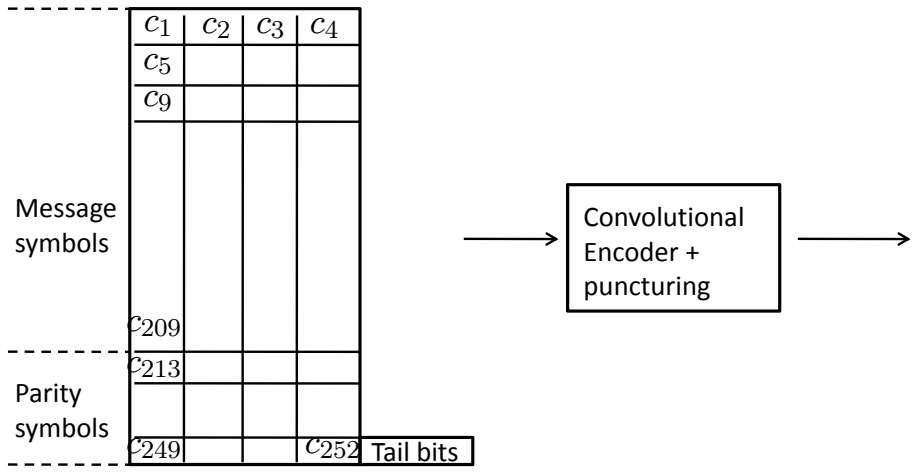
ECEN 604: Channel Coding for Communication Systems
Project 2

- Date Assigned: December 2, 2014
- Date Due: December 17, 2014

I Encoder

In this project, you will simulate the performance of coding scheme which is a concatenation of a $(63, 53)$ Reed-Solomon code with a punctured rate-1/2 systematic recursive convolutional encoder with generator polynomials $\left[1, \frac{1+D+D^2+D^3+D^4}{1+D^4}\right]$. The puncturing pattern to use is $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$. Thus, the punctured convolutional code is of rate 3/5 and the overall rate is $\frac{3}{5} \times \frac{53}{63} = 0.5048$ which is almost 1/2. A schematic of the coding scheme is shown in the figure. Assume that data is transmitted in blocks of $63 \times 4 \times 6 + 4$ bits. Let c_k denote the kth RS code symbol which is comprised of 6 bits $[b_k^1, b_k^2, \ldots, b_k^6]$. You can use the linearity of the coding scheme and transmit the all-zeros sequence.



- (20 points) Your first job is to simulate a received vector $\underline{r}$ for a given value of E_b/N_0 by adding Gaussian noise of appropriate variance.

II Decoding

There are two stages to the decoder. In the first stage, a hard decision Viterbi decoder is used to produce estimates of the bits. In the second stage of the decoder, you will perform bounded distance decoding of the RS code. You do not have to implement the decoder itself, it is enough to check whether the decoding condition for the RS code would be satisfied or not. If the RS decoder fails, you can just take the output of the Viterbi decoder as the decision.

You are expected to do the following

- (60 points) Write a program to simulate the above system and write the Viterbi algorithm in software. Estimate the bit error rate at the output of the convolutional encoder through monte carlo simulations and use it to estimate the error rate at the output of the RS decoder. Plot the BER as a function of E_b/N_0.
- (20 points) Compare the performance of the above scheme with that of a convolutional code of constraint length 7 with connection polynomials $[247, 371]$. Compare the slopes of the BER curves. Which one do you think will be better at lower error rates?
- In all cases plot BER from about 10^{-2} to 10^{-6} or so.