ANALYSIS OF MULTIPLE ACCESS CHANNEL USING MULTIPLE LEVEL FSK

László Győrfi
István Kerekes
Technical University of Budapest
H-1111 Budapest
Stoczek u. 2.
Hungary

Abstract. For multiple level FSK system of multiple user communication a model is considered containing independent parallel noisy OR channels. The error probability is calculated if a random block code and a majority type decoding rule is applied.

Channel model

Initiated by Viterbi [1], Goodman, Henry and Prabhu [2] investigated the performance of a multiple access channel consisting of multiple frequency bands, and they gave an approximation on the probability of decoding error for a random code and a majority type decoder. Our purpose is to give a channel model for this problem and an exponential bound on the probability of error.

Fig. 1.
Suppose that each of the \( M \) users can access the parallel channels \( C_1, C_2, \ldots, C_{2^K} \). \( C_j \) is assumed to be a noisy OR channel, i.e. \( C_j \) is an OR channel followed by a binary memoryless channel with transition probabilities \( p_F \) (false alarm), \( 0 \rightarrow 1 \) and \( p_D \) (deletion), \( 1 \rightarrow 0 \), \( j = 1, 2, \ldots, 2^K \).\( /\text{Fig. 1.}/ \). \( C_1, C_2, \ldots, C_{2^K} \) are independent.

The channels \( C_1, C_2, \ldots, C_{2^K} \) are the models of the \( 2^K \) frequency bands. The transmitters send the bit 1 through one of the channels \( C_1, C_2, \ldots, C_{2^K} \), which means that they send a single frequency sinus signal in a bit time. The receivers try to detect the subset of \( C_1, C_2, \ldots, C_{2^K} \) through which sinus signals were sent.

This channel is a multiple access channel. Although each of the receivers has the same input sequence, we investigate the case, when the encoders are asynchronous, the decoders are separated, the \( i \)-th decoder is synchronized to the \( i \)-th encoder and it knows only the codebook of the \( i \)-th encoder \( /i = 1, 2, \ldots, M/ \). This is an important scheme of multiple user communication if, for example, the population of the users is changing from time to time.

Einarsson [3] and Timor [4] constructed a block code for such channel if \( C_1, C_2, \ldots, C_{2^K} \) are noiseless OR channels and supposed a fixed or slightly varying population of users.

\section*{Coding-decoding rule}