EE6401 Advanced Digital Signal Processing
Assignment for Part II

Note:

1). Write your name and matriculation number clearly on the first page.

2). There are three questions in this assignment. Answer ALL the questions. Type (preferred) or write (do NOT use pencils) clearly your answers to all questions, showing all the detailed steps.

3). Please submit your completed assignment (hard copy only) to me during the evening lecture on Tuesday of week 13 (12 Nov. 2019). In case you are unable to come for the lecture on this evening, you need to submit the assignment to my office (S2-B2a-14) by 12 Nov. 2019. PENALTY will be enforced for PLAGIARISM in your assignment report and/or LATE submission.

Q. 1. Consider the autocorrelation matrix of $x[n]$, $\mathbf{\Gamma}_M = \begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}$ and the cross-correlation vector between $x[n]$ and $d[n]$, $\gamma_d = \begin{bmatrix} 0.25 \\ -0.25 \end{bmatrix}$.

1. Find $\boldsymbol{h}_{opt} = \begin{bmatrix} h_{opt}[0] \\ h_{opt}[1] \end{bmatrix}$ directly.

2. Let $\mu = 0.1$ and $\boldsymbol{h}_M(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ use the LMS algorithm to find $\boldsymbol{h}_{opt}$.

3. Let $\mu = 0.35$ and $\boldsymbol{h}_M(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ use the LMS algorithm to find $\boldsymbol{h}_{opt}$.

For each case plot the evolution graphs of the filter parameters , i.e., $h_M[0](n)$ versus n and $h_M[1](n)$ versus n.

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Q. 2. Consider the primary signal $d[n] = cos(2\pi\omega_0 n) + y_0[n]$ where the noise $y_0[n]$ is the output of the $F_0(z) = 0.5 - 0.5z^{-1}$ when excited with a white noise sequence $w[n]$.
Consider an input signal $x[n] = w[n]$.

1. Let $\mu = 0.00125$ and $\boldsymbol{h}_M(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ use the LMS algorithm to find $\boldsymbol{h}_{opt}$.

2. Plot the primary signal $d[n]$.

3. Plot $e[n] = d[n] - y[n]$ and the desired sine wave signal.

4. Plot the evolution of the two filter parameters.

Q. 3.

1. Let $\Gamma_{ss}(z) = \frac{1}{(1-0.6z^{-1})(1-0.6z)}$, $\Gamma_{ww}(z) = 1$, and $\Gamma_{xx}(z) = \Gamma_{ss}(z) + \Gamma_{ww}(z)$. Factorize $\Gamma_{xx}(z)$ as $\Gamma_{xx}(z) = G(z)G(z^{-1})$, where $G(z)$ is the minimum phase causal and stable filter.

2. Plot the power spectrum density function $\Gamma_{xx}(f)$.

3. Consider an aut-oregessive AR(2) random process $v[n]$, having auto-correlation function $r_v[m]$, with $r_v[0] = 0.5196$, $r_v[1] = 0.4171$ and $r_v[2] = 0.1654$. Plot the power spectrum density function $\Gamma_{vv}(f)$ using the Yule-Walker method.

4. Compare the plots of $\Gamma_{xx}(f)$ and $\Gamma_{vv}(f)$ and briefly comment on them.

End of assignment