Signal Compression (ECE 242) **May 10, 2011**
Gibson

Homework No. 3

Due on May 17th

Problems from J. D. Gibson, *Principles of Digital and Analog Communications*, first edition, Macmillan, 1989.

1.

13.9–23. A block of speech data has autocorrelation terms as in Eq. (13.5–14) given by $R(0) = 1.0$, $R(1) = 0.866$, $R(2) = 0.554$, and $R(3) = 0.225$. Find the predictor coefficients $\{a_i,\ i = 1,\ 2,\ 3\}$.

2.

13.9–24. Given the set of predictor coefficients $a_1 = 1.295$, $a_2 = -0.535$, $a_3 = 0.171$, and $a_4 = -0.233$, assume that $R(0) = 1$.

(a) Find the PARCOR coefficients $\{p_i,\ i = 1,\ 2,\ 3,\ 4\}$;

(b) Calculate the mean squared prediction error for the first through fourth order systems;

(c) Is the fourth order system (synthesizer) stable?

3.

13.9–25. The following PARCOR coefficients are computed from a frame of speech data: $p_1 = -0.9454$, $p_2 = 0.92386$, $p_3 = -0.56198$, $p_4 = -0.09454$, $p_5 = 0.20218$, $p_6 = 0.53595$, $p_7 = -0.32922$, $p_8 = -0.05899$.

(a) Do these coefficients represent a stable system?

(b) What is the mean squared prediction error for this 8th order system?

(c) Find the corresponding predictor coefficients for a 4th order predictor.

4.

13.9–26. An LPC system has the predictor coefficients $a_1 = 1.793$, $a_2 = -1.401$, $a_3 = 0.566$, and $a_4 = -0.147$. Let the receiver gain $G = 2$, the pitch period length $P = 60$, and assume that the speech is voiced. For zero initial conditions at the beginning of the pitch period, synthesize the first 10 samples.

5. For the coefficients given in Problem 13.9-25, (a) Plot the spectrum of the linear prediction model with the corresponding linear prediction coefficients, and (b) plot the impulse response of this system for up to 50 samples, assuming zero initial conditions.