Special Topics
Assignment # 1 - Solution

It is decided to estimate the 60 Hz voltage phasors by using sampled and digitized values of voltage observed at a transmission line terminal and Rockefeller and Udren algorithm. The sampling rate used is 480 Hz.

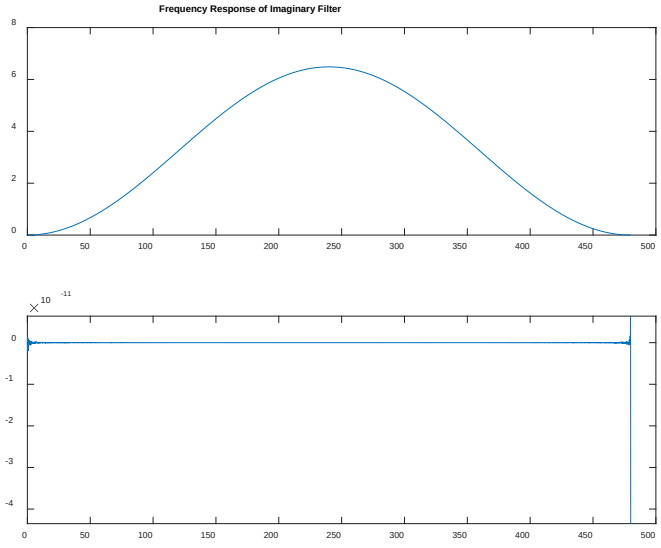
(a) Determine the filters for obtaining the real and imaginary components of the voltage phasors.

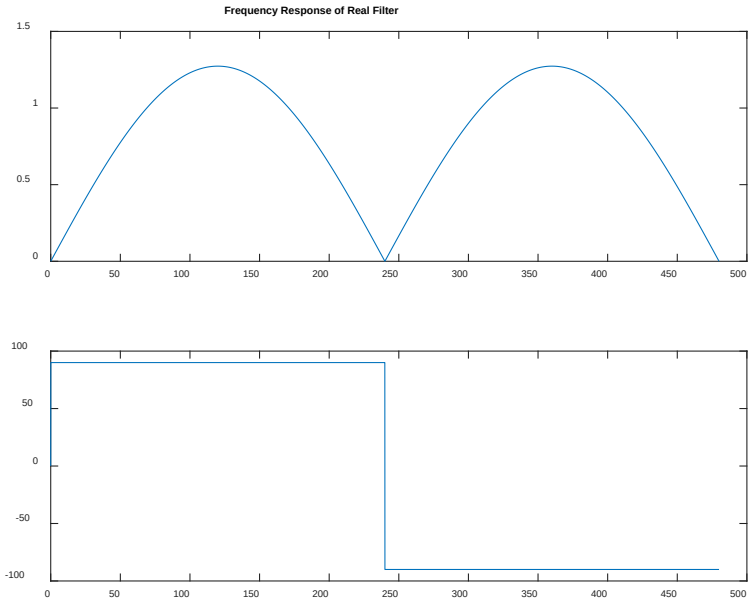
Using the formulas for Rockefeller Udren algorithm as discussed in class and using a sampling frequency of 480Hz, the following coefficients for filters are obtained:

Real Part Filter	0.6366	0	-0.6366
Imag Part Filter	-1.6211	3.2423	-1.6211

(b) Plot the frequency response of the filters and discuss them in terms of their effectiveness for eliminating non-60Hz components.

See the plots below:





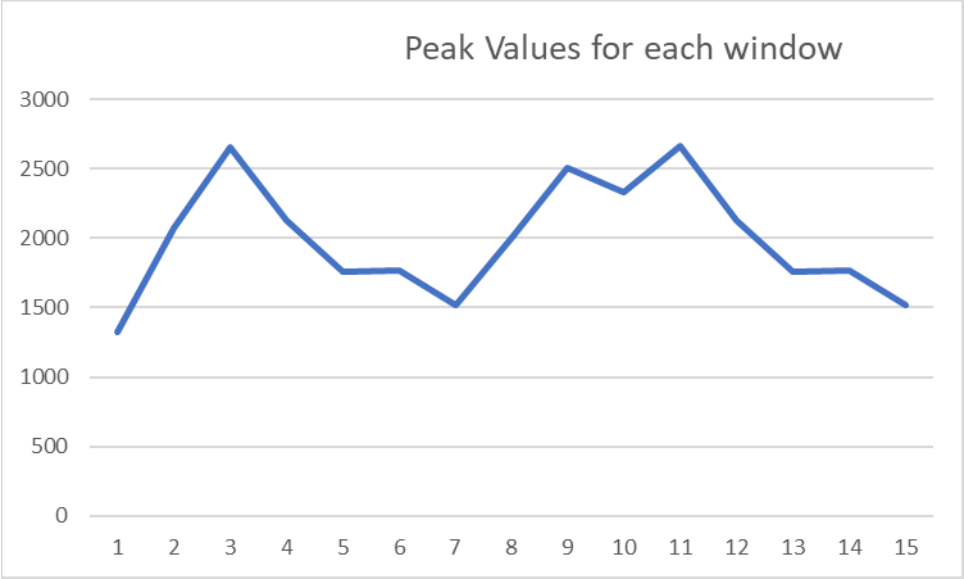
As discussed in class, the magnitude for real part and imaginary part filters at 60Hz is 0.9003 and 0.9496. Therefore, to get correct values for real part and imaginary parts, we have to divide the filter outputs by 0.9003 and 0.9496 respectively.

