

HOMework 7 OF ELEC 430*

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Exercise 1

Consider an On-Off Keying system where $s_1(t) = A\cos(2\pi f_c t + \theta)$ for $0 \leq t \leq T$ and $s_2(t) = 0$ for $0 \leq t \leq T$. The channel is ideal AWGN with zero mean and spectral height $\frac{N_0}{2}$.

1. Assume θ is known at the receiver. What is the average probability of bit-error using an optimum receiver?
2. Assume that we estimate the receiver phase to be $\hat{\theta}$ and that $\hat{\theta} \neq \theta$. Analyze the performance of the matched filter with the wrong phase, that is, examine \bar{P}_e as a function of the phase error.
3. When does noncoherent become preferable? (You can find an expression for the \bar{P}_e of noncoherent receivers for OOK in your textbook.) That is, how big should the phase error be before you would switch to noncoherent?

Exercise 2

Proakis and Salehi, Problems 9.4 and 9.14

Exercise 3

A **coherent** phase-shift keyed system operating over an AWGN channel with two sided power spectral density $\frac{N_0}{2}$ uses $s_0(t) = Ap_T(t) \cos(\omega_c t + \theta_0)$ and $s_1(t) = Ap_T(t) \cos(\omega_c t + \theta_1)$ where $\forall i, i \in \{0, 1\} : (|\theta_i| \leq \frac{\pi}{3})$, are constants and that $f_c T = \text{integer}$ with $\omega_c = 2\pi f_c$.

1. Suppose θ_0 and θ_1 are **known** constants and that the optimum receiver uses filters matched to $s_0(t)$ and $s_1(t)$. What are the values of P_{e0} and P_{e1} ?
2. Suppose θ_0 and θ_1 are **unknown** constants and that the receiver filters are matched to $\hat{s}_0(t) = Ap_T(t) \cos(\omega_c t)$ and $\hat{s}_1(t) = Ap_T(t) \cos(\omega_c t + \pi)$ and the threshold is zero.

NOTE: Use a correlation receiver structure.

What are P_{e0} and P_{e1} now? What are the minimum values of P_{e0} and P_{e1} (as a function of θ_0 and θ_1)?

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