Homework 9

Reading

- Chapter 2 in the Anderson text

Problems

1. Sketch the optimum MAP receiver implementation using a bank of filters matched to the basis of signal space $\phi_1(t), \cdots, \phi_J(t)$.
2. Sketch the optimum ML receiver implementation using a bank of correlators that multiply by the signal space basis functions $\phi_1(t), \cdots, \phi_J(t)$.
3. Sketch the optimum MAP receiver implementation using a bank of correlators that multiply by the pulses $s_1(t), \cdots, s_M(t)$.
4. Sketch the optimum ML receiver implementation using a bank of filters matched to the pulses $s_1(t), \cdots, s_M(t)$.
5. Sketch the generalized transmitter that inputs bits on one end and synthesizes the signal pulse
$$s_m(t) = \sum_{j=1}^{J} s_{mj}\phi_j(t)$$
6. What is a decision region?
7. How do MAP and ML decision regions differ?
8. Let $\mathbf{s}_0$ and $\mathbf{s}_1$ be two symbols in a binary communication system occurring with probabilities $p(\mathbf{s}_0) = 1/3$ and $p(\mathbf{s}_1) = 2/3$. Which symbol will have a larger decision region if the ML decision rule is used? Which symbol will have a larger decision region if the MAP rule is used?
9. Under what condition does the MAP and ML rules lead to the same decision?
10. Was the signal space development worth it? The answer is: "Yes, definitely!" Why is working with the signal space representation of $s_i(t), r(t)$, and $\eta(t)$ easier than working with the waveforms themselves?
11. The ML decision rule can be explained as a minimum distance rule and as a maximum correlation rule. How is this possible?
12. Calculate the average symbol energy and average bit energy of the five constellations in Figure 2.26 (page 51 of the Anderson text).