Exercise 3:

P_1: Let $x(n)$ be an AR(2) process, i.e.,

$$x(n) + a_1^0(n-1) + a_2^0 x(n-2) = w(n).$$

- Derive the one-step forward linear predictor of order p and the corresponding mean-square prediction error in terms of the auto-correlation function $\gamma_x(m)$ for $p = 1, 2$, respectively.
- With $a_1^0 = -1,\ a_2^0 = 0.6$ and $\sigma_w^2 = 1$, compute $\gamma_x(m)$ for $m = 0, 1, 2, 3, 4, 5$. Then specify the predictors obtained above.

P_2: Look at the noise canceller depicted in Figure 1, where the measurable signal $d(n)$ has the desired signal $s(n)$ and an additive noise $v(n)$, which is uncorrelated with $s(n)$. The second measurable signal $x(n)$ is assumed uncorrelated with the zero-mean $s(n)$ but correlated with $v(n)$.

The Wiener filter is designed to to minimize $E[e^2(n)]$. Show that the Wiener filter can be obtained by minimizing $E[|\hat{v}(n) - v(n)|^2]$. Find out the optimum FIR Wiener filter of order N.

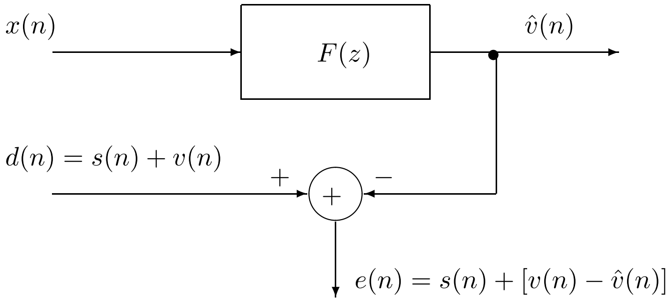

Figure 1: Block diagram of a noise canceller.

P_3: If the noise canceller depicted in Figure 1 above is an adaptive FIR filter. Derive the corresponding LMS algorithm and analyze its convergence behavior.