

Scheme

To improve the LLR calculation accuracy of the PS transmission system, a scheme of LLR calculation based on neural network is proposed.

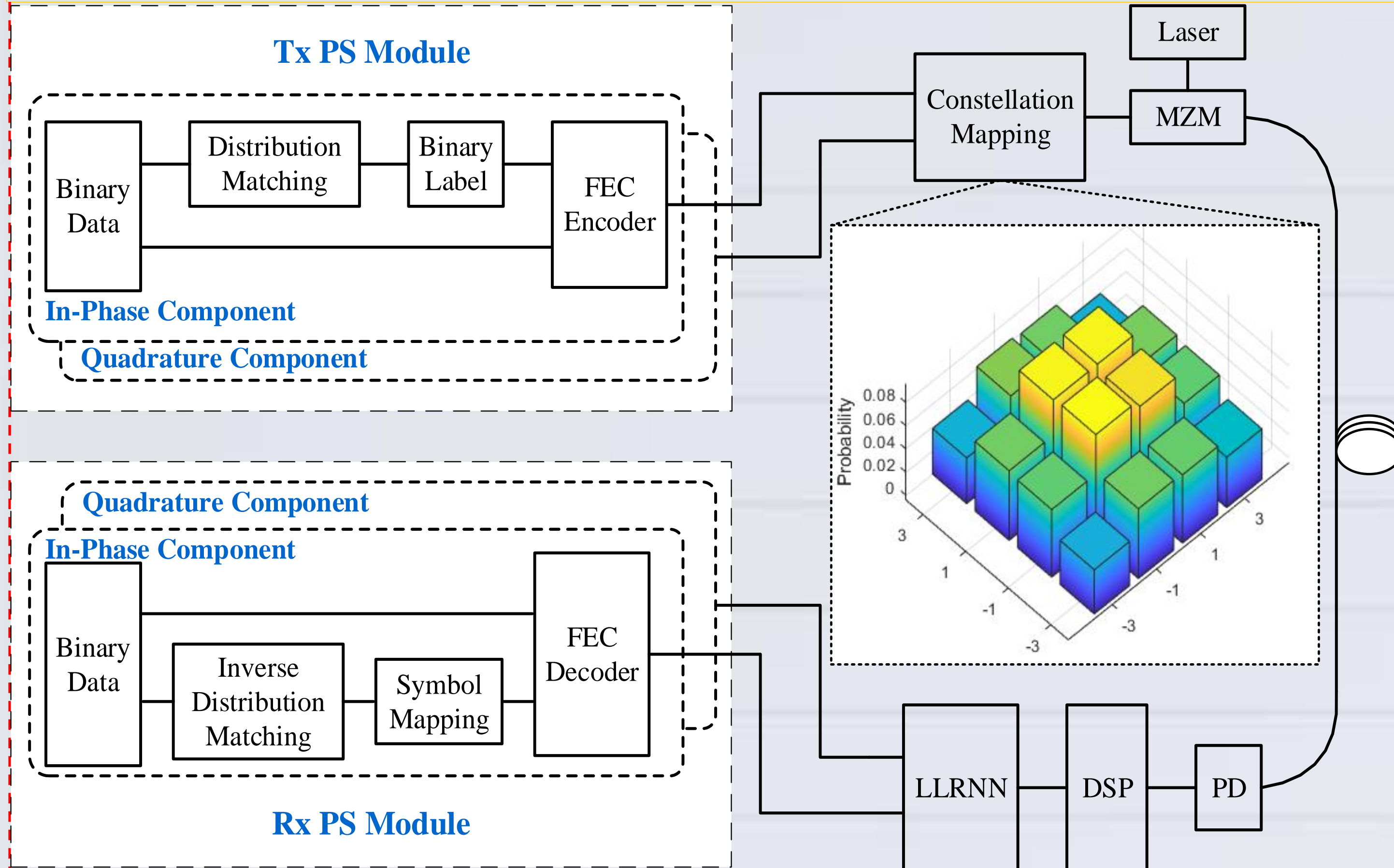


Fig. 1. The scheme of probabilistic shaping signal transmission based on neural network LLR calculation

