Digital Signal Processing - Assignment 8

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Exercise 1

1.1

We can use the error function:

$$e(n) = s(n) - \hat{s}(n) = s(n) - h(n) * x(n)$$

converted to the frequency domain to find $J(\omega)$. Using the properties of additivity, and that convolution in the time domain is multiplication in the frequency domain, this is:

$$J(\omega) = S(\omega) - H(\omega)X(\omega)$$

1.2

$$\begin{aligned} E[J(\omega)^2] &= E[(S(\omega) - H(\omega)X(\omega))^2] \\ &= (S(\omega))^2 - 2S(\omega)H(\omega)X(\omega) + (H(\omega)X(\omega))^2 \end{aligned}$$

TODO: take the derivative $\frac{\partial J}{\partial H(\omega)}$, set to zero, somehow algebra it into the given equation

1.3

$$H(\omega) = \frac{\Phi_{sx}(\omega_k)}{\Phi_{ss}(\omega_k)\Phi_{nn}(\omega_k)}$$

TODO: figure out how to handle the numerator

1.4

should just be multiply by $X(\omega)$ and take the inverse fourier transform? double-check this

1.5

TODO, answer 1.3 is probably helpful

1.6

TODO