

Hybrid Noise-Resilient Deep Learning Architecture for Modulation Classification in Cognitive Radio Networks

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Abstract. The increasing maturity of the concepts which would allow for the operation of a practical Cognitive Radio (CR) Network require functionalities that include different methodologies from other fields. One such approach is Deep Learning (DL) which can be applied to diverse problems in CR to enhance its effectiveness by increasing the utilization of the unused radio spectrum. Using DL, the CR device can identify whether the signal comes from the Primary User (PU) transmitter or from an interferer. The method proposed in this paper is a hybrid DL architecture which aims at achieving high recognition rate at low signal-to-noise ratio (SNR) and various channel impairments including fading because these are the relevant conditions of operation of the CR. It consists of an autoencoder and a neural network structure due to the good denoising qualities of the former and the recognition accuracy of the latter. The autoencoder aims to restore the original signal from the corrupted samples which would increase the accuracy of the classifier. Afterwards its output is fed into the NN which learns the characteristics of each modulation type and classifies the restored signal correctly with certain probability. To determine the optimal classification DL model, several types of NN structures are examined and compared for two kinds of input - the IQ samples of the reconstructed signal and special features extracted from it. The performance of the proposed DL architecture in comparison to similar models for the relevant parameters in different channel impairments scenarios is also analyzed.

Keywords: Cognitive Radio · Deep Learning · Modulation classification · spectrum sensing.

1 Introduction

The increasing effort to improve the applicability of modern telecommunications and introduce new generations of networks and services has significantly