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Optimum Threshold of ACM

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Abstract-In this paper the threshold effect of an adaptive modulation over AWGN was investigated. Two types of modulation were considered, the 4QAM and the 16QAM. The simulation was done for two range of SNR. The metric used to compare the optimum threshold SNR was (Rate (bit/symbol) / BER). It was found that the best threshold for range (0 to 10) db is 7 dB. While for the second range it was 8 dB.

INTRODUCTION

Design of good communication system is the aim and goal of all communication engineers. To get better system, developments are in progress and more enhancements are introduced. The enhancements are in power, size of devices and bandwidth efficiency. Adaptive modulation (AM) [1] is one of the ways to enhance the transmission performance over any channel. The signal to noise ratio (SNR) range over which work is going on depends on the system and band used. But in general an optimum threshold should be used to get the better performance. The finding an optimum threshold is not a new direction in research. It has been long time from introducing an algorithm for adapting the threshold to be optimum [2], and other algorithms are introduced in [3] and [4] where in the last one a method to find the optimum threshold levels of SNR using interpolation was proposed for mobile in the fading channel. Even that, a simple study is needed to give clear view for researcher to know the effect of changing the threshold and enhance their knowledge about AM.

SYSTEM MODEL

The system used in our paper is shown in fig 1 below, where the modulation type is selected according to the SNR level. The backward channel and the channel estimator are supposed to be ideal. The system is work as follows: first the channel SNR is to be checked, then upon this value the system selects the appropriate modulation order. A transmission is hold on for a fixed time called window. After the window is over the system checks the SNR again. The window size is proposed to be the same time that the SNR changes after.

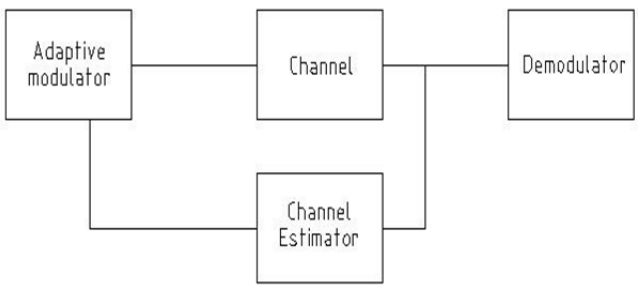

Figure 1
System model

RESULTS AND CONCLUSIONS

In the simulation, the proposed system modulation orders are 4QAM and 16QAM. The SNR range that the system works in was proposed to be from 0dB to 10 dB for the first range and from 0 to 15 db for the second range. The simulation results are shown in table 1 for the first range and in table 2 for the second range.

Table 1
Results for 4/16 QAM and SNR range1

Threshold	BER	Rate
0	0.0455	4
1	0.0392	3.6345
2	0.0333	3.3285
3	0.0281	3.083
4	0.0229	2.86
5	0.0195	2.667
6	0.0169	2.5
7	0.015	2.3537
8	0.0146	2.222
9	0.0143	2.1059
10	0.0139	2

Table 2
Results for 4/16 QAM and SNR range2

Threshold	BER	Rate
0	0.0302	4
1	0.0262	3.74
2	0.0225	3.53
3	0.0189	3.33
4	0.0152	3.16
5	0.0131	3.01
6	0.0115	2.855
7	0.0105	2.723
8	0.0097	2.61
9	0.0095	2.49
10	0.009	2.398
11	0.0091	2.3
12	0.0092	2.22
13	0.0093	2.144
14	0.0094	2.068
15	0.0092	2

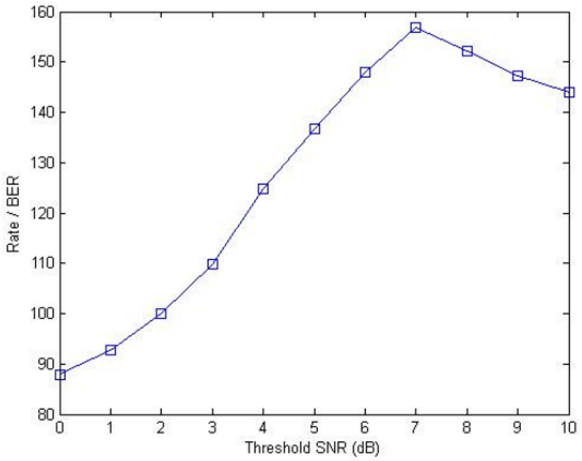

Figure 2
Threshold versus (Rate/ BER) for SNR range 1

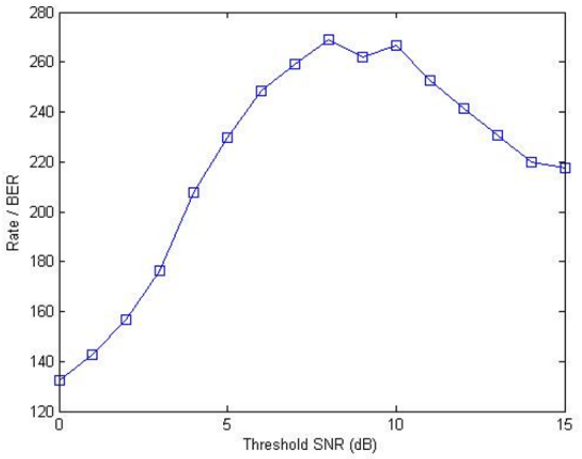

Figure 2
Threshold versus (Rate/ BER) for SNR range 1

From the two figures above it is easy to observe the peak point. It is noticeable that the peak in first figure is above the center because of the low performance of the modulation. When the range was increased the peak has move to the center of the range. As a result for low values of SNR it not necessary for the threshold to be in the center of range, and hence it is recommended that the designer simulate the transmission technique over the required channel to find the optimum for specific range.

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