EE 564

Homework 7

Due Monday April 7, 2014

Work all 3 problems.

Problem 1. In class we had

$$\begin{aligned} r_n &= \int_{T_0} r(t)\phi_n(t)dt \\ s_n(\theta) &= \int_{T_0} s(t;\theta)\phi_n(t)dt \end{aligned}$$

where $r(t)$ is the received waveform and $s(t;\theta)$ is the signal waveform. Show

$$\lim_{N\to\infty} \frac{1}{2\sigma^2} \sum_{n=1}^{N} [r_n - s_n(\theta)]^2 = \frac{1}{N_0} \int_{T_0} [r(t) - s(t;\theta)]^2 dt.$$

Problem 2. In class we derived for an amplitude modulated signal of the form

$$s(t) = A(t)\cos(2\pi f_c t + \phi)$$

and a carrier reference

$$c(t) = \cos(2\pi f_c t + \hat{\phi})$$

the power reduction seen after the demodulator is $\cos^2(\phi - \hat{\phi})$. Plot this power reduction (in dB) as a function of

$$\Delta\phi = |\phi - \hat{\phi}|.$$

Problem 3. Consider a received waveform of the form

$$r(t) = A\cos(2\pi f_c t + \phi) + n(t)$$

where ϕ is an unknown phase. Find both implicit and explicit expressions for $\hat{\phi}_{ML}$ and draw block diagrams illustrating the logic for each expression.