Fall 2018 EE 313 Linear Systems and Signals Prof. Evans

Homework #4

Finite Impulse Response (FIR) Filters

Assigned on Friday, October 5, 2018
Due on Friday, October 12, 2017, by 5:00 pm via Canvas submission

Late homework is subject to a late penalty of two points per minute late.

Reading: McClellan, Schafer and Yoder, *Signal Processing First*, 2003, Chapter 5 (all).
Companion Web site with demos and other supplemental information: http://dspfirst.gatech.edu/
Web site contains solutions to selected homework problems from *DSP First*.

The e-mail address for Mr. Houshang Salimian (TA) is salimian.houshang@gmail.com.
Office hours for Mr. Salimian and Prof. Evans follow:

Time Slot	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*
11:00 am		**Salimian (EER 0.814 Table #4)**		**Salimian (EER 0.814A)**	**Salimian (EER 0.814D)**
11:30 am		**Salimian (EER 0.814 Table #4)**		**Salimian (EER 0.814A)**	**Salimian (EER 0.814D)**
12:00 pm		**Salimian (EER 0.814 Table #4)**		**Salimian (EER 0.814A)**	**Salimian (EER 0.814D)**
12:30 pm		Evans (EER 1.516)		Evans (EER 1.516)	**Salimian (EER 0.814D)**
1:00 pm		Evans (EER 1.516)		Evans (EER 1.516)	
1:30 pm		Evans (EER 1.516)		Evans (EER 1.516)	
2:00 pm		Evans (EER 6.882)		Evans (EER 6.882)	
2:30 pm		Evans (EER 6.882)		Evans (EER 6.882)	
3:00 pm		Evans (EER 6.882)	**Salimian (EER 1.810)**	Evans (EER 6.882)	
3:30 pm			**Salimian (EER 1.810)**		
4:00 pm			**Salimian (EER 1.810)**		
4:30 pm					

Prof. Evans holds coffee/advising hours on Fridays 12:00-2:00pm in the EERC café.

EE 313 tutoring is available on Sundays through Thursdays from 7:00pm to 10:00pm in EER 0.814:
http://www.ece.utexas.edu/undergraduate/tutoring

1. Mathematical Review. 18 points

The mathematical operations in parts (a) and (b) below were important on midterm #1 and will continue to be important. The mathematical operations in part (c) will be needed for discrete-time linear systems.

(a) Binomial expansions.

i. Expand $(a + b)^3$.

ii. Use the binomial expansion in part i. to compute $\cos^3(2\pi f_0 t)$ after rewriting $\cos(2\pi f_0 t)$ using the inverse Euler form of $\frac{e^{j2\pi f_0 t} + e^{-j2\pi f_0 t}}{2}$. Plot the spectrum.

(b) Integration.

i. Compute the integral $a_0 = \frac{1}{2}\int_{-1}^{0} e^t dt + \frac{1}{2}\int_{0}^{1} e^{-t} dt$

ii. Compute the integral $a_0 = \frac{1}{T_0}\int_{0}^{T_0} \cos(2\pi f_0 t)\, dt$ where $f_0 = \frac{1}{T_0}$

(c) Summations.

i. Compute $\sum_{n=0}^{\infty} a^n$. Give the condition on the complex-valued scalar a for the summation to converge.

ii. Compute $\sum_{n=0}^{N-1} a^n$ for a positive, finite integer N.

2. Finite Impulse Response (FIR) Filter. 27 points.

Signal Processing First, problem P-5.3, page 126.

3. System Properties. 28 points.

Signal Processing First, problem P-5.6, page 127.

4. Deconvolution. 27 points.

Signal Processing First, problem P-5.15, page 129.

As stated on the course descriptor, "Discussion of homework questions is encouraged. Please be sure to submit your own independent homework solution."

NOTE: In your solutions, please put all work for problem 1 together, then all work for problem 2 together, etc. Please see additional homework guidelines on the homework page.