Indian Institute of Science

E9-251: Signal Processing for Data Recording Channels

Instructor: Shayan G. Srinivasa

Home Work #3, Spring 2014

Late submission policy: Points scored = Correct points scored $\times e^{-d}$, d = # days late

Assigned date: March 24^{th} 2014 **Due date:** April 8^{th} 2014

PROBLEM 1: Consider a recording channel with a partial response target $T(z) = 2 + 7z^{-1} + 2z^{-2}$. It is desired to detect the non return to zero (NRZ) bits x_n from the received signal $y_n = t_n * x_n + w_n$, where, $w_n \sim \mathcal{N}(0, \sigma^2)$. Implement the BCJR algorithm that you studied in the class using log-domain algebra. Plot the bit error rate (BER) vs. signal-to-noise ratio (SNR) for the floating point case over a block length of $n = 4096$ bits. Suppose the input is quantized to 5 bits, how will you choose the quantization parameters for the implementation? Study the effect of quantization for bit budgets 5, 6 and 7 on the performance of the algorithm via simulations. Evaluate the computational and space complexity of the algorithm. (100 pts.)

NOTE: Your report should include the original Matlab/C code along with any necessary mathematical derivations whenever required.

PROBLEM 2: Consider a memoryless AWGN channel taking p-biased inputs i.e., $Pr(x = -1) = p$ and $Pr(x = 1) = 1 - p$. Let received signal be $y = x + n$, where, $n \sim \mathcal{N}(0, \sigma^2)$. Design an optimal detector for this channel. Evaluate the probability of error. (25 pts.)