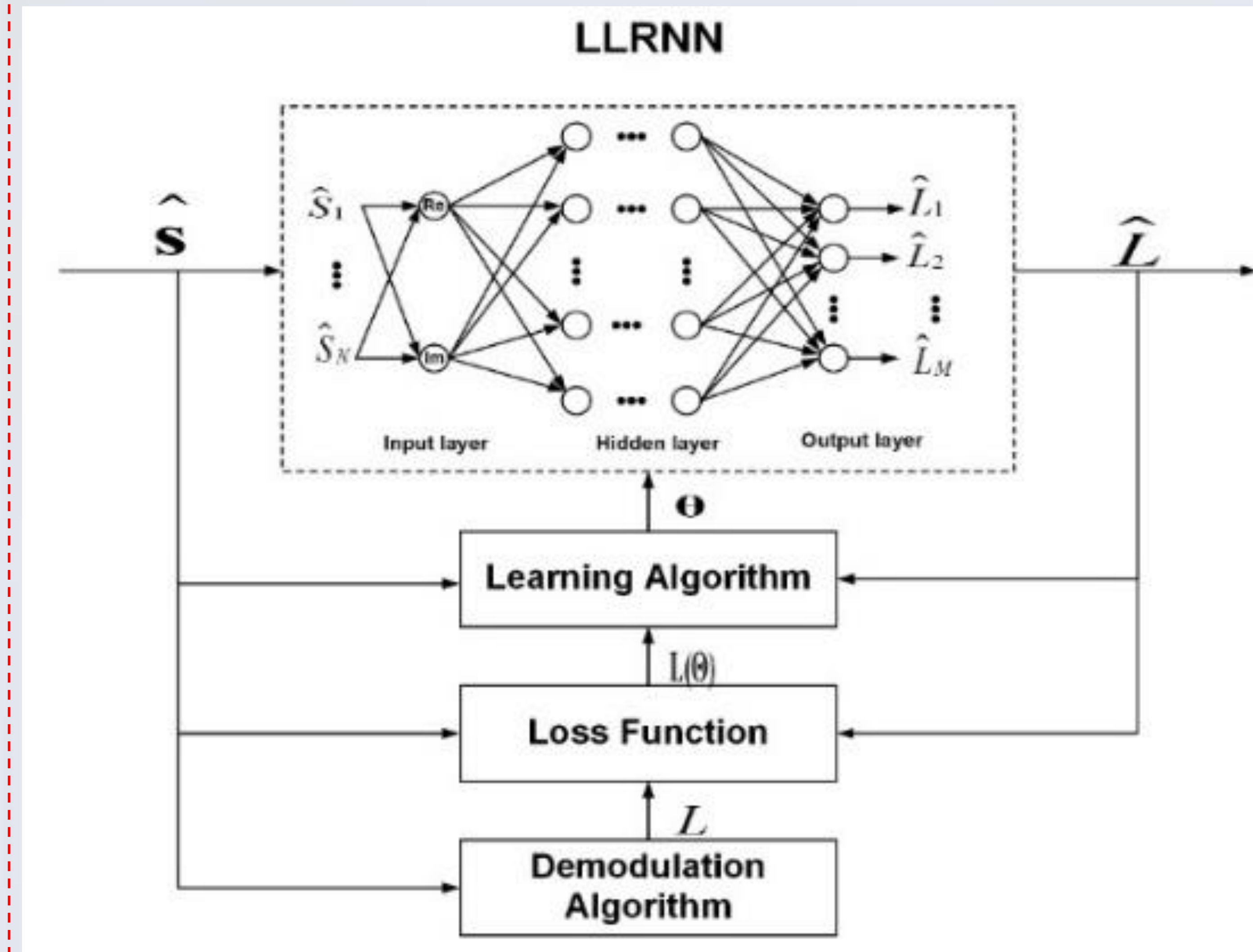


Fig. 2. structure diagram of LLRNN

Results

Under the same simulation parameters, we simulate three LLR calculation schemes in PS transmission system.

