Uncertainty quantification for complex-valued deep neural networks

Complex-valued deep neural networks (CVDNNs) are primarily used in signal processing, for instance, to leverage phase information in audio signals, synthetic aperture radar or MRI imagery.

Methods for uncertainty quantification, however, are mostly focused on real-valued neural networks. Especially for uncertainty quantification for all network layers, classic Bayesian approaches do not generalize in a straightforward manner to complex-valued neural networks.

The goal of this thesis is to:

(1) Provide an overview of the current methodology to quantify uncertainty for CVDNNs
(2) Analyze how far existing methods for uncertainty quantification are extendable to CVDNNs
(3) Extend an existing method for uncertainty quantification (e.g. deep distributional regression, Bayesian neural networks, MC-Dropout) to a CVDNN and analyze how different types of uncertainty (epistemic and aleatoric) are affected by the incorporation of phase information.

Example use cases: MRI data, SAR data

Literature:

Trabelsi, Chiheb et. al, Deep Complex Networks (2017), https://arxiv.org/abs/1705.09792

Moloud Abdar et. al, A review of uncertainty quantification in deep learning: Techniques, applications and challenges (2021), Information Fusion