Performance Analysis of Orthogonal Binary Signals with Matched Filters[*]

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Abstract

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

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

If $s_1(t)$ is transmitted

$$\begin{aligned} Y_1(T) &= \int_{-\infty}^{\infty} s_1(\tau)\, h_1^{\mathrm{opt}}(T-\tau)\, d\tau + \nu_1(T) \\ &= \int_{-\infty}^{\infty} s_1(\tau)\, s_1^*(\tau)\, d\tau + \nu_1(T) \\ &= E_s + \nu_1(T) \end{aligned} \quad (2)$$

$$\begin{aligned} Y_2(T) &= \int_{-\infty}^{\infty} s_1(\tau)\, s_2^*(\tau)\, d\tau + \nu_2(T) \\ &= \nu_2(T) \end{aligned} \quad (3)$$

If $s_2(t)$ is transmitted, $Y_1(T) = \nu_1(T)$ and $Y_2(T) = E_s + \nu_2(T)$.

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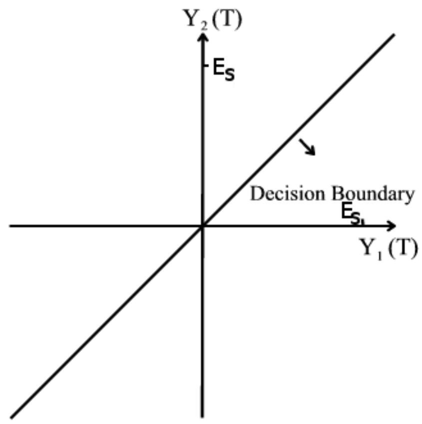

Figure 1

H0

$$Y = \begin{pmatrix} E_s \\ 0 \end{pmatrix} + \begin{pmatrix} \nu_1 \\ \nu_2 \end{pmatrix} \quad (4)$$

H1

$$Y = \begin{pmatrix} 0 \\ E_s \end{pmatrix} + \begin{pmatrix} \nu_1 \\ \nu_2 \end{pmatrix} \quad (5)$$

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 example[1].

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

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 here[2]. See Figure 2 or Figure 3.

[1]"Performance Analysis of Binary Orthogonal Signals with Correlation" <http://cnx.org/content/m10154/latest/>
[2]"Performance Analysis of Binary Antipodal Signals with Matched Filters" <http://cnx.org/content/m10153/latest/>

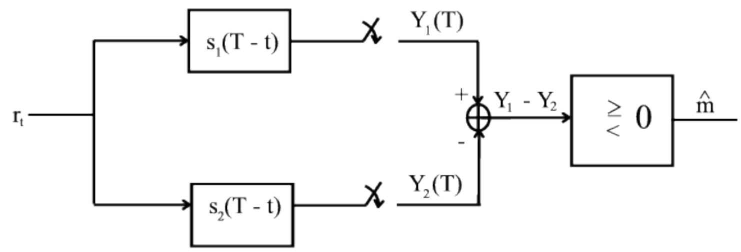

Figure 2

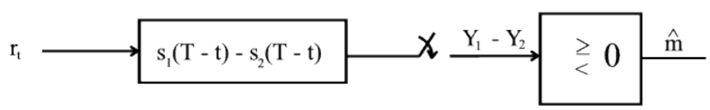

Figure 3