Scheme N: the proposed scheme
Scheme A: ALLR scheme
Scheme E: ELLR scheme

$$RMS = \sqrt{\frac{(L-E)^2}{E^2}}$$

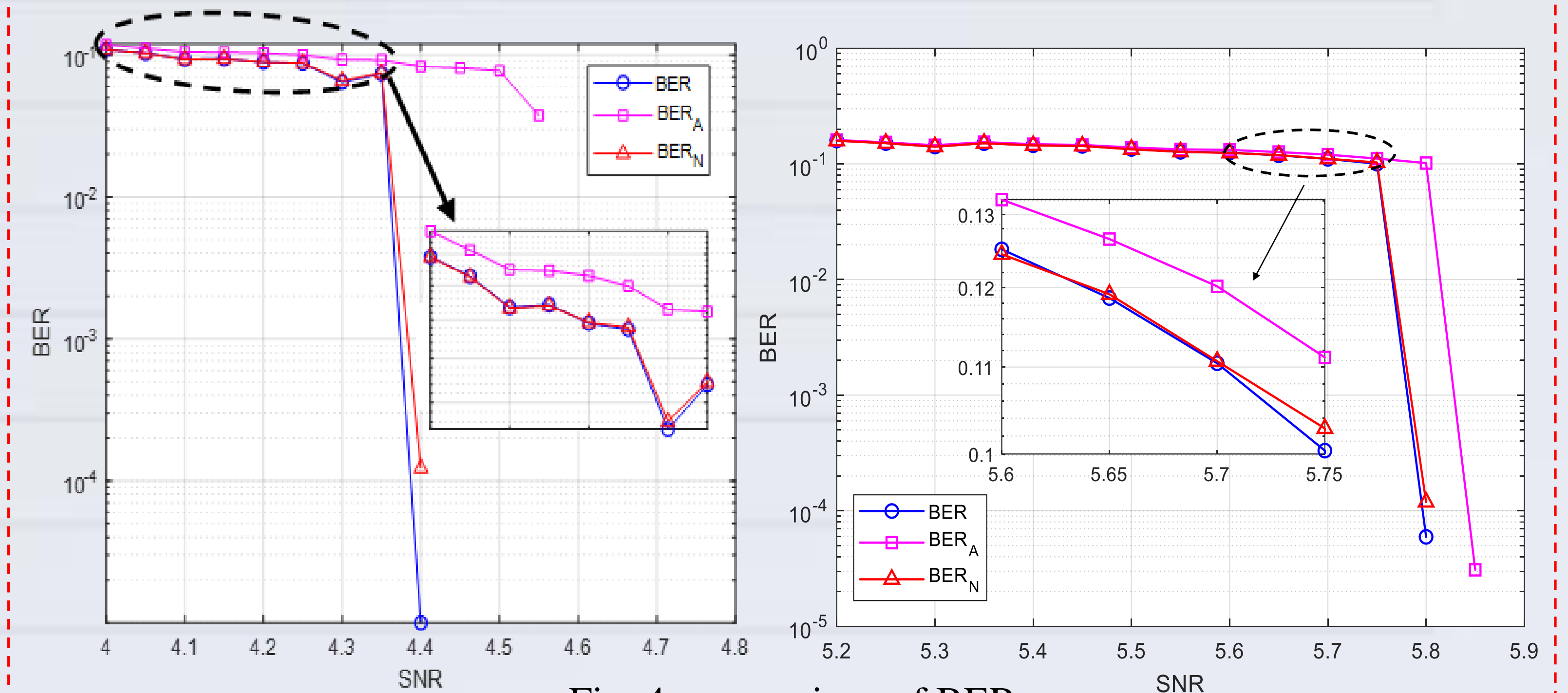


Fig. 3. comparison of RMS

Fig. 4. comparison of BER

Table I. The comparison of computational complexity

Schemes	Log-MAP	LLRNN (hiddenlayers = 8)
Operators		
<i>Multiplication & division</i>	68	40
<i>Addition & subtraction</i>	104	40
<i>Exponent & logarithm</i>	20	0
<i>Comparator</i>	0	8
Total	192	88

Conclusions

In this paper, a scheme that probabilistic shaping signal transmission based on neural network LLR calculation is proposed. Compared with the current transmission scheme based on the ALLR calculation, the simulation results show that under the same modulation format, the LLR calculation accuracy of the proposed scheme is higher, and the error performance is improved by more than 0.1dB. At the same time, compared with the scheme based on the ELLR, the scheme proposed in this paper has lower computational complexity, and can be used as a better choice of the probabilistic shaping signal transmission scheme.

Abstract

In order to improve the decoding accuracy and the BER performance of PS optical fiber transmission system, a scheme of PS signal transmission utilizing neural network based LLR calculation is proposed.

Abbreviations

BER Bit Error Ratio;
PS Probabilistic Shaping;
LLR Log-Likelihood Ratio;
MSER Mean Square Error Ratio;
FEC Forward Error Correction;
ALLR Approximation LLR;
ELLR Exact LLR.



The research of probabilistic shaping signal transmission scheme based on neural network LLR calculation

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Introduction

Probabilistic Shaping Signal Transmission

Compared to the uniform distribution, PS technology making the signal transmission achieving a performance closer to the Shannon limit. Moreover, combined with FEC and soft decision, the performance of PS system can be further improved.

Log-Likelihood Ratio Calculation

For the LLR algorithm in soft decision decoding, the calculation of ELLR involves a lot of exponential and logarithmic operations, which means a high operation costs. Therefore, the ALLR calculation method is mostly used in the actual communication system.