Advanced Digital Communications (EQ2410)
Period 3, 2016

Assignment 4

Due: Wednesday, Jan. 29, 2014 M. Xiao

Reading assignment

- Madhow, Fundamentals of Digital Communication: chapters 7.3 (pp. 342-356)

Preparation tasks

Problem 4.1: In this problem, we will recapitulate a few properties of binary block codes. Consider in the following a linear block code $\mathcal{C}$ which is given by its encoder characterized by the $(k \times n)$ generator matrix

$$\boldsymbol{G} = \begin{bmatrix} \boldsymbol{v}_1 \\ \vdots \\ \boldsymbol{v}_k \end{bmatrix}.$$

(a) What is the difference between "encoder" and "code"?

(b) Show that the generator matrix $\boldsymbol{G}$ for a systematic encoder has the form

$$\boldsymbol{G} = [\boldsymbol{I}_k \ \boldsymbol{P}],$$

where $\boldsymbol{I}_k$ is the $(k \times k)$ identity matrix.

(c) Explain why a generator matrix $\boldsymbol{G}'$ which is obtained by substituting $\boldsymbol{v}_i$ (i.e., the i-th row of $\boldsymbol{G}$) by $\boldsymbol{v}_i + \boldsymbol{v}_j$, with $i \neq j$, constructs the same code.

(d) Explain how you can generate a systematic encoder for a code which is given by a non-systematic generator matrix.

(e) Show that the parity-check matrix of a systematic code can be expressed as $\boldsymbol{H} = [-\boldsymbol{P}^T \ \boldsymbol{I}_{n-k}]$.

(e) Explain why the result from (c) applies as well for the $((n-k) \times n)$ check matrix $\boldsymbol{H}$.