Machine Learning Applications for Wireless Communications
Spring Semester 2019
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Modulation Classification in Multipath Channel

TASK:

To identify the modulation classes in the given data sets. This is a supervised learning problem. There will be 3 modulation classes sent over an 2-tap Rayleigh fading channel. The channel is kept constant over the entire data set.

Data Set Information:

In this competition you will classify 3 modulation schemes - QPSK, 16-QAM and 64-QAM. The data set is generated by passing these modulation symbols in AWGN noise with SNR 30 dB and 2-tap multipath fading channel as follows -

y=convolution(h,x)+n

where h is the channel, x is the data sample and n is the AWGN noise

The data is provided in the form of I+jQ and the label as (1,2,3) to signify the modulation class. Specifically, 100 (i,q) samples are provided in each row of the training and testing data which correspond to one data snapshot.

Architecture Used :

I started with 2 convolutional layers followed by 1 fully connected layer but the accuracy never increased above 0.563 on changing various parameters then I thought of implementing it in an entirely different way using only Multi Layer Perceptron which lead to an accuracy around 0.92 and then on tuning the parameters and changing the architecture , the testing accuracy reached 1 as on kaggle leaderboard. Another way was to shuffle the 100 inputs according to their labels for the MLP to get a broader dataset to train.

Loss Used :

Categorical cross entropy was used. It compares the predicted label and true label and calculates the loss.

Optimizer :

Trained over different optimization methods (Stochastic Gradient Descent , AdaGrad , RMSprop , Adam) using mlp_keras code and compared to rule out the best that is Adam.

Code Submission :
1. Keras
Code of MLP using keras framework. The model was trained with the given architecture for 400 epochs with Adam as the optimizer leading to a maximum validation accuracy as 0.95 and testing accuracy to be 1.0 .

Graphs: