D-GF-CNN Algorithm for Modulation Recognition

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Research Article

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Abstract

This paper presents a novel modulation recognition algorithm based D-GF convolutional neural networks, named as D-GF-CNN algorithm. Firstly, a asynchronous delay sampling (ADS) technique is introduced. Via the defined ADS, the received signal is converted into asynchronous delay histogram (ADH). The ADH of different modulation signal has distinct characteristics, which provides great convenience for the neural network to identify the modulation mode. Then, the pixel point matrix of histogram is convolved with the dilated convolution kernel of the convolutional neural network, and the automatic extraction of signal features is completed so that the manual feature extraction processing can be effectively avoid. According to the optimization theory, a novel GF regularization function is given, which can improve the constraint ability of the loss function on the weight and effectively weaken the influence of network over-fitting on the modulation recognition accuracy. Theoretical analysis and simulation experiments show that the proposed algorithm can offer several advantages, such as automatically extract features, effectively prevent network over-fitting and improve recognition accuracy, etc.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and accessed as a PDF.

Figures

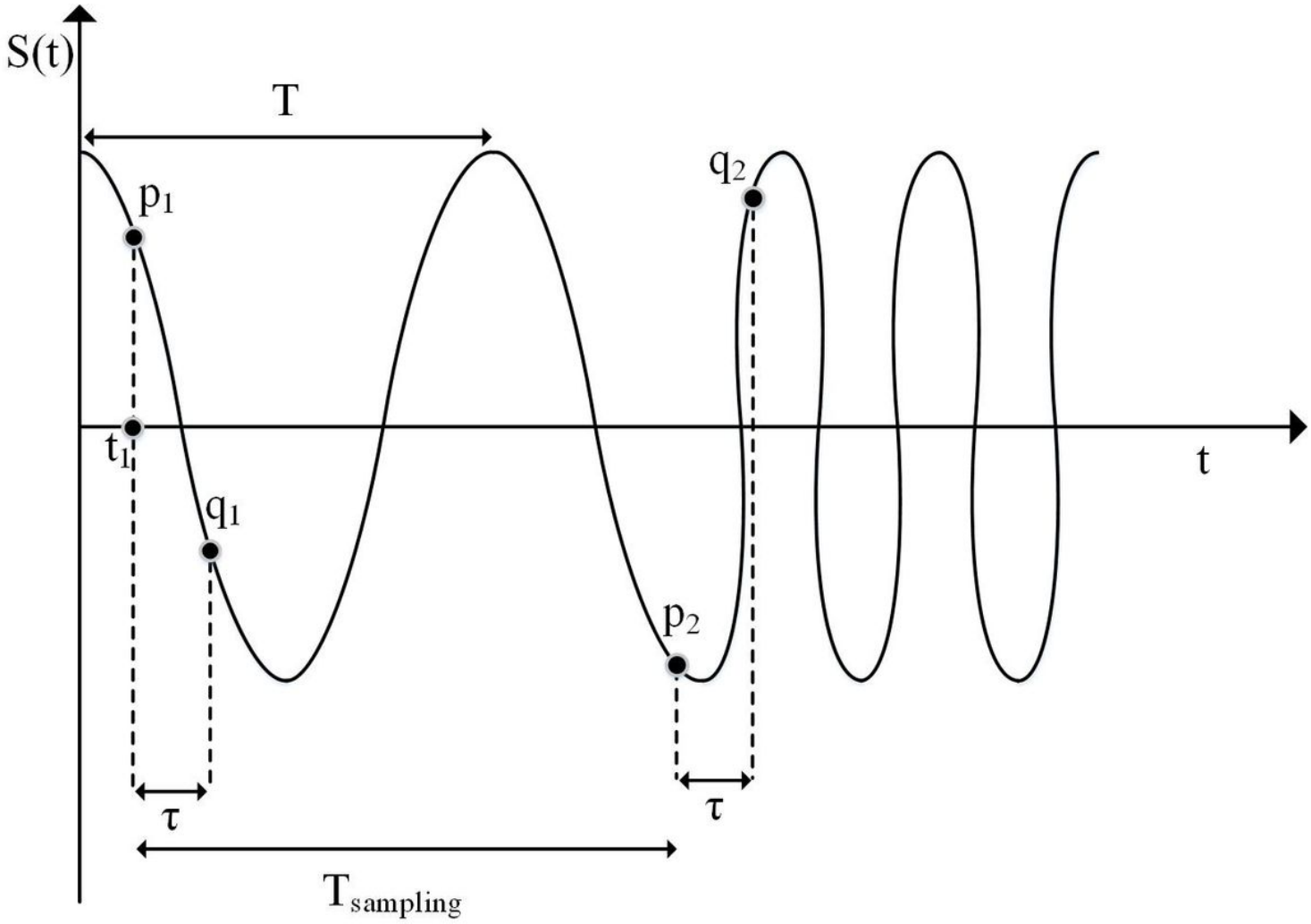

Figure 1

Asynchronous delay sampling

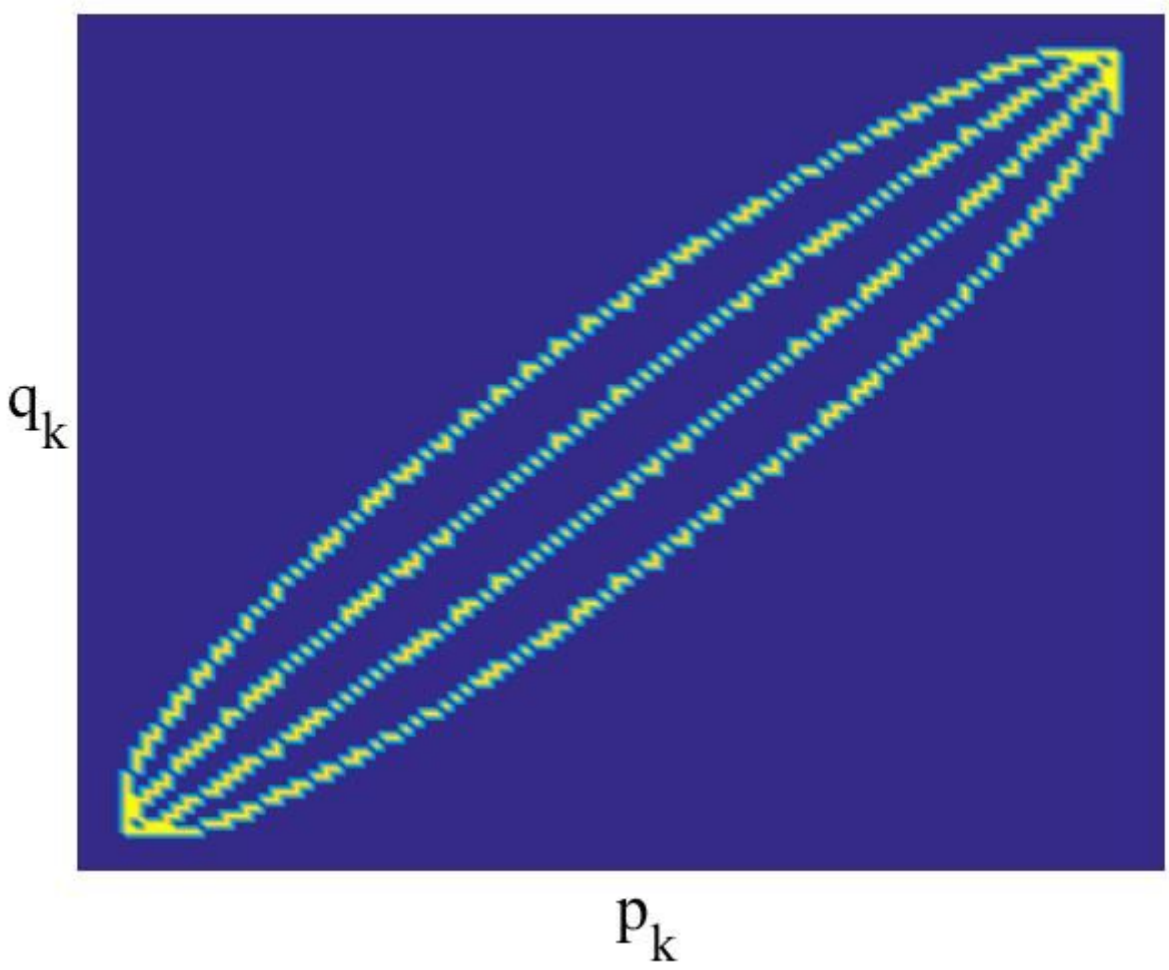

Figure 2

Asynchronous delay sampling of FSK

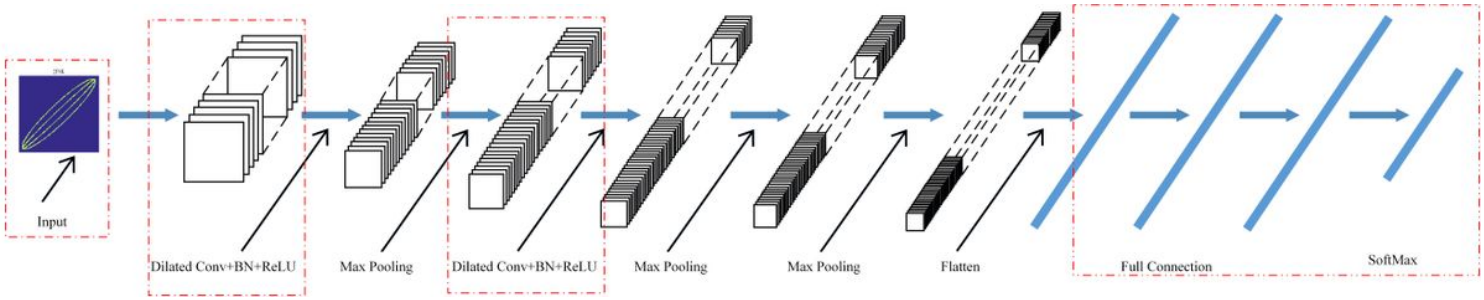

Figure 3

D-GF convolution neural network structure

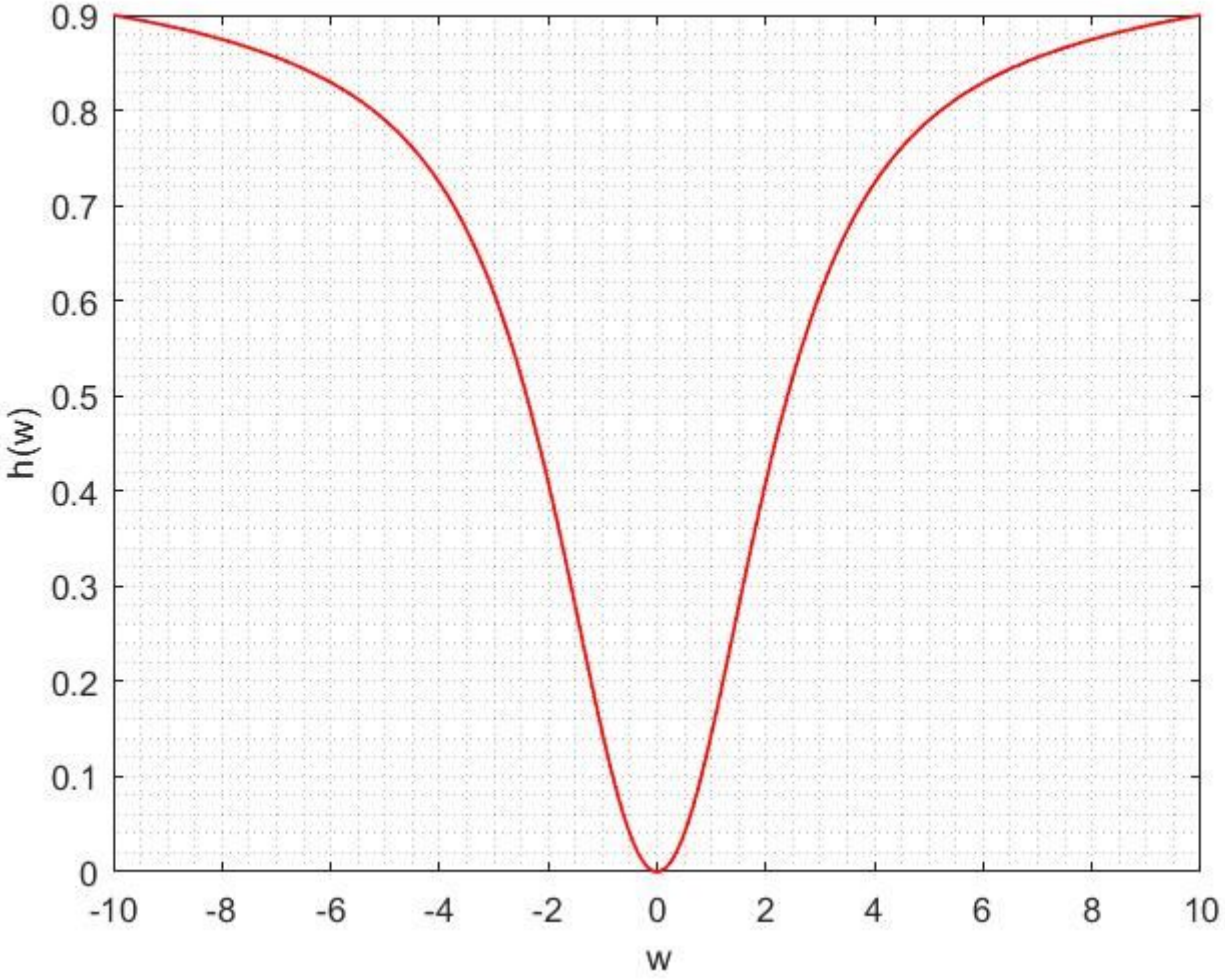

Figure 4

h(ω)

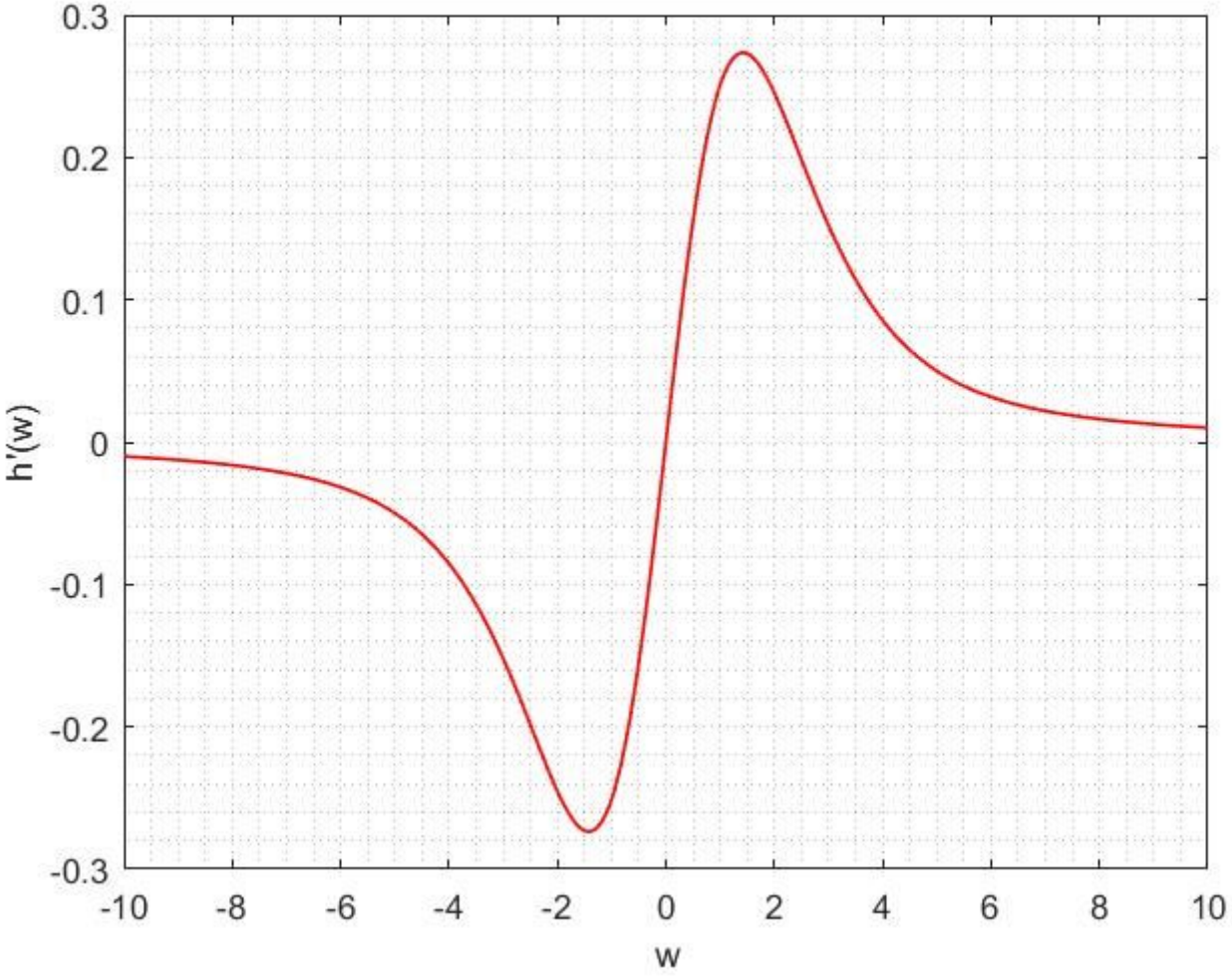

Figure 5

h'(ω)

