Digital Pre-Distortion using Deep Learning

A Project Report

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ABSTRACT

The objective of this project is to implement Digital Pre-distortion(DPD) for different Power Amplifiers using deep learning and analyse the performances of Neural network based DPD models in Linearization. Power amplifiers when operated below a certain power level amplify the input signal linearly but beyond that, the power amplifiers introduce non-linearities. Pre-distortion is a technique used to improve the linearity of the power amplifiers. In this method, the signal is distorted before it enters the Power amplifier so that the output will be linear even when operated at higher power. In the past, pre-distorter models were based on the Volterra series, memory polynomials and Wiener-Hammerstein models. Then machine learning-based Predistorters were proposed and proved useful. Since then, so many ML-PD linearizers have been developed. PD linearizers using shallow neural networks map the inverse transfer function well in the absence of system characteristics (IQ imbalance, DC offset). On the other hand, deep neural networks can even map the complex inverse transfer function under different system conditions.

In this project, we use different neural networks to implement pre-distortion for different types of power amplifiers. We start by implementing DPD for memoryless power amplifier models using Multilayer Feedforward Neural networks, then use LSTM networks for realizing DPD for power amplifier models with memory, and finally deal with DPD for a real-world Power Amplifier. Two methods of training the neural networks are used in the project and also discussed in this report. We analyse the performances of the NN-based DPD models using AM-AM, AM-PM and spectral plots.

Complete thesis is available with the project guide Prof.Devendra Jalihal. Please contact him if you want the full project report.