Tutorial No.8

Period 3 - 2006

Topic: Convolutional codes, Intersymbol interference, ARQ, Interleaving

Exercise 1

A rate 1/2 convolutional encoder has the generator vectors

$\mathbf{g}_1 = [1111]$

$\mathbf{g}_2 = [1101]$

Draw the state diagram, find the free distance, and determine the output bits if the input is 1,0,1,1,1. Calculate the bit error probability after the decoder if the bit error probability for the transmitted bits is $P_{B,uncoded} = 10^{-3}$.

Exercise 2

Binary data $x_k \in \{\pm 1\}$ is transmitted over a channel that is described by the model $H_c(z) = 1 - 0.8z^{-1} + 0.2z^{-2}$.

1. Draw the state diagram for this channel. Assign data symbols to each state and channel outputs to each transition.
2. Draw a trellis for the channel. Assume a starting state of $\{+1, +1\}$, that the message is seven symbols long and that the last symbols are +1, +1.
3. What is the ML decision when -1.4, 1.9, -0.1, -1.7, 2.3, -0.1, 0.3 is received?
4. What is the decision from an ordinary symbol by symbol detector when no equalizer is used? Compare with the result in part (3) above.

Exercise 3

Assume a packet-based wireless communication system where the information bits are partitioned into blocks of size $k = 120$ bits. Each data block is encoded using a BCH (127,120) code with error correction capability of $t = 1$. The coded bits are modulated using BPSK and are transmitted at rate $R_s = 5$ [ksymbols/s] over the channel. The channel is modelled by a Rayleigh fading distribution. Usually, when the transmitted signal experiences fading, burst errors occur. Statistics have shown that the average fading duration is about

$\bar{\tau} = 2$ ms. To combat the burst error phenomenon, we use a block interleaver at the transmitter. Determine the minimum size of the block interleaver and the corresponding delay due to using interleaving.