EE 530 – Homework 5

(due by Monday 5:00 p.m., March 22, 1999)

1. For the non-causal IIR least-squares problem,

$$\min_{h(n)\in l_2} \mathrm{E}(e^2(k)),$$

where $e(k) = x(k) - \sum_n h(n)y(k-n)$ is the error sequence, show that the solution (Wiener filter)

$$H(e^{j\theta}) = \begin{cases} \frac{S_{xy}(\theta)}{S_{yy}(\theta)}, & S_{yy}(\theta) > 0 \\ 0, & \text{otherwise,} \end{cases}$$

can be obtained directly from the orthogonality condition

$$\mathrm{E}(e(k)y(k+n)) = 0, \text{ for all integer } n.$$

2. Suppose $x(n)$ is a WSS sequence with (constant) mean μ and autocorrelation $r_{xx}(k)$. Let $y(n) = x(n) - \mu$ be the centered sequence. Show that $y(n)$ is a zero-mean WSS sequence and find an expression for its autocorrelation $r_{yy}(k)$ in terms of $r_{xx}(k)$.

3. Consider the least squares problem where the desired signal $x(n)$ is WSS with mean μ, but you have no data i.e., no signal $y(n)$ is observed. In this case, the the best estimate of $x(n)$ (in the sense of mean squared error) is some constant a (for all n). What is the value of a that minimizes the mean-squared error?

4. Problem 7.24 from text.

5. Problem 7.25 from text.

6. Problem 7.28 from text.