S-72.227 Digital Communication Systems

Spring 2002 Tutorial#3, 11.02.2002

E 3.1

Construct the code trellis diagram for a (2,1,2) code with

$$x_j' = m_{j-1} \oplus m_j \qquad x_j'' = m_{j-2} \oplus m_{j-1}.$$

a) Apply the Viterbi algorithm to find $Y + \hat{E}$ and $\hat{M}$ when Y=10 11 01 01 10 01 10 11.

b) If two paths arriving at a given node have equal running metrics, arbitrarily keep the upper path.

E 3.2

From the following equation

$$G_{lp}(f) = G_i(f) = \frac{M^2 - 1}{12r}\operatorname{sinc}^2\frac{f}{r} + \frac{(M-1)^2}{4}d(f),$$

find the average power $\overline{x_c^2}$ and the carrier-frequency power P_c of an M-ary ASK signal. Then form the ratio $P_c \big/ \overline{x_c^2}$ and simplify for M=2 and M>>1.

E 3.3

The envelope and phase variations of a QAM signal are

$$A(t) = A_c\left[x_i^2(t) + x_q^2(t)\right]^{1/2} \text{ And } f(t) = \arctan\left[x_q(t)/x_i(t)\right] \text{ respectively.}$$

(a) By considering the time interval $kD<t<(k+1)D$, obtain expression for A(t) and $f(t)$ with a rectangular pulse shape $P_D(t)$.

(b) Redo part a with an arbitrary pulse shape p(t) whose duration does not exceed D.

E 3.4

Suppose an OOK signal has raised-cosine pulse shaping so that

$$S_1(t) = A_c \sin^2(pt/T_p)P_{T_b}(t)\cos w_c t$$

Draw and label the block diagram of an optimum coherent receiver using:

(a) matched filter;

(b) Correlation detection.

Homework-3 Deadline February 18,2002 at 10.00

Homework return box is located at Otakaari 5, 2nd floor, near the E-wing. You can also return the answers to the assistant just before the class.

Suppose a binary FSK signal with discontinuous phase is generated by switching between two oscillators with outputs $A_c \cos(2pf_o t + q_o)$ and $A_c \cos(2pf_1 t + q_1)$.

Since the oscillators are unsynchronized, the FSK signal may be viewed as the interleaved sum of two independent binary ASK signals.

Use this approach to find, sketch, and label $G_c(f)$ for $f > 0$ when $f_o = f_c - r_b/2$ and $f_1 = f_c + r_b/2$ with $f_c >> r_b$.