72.3280 Advanced Radio Transmission Methods

Home assignment 19.04.2007 to be returned before 3.05.2007

1. Consider a Convolutional code with the generator given on Figure 1.

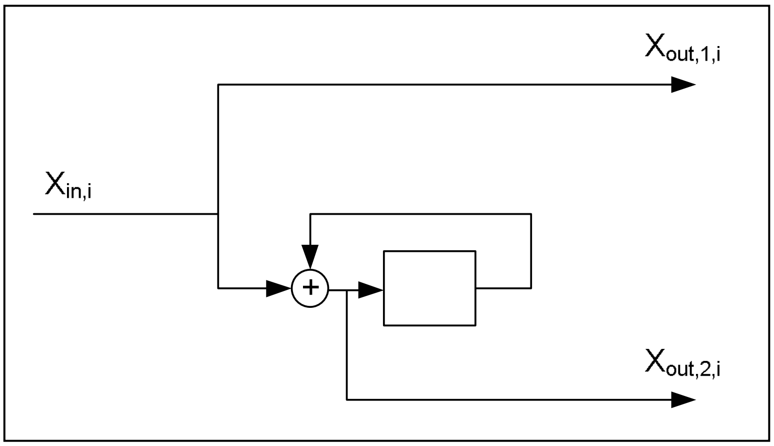

Figure 1. Convolutional encoder.

The first input bit to the encoder is 1, other input bits are calculated from your student number by taking modulo 2 from each individual number.

For example in case of the study number $\begin{bmatrix}1 & 2 & 3 & 4 & 5\end{bmatrix}$

$\begin{bmatrix}1 & 2 & 3 & 4 & 5\end{bmatrix} \bmod 2 \Rightarrow \begin{bmatrix}1 & 0 & 1 & 0 & 1\end{bmatrix}$. $x_{in} = \begin{bmatrix}1 & [student\_number] \bmod 2\end{bmatrix}$.

The codeword contains only 12 first output bits: 6 systematic and 6 encoded bits.

$x_{out} = \begin{bmatrix}x_{out,1,1} & x_{out,2,1} & \dots & x_{out,1,6} & x_{out,2,6}\end{bmatrix}$.

The encoded bits are mapped to the channel symbols $\{x_{out} = 0\} \Rightarrow -1$; $\{x_{out} = 1\} \Rightarrow 1$.

The received signal is in the form $y_i = x_i + n_i$ where the noise values in the channel are

$n_i = \begin{bmatrix}0.13 & 0.31 & 0.66 & -0.61 & -0.16 & 0.52 & -0.28 & 0.16 & -0.09 & 0.26 & 0.03 & -0.10\end{bmatrix}$

The Signal to noise ratio is 1 dB. Add the noise to the encoded signal.

Assume that we have extrinsic information for each bit in logarithmic domain calculated as $2\left(x_{in,i} - 0.5\right) \cdot L_{extr,i}$. The amplitudes of the extrinsic information values are

$L_{extr,i} = \begin{bmatrix}10 & 25 & 5 & 12 & 18 & 9\end{bmatrix}$.

1) Calculate the encoded codeword.
2) Calculate the most likely codeword after the channel (without extrinsic information)? (You can use for example a Viterbi decoder)
3) Calculate the marginal probability for each information bit without extrinsic information.

4) Calculate the marginal probability for each bit by considering also the extrinsic information.