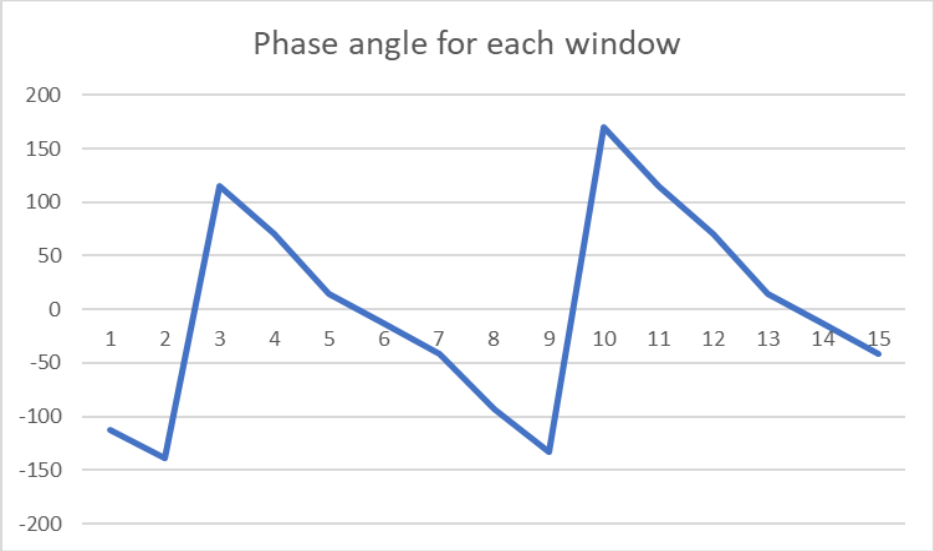
(c) Implement the filters designed in part (a) to estimate the successive peak values and phase angles of a voltage signal whose digitized samples taken at 480 Hz are given below. Plot the estimates.

Sample #	Digitized Voltage
1	714
2	2218
3	2314
4	1233
5	-99
6	-1195
7	-1699
8	-1029
9	714
10	2219
11	2314
12	1233
13	-99
14	-1195
15	-1699

Estimation of peak values and phase angles for successive data windows is given in the Table below:

Window				***Imag Part***	***Corrected Imag Part***	***Real Part***	***Corrected Real Part***	***Peak Value***	Phase
1	***0***	***0***	***714***	***-1157***	***-1220***	***454***	***504***	***1320***	-67.52183
2	***0***	***714***	***2218***	***-1280***	***-1349***	***1411***	***1568***	***2069***	-40.72089
3	***714***	***2218***	***2314***	***2282***	***2406***	***1018***	***1131***	***2659***	64.819722
4	***2218***	***2314***	***1233***	***1908***	***2011***	***-627***	***-696***	***2128***	109.09693
5	***2314***	***1233***	***-99***	***407***	***429***	***-1536***	***-1706***	***1759***	165.88384
6	***1233***	***-99***	***-1195***	***-382***	***-403***	***-1545***	***-1716***	***1763***	-166.7793
7	***-99***	***-1195***	***-1699***	***-959***	***-1011***	***-1018***	***-1131***	***1517***	-138.1921
8	***-1195***	***-1699***	***-1029***	***-1903***	***-2006***	***105***	***117***	***2009***	-86.65182
9	***-1699***	***-1029***	***714***	***-1739***	***-1833***	***1536***	***1706***	***2504***	-47.0638
10	***-1029***	***714***	***2219***	***385***	***406***	***2067***	***2296***	***2332***	10.044513
11	***714***	***2219***	***2314***	***2285***	***2409***	***1018***	***1131***	***2662***	64.85102
12	***2219***	***2314***	***1233***	***1906***	***2009***	***-627***	***-697***	***2127***	109.12999
13	***2314***	***1233***	***-99***	***407***	***429***	***-1536***	***-1706***	***1759***	165.88384
14	***1233***	***-99***	***-1195***	***-382***	***-403***	***-1545***	***-1716***	***1763***	-166.7793
15	***-99***	***-1195***	***-1699***	***-959***	***-1011***	***-1018***	***-1131***	***1517***	-138.1921


Peak Values for each window
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15


Phase angle for each window
200
150
100
50
0
-50
-100
-150
-200
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15