KING ABDULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
ELECTRICAL ENGINEERING DEPARTMENT
Fall 2012
EE 242/571 Digital Communications and Coding
Homework 3
(due Nov 10, 2012)

Note: Make sure that you understand the notes of 'Lempel-Ziv coding' uploaded on the course webpage.

1. Consider the following two 4-PAM constellations

(a) Equi-distance PAM (Fig. 1) and (b) Variable distance PAM (Fig. 2)

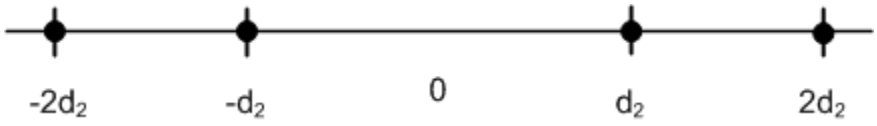

Figure 1: Variable distance PAM

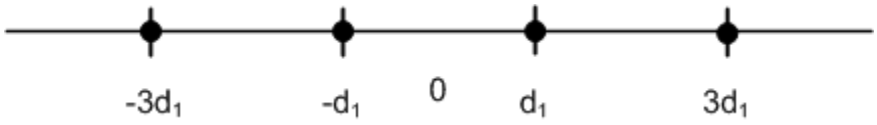

Figure 2: Equi-distance PAM

i. Evaluate the probability of symbol error for both in terms of the average energy of the constellation.
ii. Plot the probability of error vs. E_b/N_0 for the constellations.
iii. Which one shows a better performance? Can you explain why?

2. Solve Problem 4.8 from Proakis.

3. Consider the signal set shown in the following figure (Fig. 3) with an AWGN channel and let $\sigma^2 = 0.1$.

i. Does P_e depend on L and θ?
ii. Find the nearest neighbor union bound on P_e for the ML detector assuming $p_x(i) = \frac{1}{9}\ \forall i$.
iii. Find P_e exactly using the assumptions of the previous part. How far off was the NNUB?

iv. Suppose we have a minimum energy constraint on the signal constellation. How would we change the constellation of this problem without changing the P_e? How does θ affect the constellation energy?

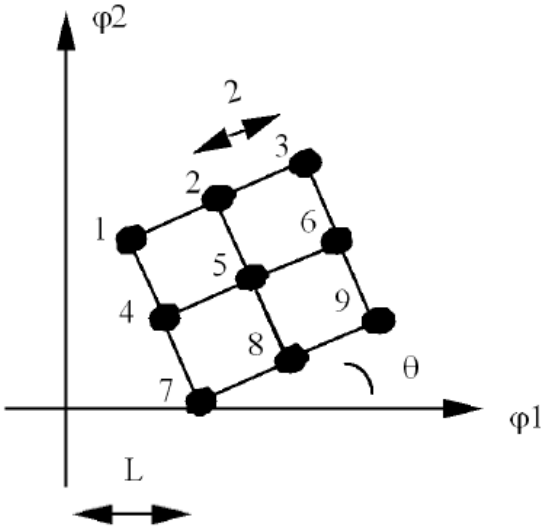

Figure 3: Constellation for Q5.