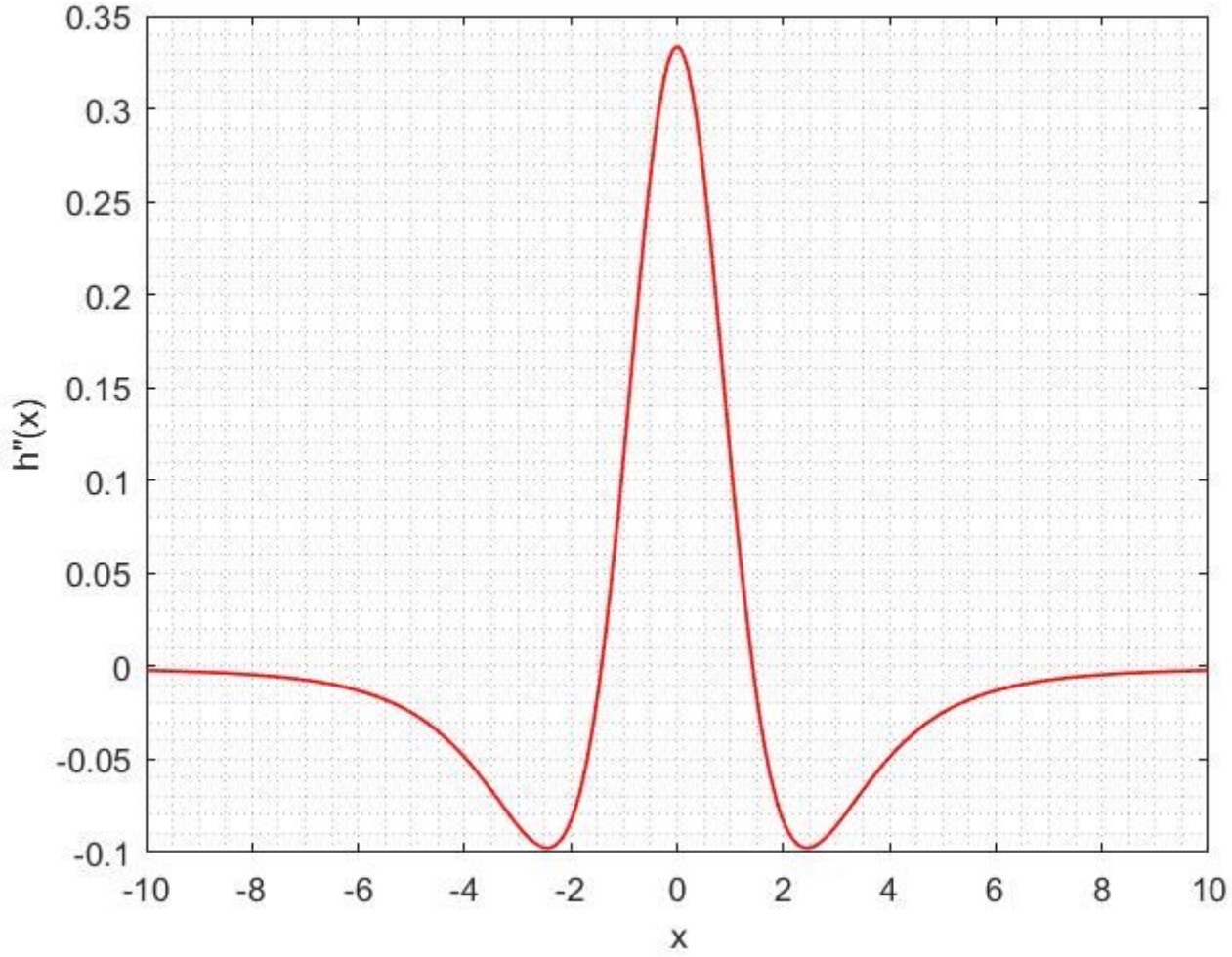

Figure 6

h''(ω)

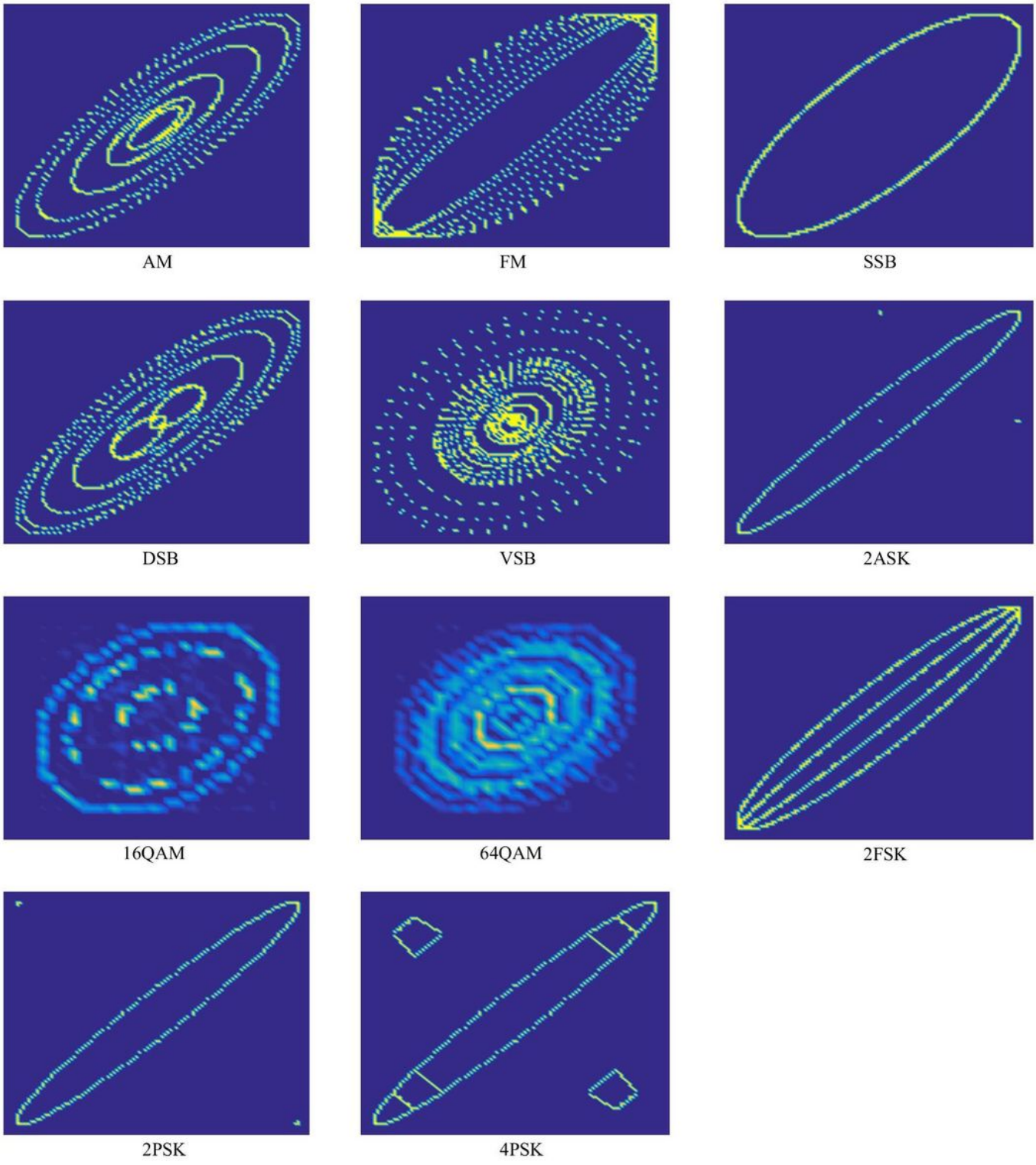

Figure 7

ADS Dataset

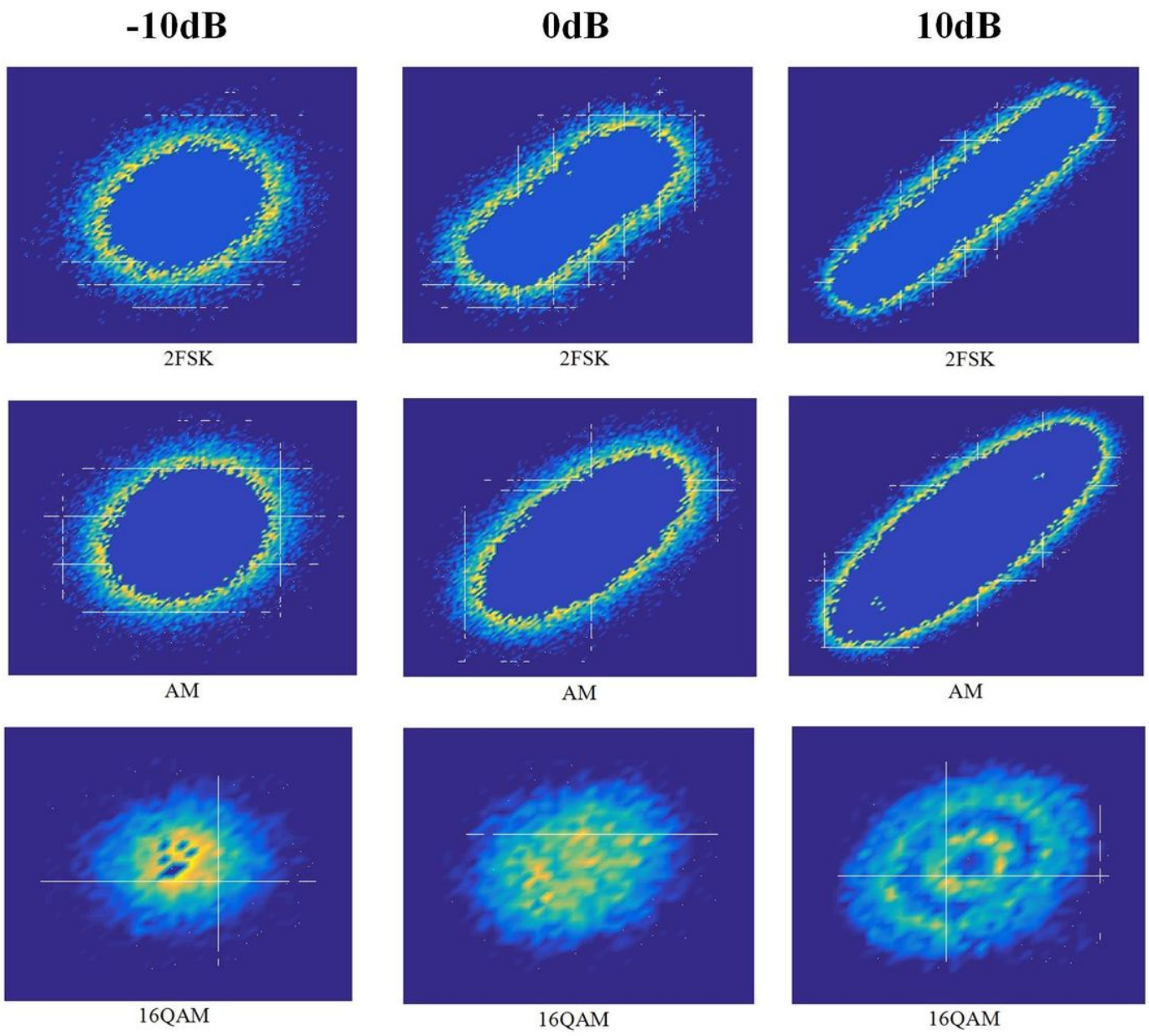

Figure 8

ADS histograms at different SNR

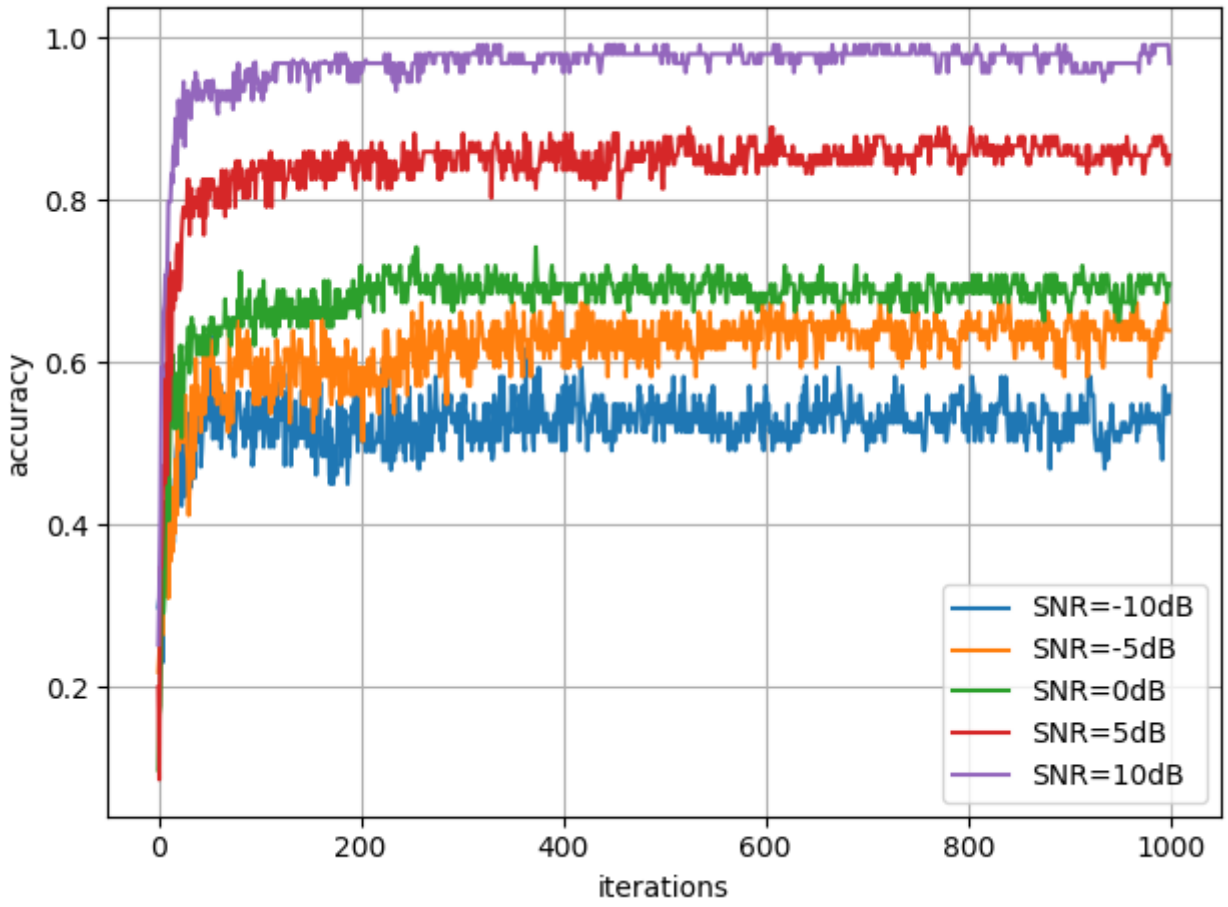

Figure 9

