Assignment 9

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Outline

Problem Statement

(Papoulis chap-13- 13.14) One step predictor $\hat{s}_1$[n] of an AR process of order m in terms of its entire past equals

$$\hat{E}[s[n]|s[n-k], k \geq 1| = -\sum_{k=1}^{m} a_k s[n-k]$$

Show that its two step predictor $\hat{s}_2$[n]

$$\hat{E}[s[n]|s[n-k], k \geq 2| = -a_1 s_1[n-1] - \sum_{k=1}^{m} a_k s[n-k]$$

Solution

As we know, if

$$s[n] = a_1 s[n-1] + ... + a_m s[n-m] + \epsilon[n] \tag{1}$$

where

$$\epsilon[n]$$

is white noise, then the one-step predictor of s[n] equals

$$s_1[n] = a_1 s[n-1] + ... + a_m s[n-m] \tag{2}$$

is its two step-predictor. It suffices to show that

$$s[n] = \hat{s}_2[n] \perp s[n-k]$$

for k $\geq$ 2

$$s[n] - \hat{s}_2[n] = a_1 \left\{ s_1[n-1] - \hat{s}_1[n-1] \right\} + \epsilon[n] \tag{3}$$

So,

$$s_1[n-1] = \hat{s}_1[n-1] \perp s[n-k],$$

$$k \geq 2 \quad and \quad \epsilon[n] \perp s[n-k] \quad for \quad k \geq 1$$