Assignment
GATE-EC-39

EE23BTECH11034 - Prabhat Kukunuri

I. Question

Consider a polar non-return to zero (NRZ) waveform, using $+2V$ and $-2V$ for representing binary '1' and '0' respectively, is transmitted in the presence of additive zero-mean white Gaussian noise with variance 0.4 V^2. If the a *priori* probability of transmission of a binary '1' is 0.4, the optimum threshold voltage for a maximum a *posteriori*(MAP)receiver (rounded off to two decimal places) is ________V.

Solution:

Symbol	Value	Description
v_{th}	$\frac{a_1+a_2}{2}+\frac{\sigma_n^2}{a_1-a_2}ln\left(\frac{P(0)}{P(1)}\right)$	optimum threshold value
$P(0)$	0.6	Probability of error when 0 is transmitted
$P(1)$	0.4	Probability of error when 1 is transmitted
σ_n^2	$0.4V^2$	Variance of the noise
a_1	$E[X+N]$	voltage of transmission for binary 1
a_2	$E[X+N]$	voltage of transmission for binary 0

TABLE 0
VARIABLE DESCRIPTION

$$a_1 = E[X+N] \quad (1)$$
$$a_1 = E[X]+E[N] \quad (2)$$
$$\text{Given mean noise is zero}\,(E[N]=0) \quad (3)$$
$$a_1 = E[2] \quad (4)$$
$$a_1 = 2 \quad (5)$$

Similarly,

$$a_2 = E[X+N] \quad (6)$$
$$a_2 = E[-2]+E[N] \quad (7)$$
$$a_2 = -2 \quad (8)$$

Optimum threshold voltage is,

$$v_{th} = \frac{2-2}{2}+\frac{0.4}{2-(-2)}ln\left(\frac{0.6}{0.4}\right) \quad (9)$$
$$v_{th} = 0.04V \quad (10)$$

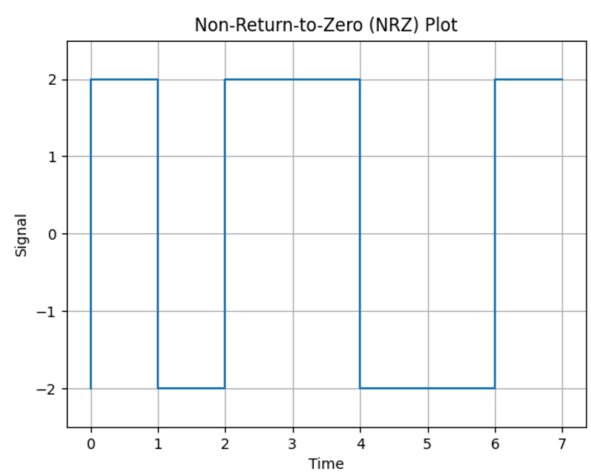

Fig. 0. Plot of x(n) *vs* n