Validation curves of accuracy

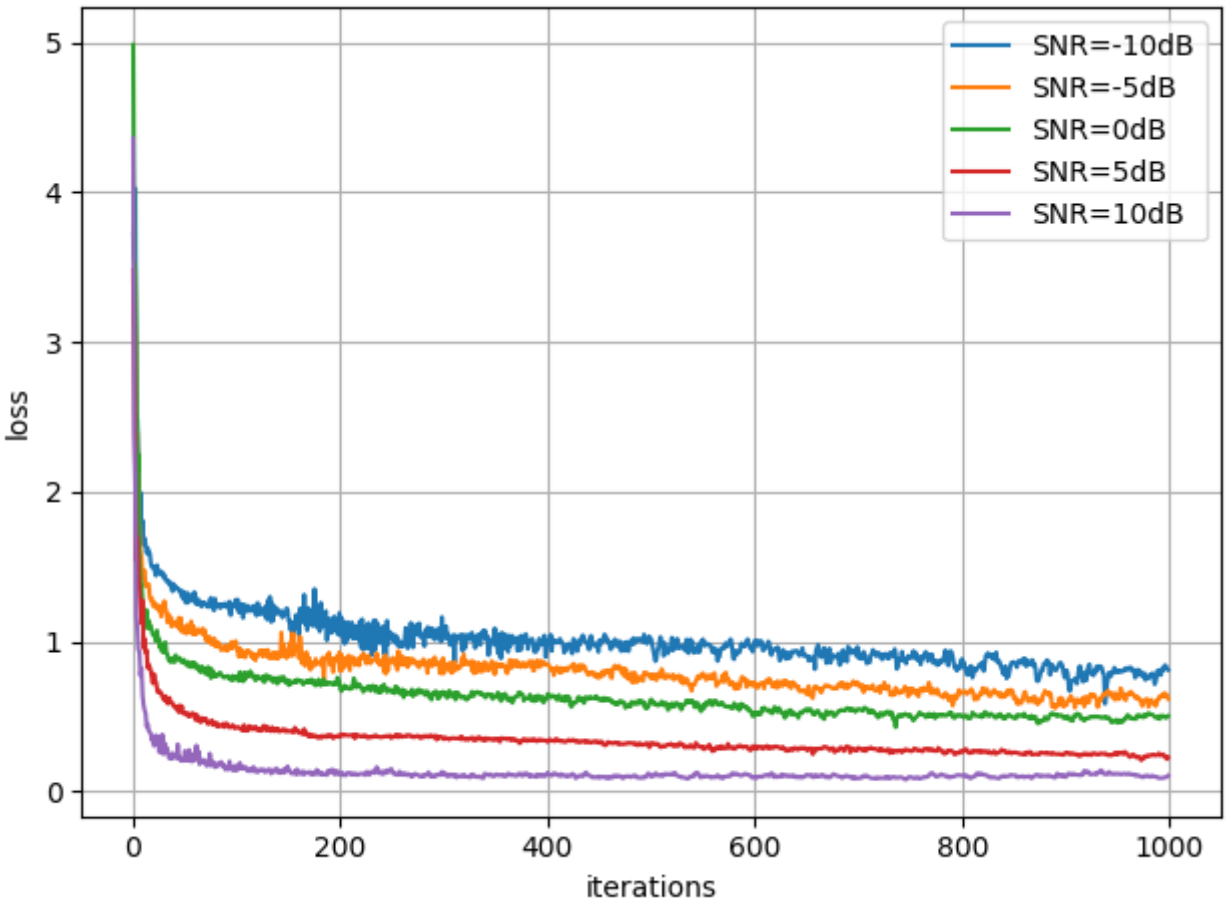

Figure 10

Validation curves of loss

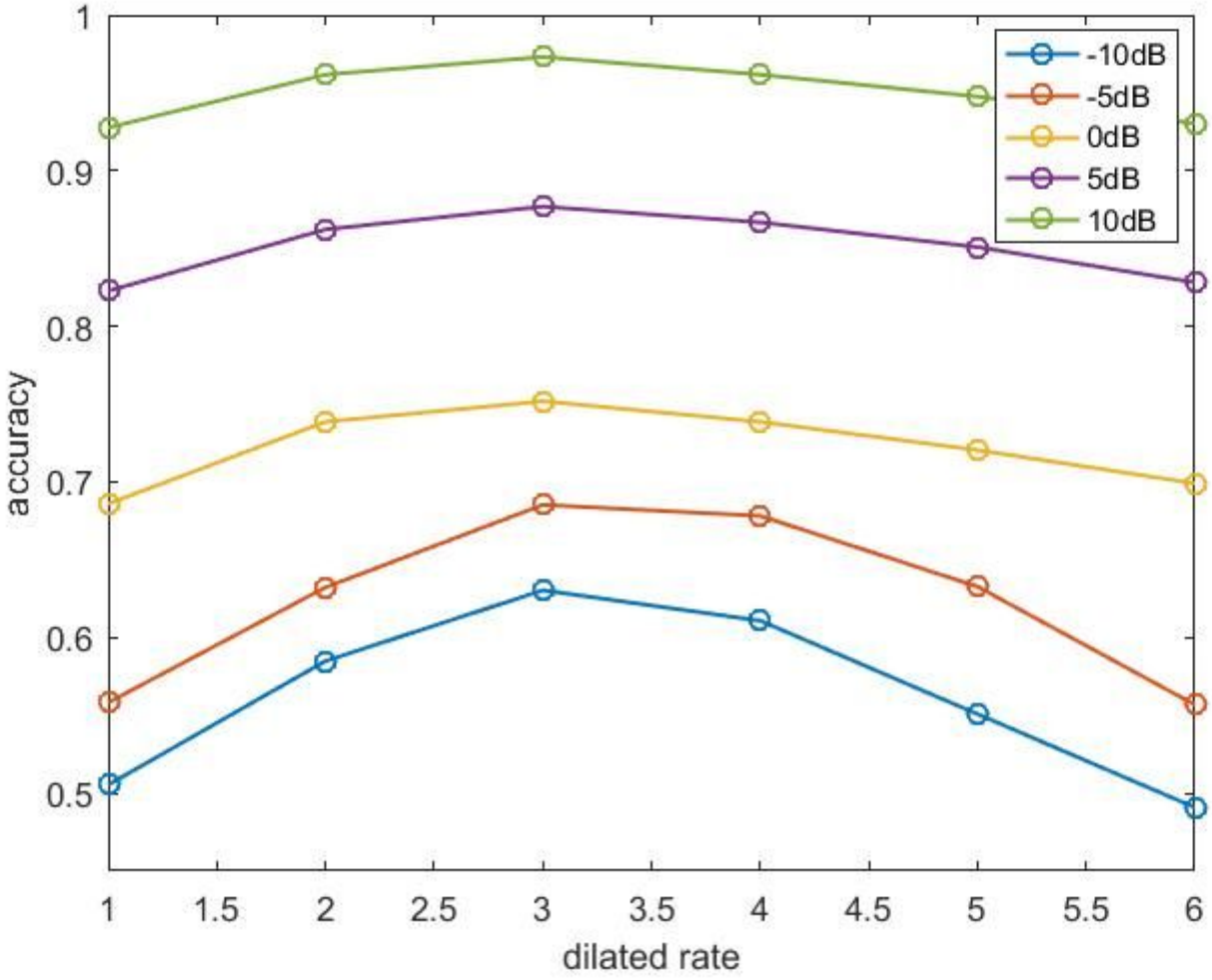

Figure 11

Accuracy in different dilated rates

