Problem Set 7

EECS123: Digital Signal Processing

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1. Problem 4.29 from Oppenheim, Schafer, and Buck.

2. Problem 4.37 from Oppenheim, Schafer, and Buck.

   Note: The sampling rate in Figure P4.37-2 should be $T = \frac{1}{6} \times 10^{-3}$.

3. Problem 4.44 from Oppenheim, Schafer, and Buck.

   Note: The input in Figure P4.44-1 should be $r_c(t)$ instead of $x[n]$.

4. Problem 4.50 from Oppenheim, Schafer, and Buck.

5. This problem deals with the identification of complex exponentials with by using minimum number of samples. You should use the annihilation-filter method.

   (a) It is known that $y_1[n] = a_0 e^{j\omega_0 n} + a_1 e^{j\omega_1 n}$. Using this prior information, find the unknown $a_0, a_1, \omega_0, \omega_1$ using the samples $\{y_1[n]\}_0^3$ stored in `y1.mat`.

   (b) Consider another signal $y_2[n]$. It is known that $y_2[n] = \sum_{k=0}^{N-1} a_k e^{j\omega_k n}$, where the only information available about N is that $N \leq 5$. Using this information, find the unknown $\{a_k, \omega_k\}_0^4$ using the samples $\{y_2[n]\}_0^9$ stored in `y2.mat`.

   Note: The files `y1.mat` and `y2.mat` can be found on the course webpage. You can load the variables $\{y_1[n]\}_0^3$ and $\{y_2[n]\}_0^9$ using the command `load y1.mat` and `load y2.mat`, respectively.

   Note: For factorizing at $N = 2$, you can use quadratic formula. For larger values of N, plot $|H_d(e^{j\omega})|$ to obtain the roots of $H_d(e^{j\omega}) = 0$.