinyl noise components. It could be shown that the output of a transformative WaveNet is approximating the desired sound characteristics of the vinyl signal considerably better if its input is summed up with the output of the Vinyl Noise Generator. The presented model structure is able to emulate the main characteristics of the vinyl sound. Yet improvements in the very low and high frequency range are desirable. This work takes a step towards 'computer audition', potentially improving the way machines understand vinyl sound.