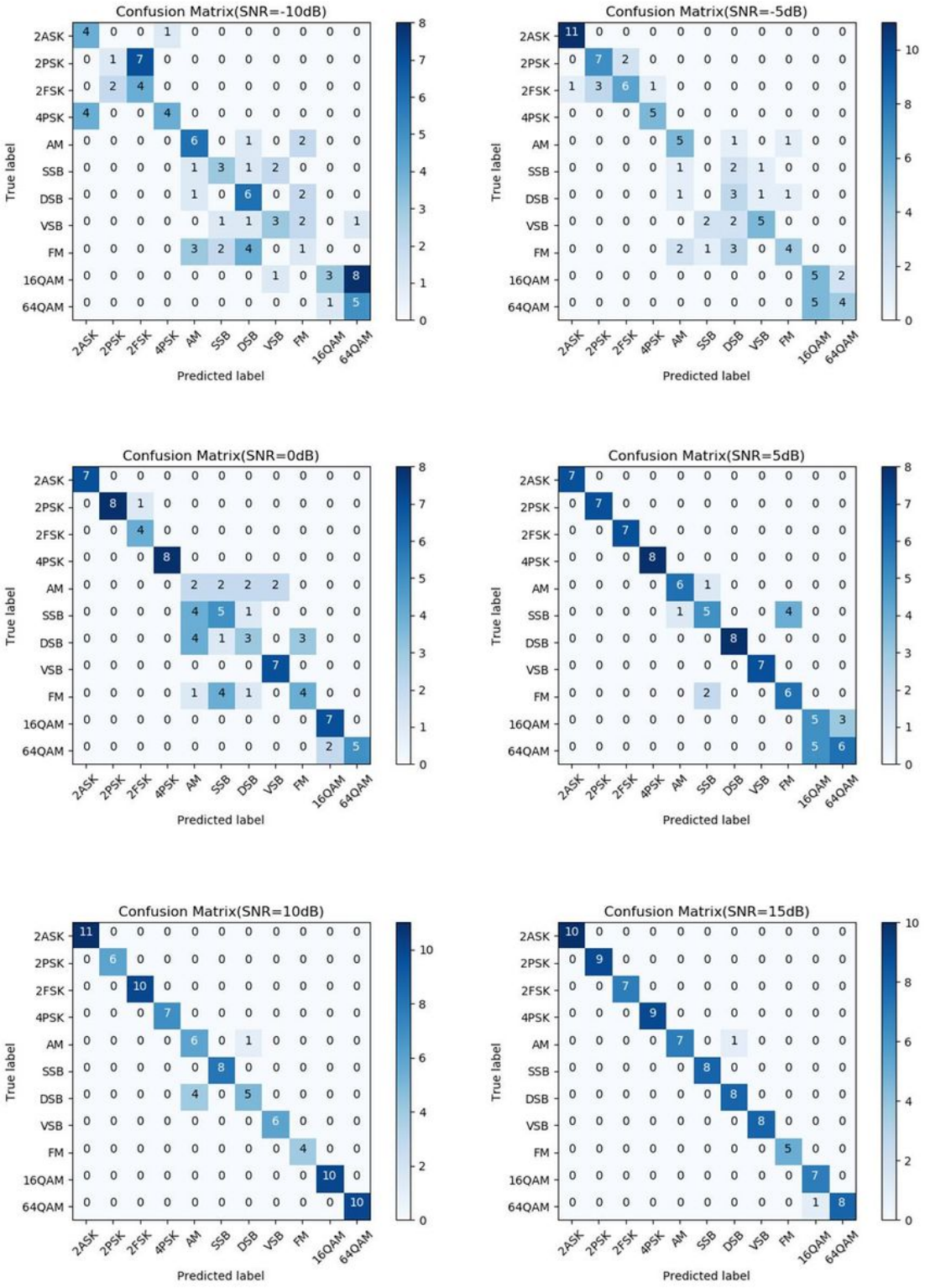

Figure 12

Confusion matrix in different SNR

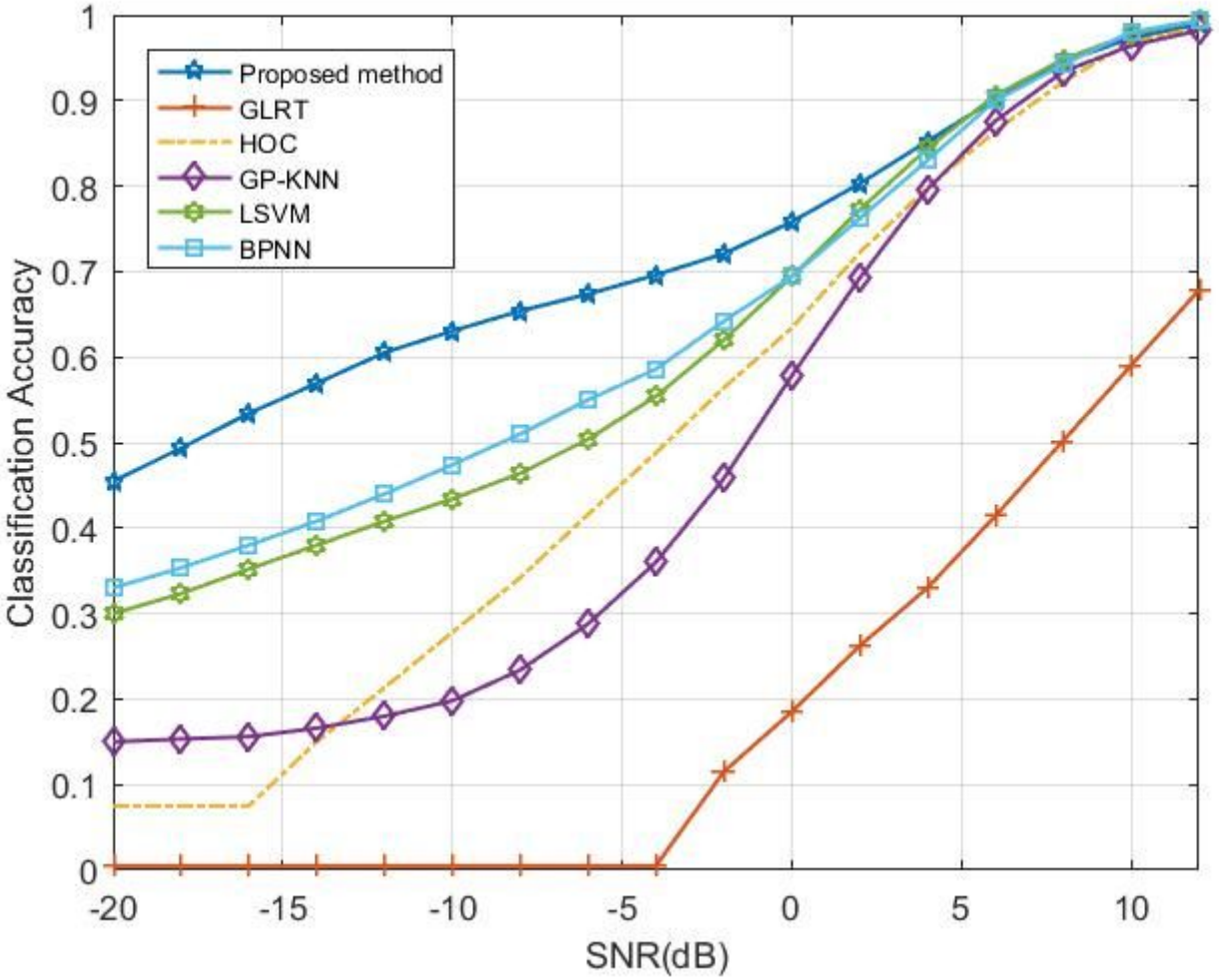

Figure 13

Classification accuracy in different SNR

