Tutorial No.7

Period 3 - 2006

Topic: Convolutional codes

Exercise 1

Draw the state diagram, tree diagram, and trellis diagram for the Convolutional encoder with the generator vectors

$$\mathbf{g}_1 = (1, 1, 1)$$
$$\mathbf{g}_2 = (0, 1, 1).$$

Exercise 2

Find the free distance of encoder of Exercise 1 by the transfer function method.

Exercise 3

Consider the $K = 3$, rate $\frac{1}{2}$ encoder with generator vectors

$$\mathbf{g}_1 = (1, 1, 1)$$
$$\mathbf{g}_2 = (1, 0, 1).$$

This code is used over a binary symmetric channel (BSC). Assume that the initial encoder state is the 00 state. At the output of the BSC, the sequence $\mathbf{Z} = (11, 00, 00, 10, 11, \text{ rest all } "0")$ is received.

1. find the maximum likelihood path through the trellis diagram, and determine the first 5 decoded data bits. If a tie occurs between any two merged paths, choose the upper branch entering the particular state.

2. Identify any channel bits in $\mathbf{Z}$ that were inverted by the channel during transmission.

Exercise 4

For the $K = 3$, rate $\frac{1}{2}$ encoder described in Exercise 3, perform soft-decision decoding for the following demodulated sequence. The signals are 8-level quantized integers in the range of 0 to 7. The level 0 represents the perfect binary 0, and the level 7 represents the perfect binary 1. If the digits into the decoder are:

6, 7, 5, 3, 1, 0, 1, 1, 2, 0, where the left-most digit is the earliest, use a decoding trellis diagram to decode the first two data bits. Assume that the encoder has started in the 00 state, and that the decoding process is perfectly synchronized.