Connexions module: m10155

PERFORMANCE ANALYSIS OF ORTHOGONAL BINARY SIGNALS WITH MATCHED FILTERS*

Behnaam Aazhang

This work is produced by The Connexions Project and licensed under the Creative Commons Attribution License †

Abstract

Bit-error analysis for an orthogonal binary signal set by using a matched filter receiver.

$$r_t \Rightarrow \left(Y = \left(\begin{array}{c} Y_1(T) \\ Y_2(T) \end{array}\right)\right)$$
 (1)

If $s_1(t)$ is transmitted

$$Y_{1}(T) = \int_{-\infty}^{\infty} s_{1}(\tau) h_{1}^{\text{opt}}(T - \tau) d\tau + \nu_{1}(T)$$

$$= \int_{-\infty}^{\infty} s_{1}(\tau) s_{1}^{*}(\tau) d\tau + \nu_{1}(T)$$

$$= E_{s} + \nu_{1}(T)$$
(2)

$$Y_{2}(T) = \int_{-\infty}^{\infty} s_{1}(\tau) s_{2}^{*}(\tau) d\tau + \nu_{2}(T)$$

= $\nu_{2}(T)$ (3)

If $s_{2}\left(t\right)$ is transmitted, $Y_{1}\left(T\right)=\nu_{1}\left(T\right)$ and $Y_{2}\left(T\right)=E_{s}+\nu_{2}\left(T\right)$.

^{*}Version 2.9: Sep 20, 2005 11:58 am -0500

 $^{^\}dagger$ http://creativecommons.org/licenses/by/1.0

Connexions module: m10155

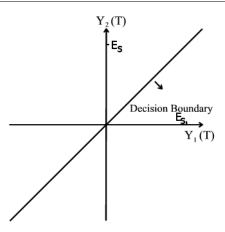


Figure 1

H0

$$Y = \begin{pmatrix} E_s \\ 0 \end{pmatrix} + \begin{pmatrix} \nu_1 \\ \nu_2 \end{pmatrix} \tag{4}$$

H1

$$Y = \begin{pmatrix} 0 \\ E_s \end{pmatrix} + \begin{pmatrix} \nu_1 \\ \nu_2 \end{pmatrix} \tag{5}$$

where ν_1 and ν_2 are independent are Gaussian with zero mean and variance $\frac{N_0}{2}E_s$. The analysis is identical to the correlator example¹.

$$P_e = Q\left(\sqrt{\frac{E_s}{N_0}}\right) \tag{6}$$

Note that the maximum likelihood detector decides based on comparing Y_1 and Y_2 . If $Y_1 \geq Y_2$ then s_1 was sent; otherwise s_2 was transmitted. For a similar analysis for binary antipodal signals, refer here². See Figure 2 or Figure 3.

 $^{{\}it 1} \hbox{"Performance Analysis of Binary Orthogonal Signals with Correlation"} < \hbox{http://cnx.org/content/m10154/latest/} > \\$

²"Performance Analysis of Binary Antipodal Signals with Matched Filters" http://cnx.org/content/m10153/latest/

Connexions module: m10155

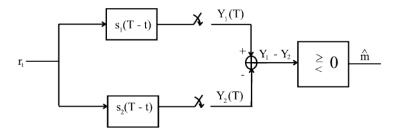


Figure 2

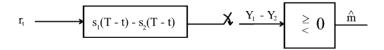


Figure 3