

EE 121: Introduction to Digital Communication Systems

Problem Set for Discussion Section 13

Mon 5/5/2008 and Wed 5/7/2008

1. (Introduction to the Viterbi algorithm) Consider the ISI channel

$$y[n] = 1.2x[n] + x[n - 1] + w[n]$$

where the $w[n]$ are i.i.d. Gaussian noise random variables with mean zero and variance 1. A sequence $x[1], x[2], \dots$ is sent. Each $x[n]$ is a 4-PAM data symbol taking on values $-3, -1, 1$ and 3 with equal probability. How many possible states are there? Draw a state diagram illustrating the possible state transitions. Draw a trellis diagram.

2. (OFDM) We wish to use OFDM to communicate over the ISI channel of problem 1. Suppose we use a block length of two and transmit a total of two data blocks. The first block consists of data symbols $d_1[1]$ and $d_1[2]$. The second block consists of data symbols $d_2[1]$ and $d_2[2]$.

- (a) How many symbols will be used in the cyclic prefix?
- (b) Draw a system diagram illustrating the OFDM encoding and decoding procedures.
- (c) For data block two, compute expressions for the symbols entering each component of your diagram. Also compute an expression for the output symbol estimates $\hat{d}_2[1]$ and $\hat{d}_2[2]$ in terms of the data symbols $d_1[1], d_1[2], d_2[1], d_2[2]$ and the noise.