A CONTRIBUTION ON ADAPTIVE CODING STRATEGIES OVER H.F. CHANNELS.

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Abstract

We present a coding scheme which makes use of adaptive coding techniques. Since we are concerned with the H.F. channel, suitable coding schemes are needed to combat diffuse errors [1], i. e. random and burst errors, introduced by the channel. We have chosen interleaved BCH codes for which we propose an efficient algorithm.

Introduction

The H.F. discrete channel is corrupted by both random and burst errors. The adaptive coding techniques, which match the rate and error control power of the code to the prevailing error conditions of the channel [2], are suitable to control this mixture of error patterns. They allow a reduction in the trasmitter power for a given error rate performance and more than one grade of service. Therefore, these techniques should be studied thoroughly so as to take full advantage of them.

The preliminar tools used and the simulation carried out will now be described. Then, the results obtained and their conclusions will be depicted.

Estimation of the b.e.r. after decoding in non-perfect block codes

Considering non-perfect block codes, the following approach can be stated in most cases:

$$\text{PROB(error at information bit due to no codeword after decoding)} = Pd \simeq Pdf \cdot e/k \qquad (1)$$

where "e" is the average number of errors at information bits per codeword, and "k" is the number of information bits per block. Pdf is the probability of not having a codeword after decoding.

Now consider that if there is a no codeword after decoding, the minimum number of errors introduced by the channel is ec + 1, where ec is the correcting ability of the block code. In addition, the effect of the decoding algorithm is to correct up to ec errors. In most practical cases, we have determined that the most reliable approach is given by the addition of the two magnitudes considered, i. e. ec + (ec + 1) = 2ec + 1. Recall that the factor k/n is also needed to take into account only information bits.

Therefore, the estimation of the b.e.r. after decoding in non-perfect block codes is

$$Pd \simeq Pdf.(2ec + 1)/n \qquad (2)$$

where Pdf can be easily calculated in reception, and both ec and n are known as well.

Description of the algorithm proposed

If the block decoded is a no codeword, both the estimated b.e.r. and the average rate are calculated. The first one is determined according to the expression given in (2). Then, depending on the present code, either the estimated b.e.r. or the average rate are compared to those required by the user. These comparisons determine whether the next code to be used is the same as the present code or not. This information is sent to the encoder so that the next codeword transmitted corresponds to the new code.

It is important to realize that the two parameters required by the user may not be compatible with the capacity of the channel considered. In this situation the parameters should be changed.

Description of the simulation

A computer simulation has been performed in order to test the coding strategy proposed. Its block diagram is shown in figure 1. This discrete simulation makes use of a H.F. discrete channel model [3], based on data derived from experiences over H.F. radiochannels. We have evaluated the adaptive coding performance taking into account both the bit error probability after decoding and the average rate. These results have been compared with those shown by the same interleaved BCH codes without the adaptive algorithm.

Results

Taking the coding choices as BCH(15,10) and BCH (15,6), we have obtained the results shown in table 1 for a bursty H.F. channel with an average bit error probability equal to 0.027.

As an example, table 2 shows the results obtained from a simulation of the two coding choices over the H.F. discrete channel considered previously. At the end of the simulation, both the actual b.e.r. and the estimated b.e.r. are calculated in order to check the reliability of (2).

Conclusions

It can be concluded that, for the H.F. discrete channel considered, the best overall performance is given by the adaptive system proposed, which has the additional advantage of being able to be controlled by the user.

With respect to the results shown in table 2, it can be said that the estimation given in (2) does not differ substantially from the actual magnitude.

References

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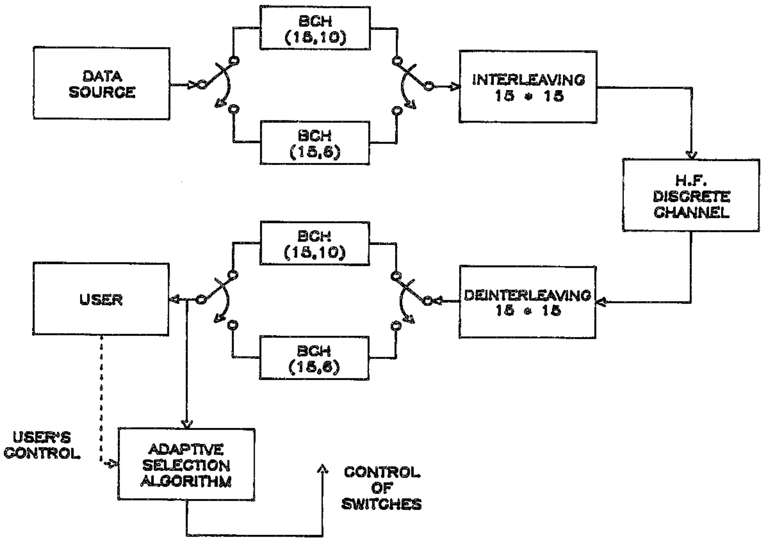

FIG. 1 : BLOCK DIAGRAM OF THE SIMULATION SYSTEM AND CODING SCHEME PROPOSED

	BCH (15,10) + INTERLEAVING	BCH (15,5) + INTERLEAVING	ADAPTIVE SYSTEM PROPOSED
BIT ERROR PROBABILITY AFTER DECODING	0,01	0,0027	0,0038
RATE	0,67	0,4	AVERAGE RATE = 0,46

TABLE 1 : RESULTS FOR A H.F. CHANNEL WITH AN AVERAGE BIT ERROR PROBABILITY EQUAL TO 0,0275

	ACTUAL B.E.R.	ESTIMATED B.E.R.
BCH (15,10) + INTERLEAVING	10^{-2}	10^{-2}
BCH (15,5) + INTERLEAVING	$2{,}7 \cdot 10^{-3}$	$2{,}6 \cdot 10^{-3}$

TABLE 2 : RESULTS FOR A H.F. CHANNEL WITH AN AVERAGE BIT ERROR PROBABILITY EQUAL TO 0,0275