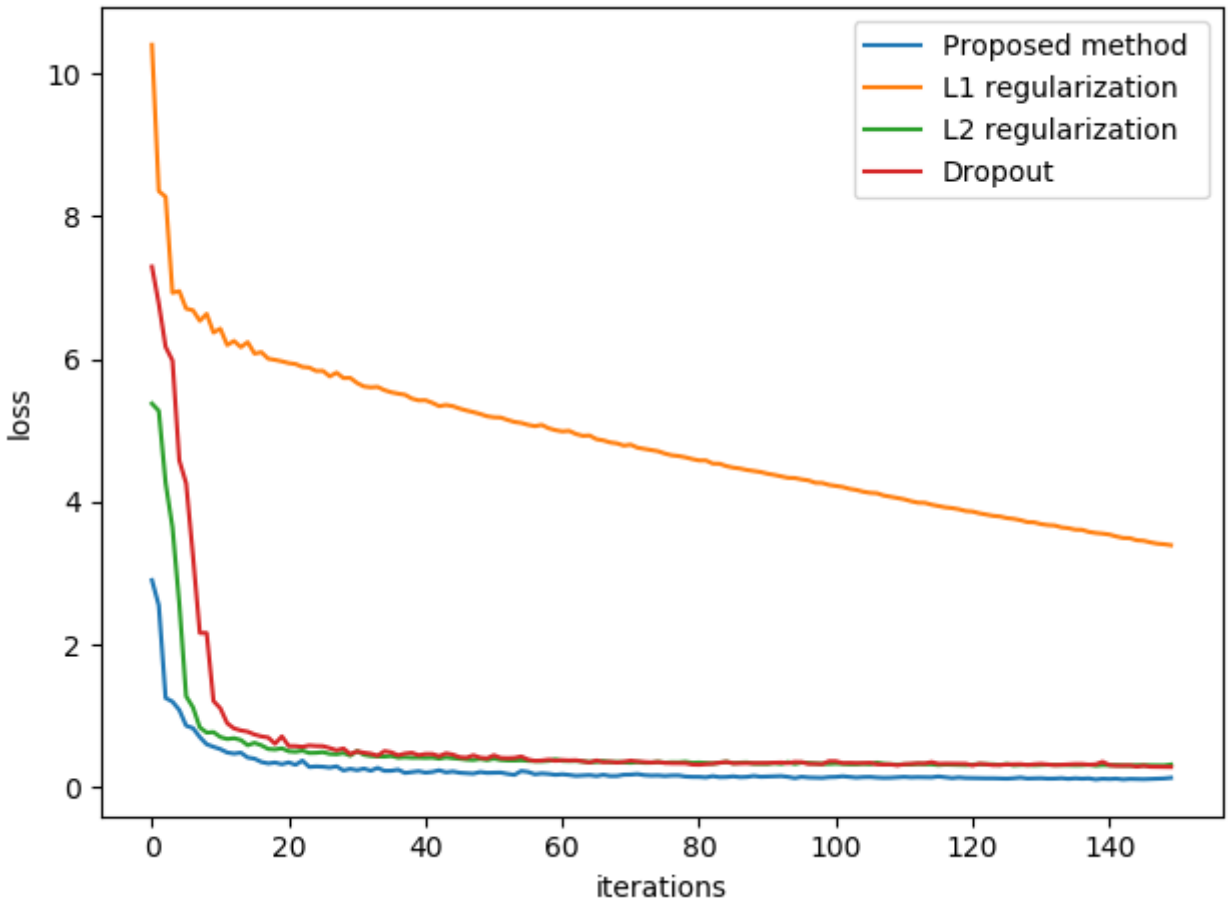

Figure 14

Loss in different regularization methods

Supplementary Files

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- DGFCNNAlgorithmforModulationRecognition.rar