EE 564

Homework 6

Due Monday March 31, 2014

Work all 3 problems.

Problem 1. In class we looked at CPFSK signaling and we showed the time-varying phase of the carrier is

$$\phi(t;I) = 4\pi T f_d \int_{-\infty}^{t} \left[\sum_n I_n g(\tau - nT) \right] d\tau$$

where I_n denotes the sequence of amplitudes obtained by mapping $k-$bit blocks of binary digits from the information sequence a_n into amplitude levels $\pm 1, \pm 3, \ldots, \pm(M-1)$, and $g(t)$ is a rectangular pulse of amplitude $1/2T$ and duration T seconds. By performing the above integration show that

$$\begin{aligned} \phi(t;I) &= 2\pi f_d T \sum_{k=-\infty}^{n-1} I_k + 2\pi f_d q(t-nT) I_n \\ &= \theta_n + 2\pi h I_n q(t-nT) \end{aligned}$$

where

$$\begin{aligned} h &= 2 f_d T \\ \theta_n &= \pi h \sum_{k=-\infty}^{n-1} I_k \\ q(t) &= \begin{cases} 0, & t < 0 \\ t/2T, & 0 \le t \le T \\ 1/2, & t > T. \end{cases} \end{aligned}$$

Problem 2. Explain clearly, using text and/or mathematics, how OQPSK (SQPSK) avoids 180 degree phase discontinuities.

Problem 3. Suppose that one of two equally likely messages is to be transmitted over an AWGN channel. The signal vectors are

$$s_0 = \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \quad s_1 = \begin{pmatrix} -2 \\ -2 \end{pmatrix}.$$

corresponding to messages m_0 and m_1, respectively. Draw the decision boundaries and give the decision logic for the optimum receiver, that is, give the optimum rule for deciding m_0 or m_1 was sent.