Assignment # 2 - Solution

It is decided to estimate the 120 Hz voltage phasors by using sampled and digitized values of voltage and half cycle DFT algorithm. The sampling rate used is 960 Hz.

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

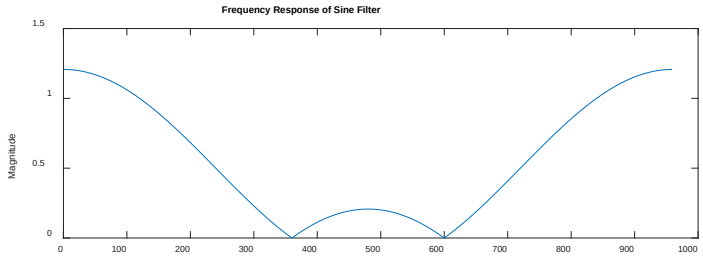
Filter Coefficients:

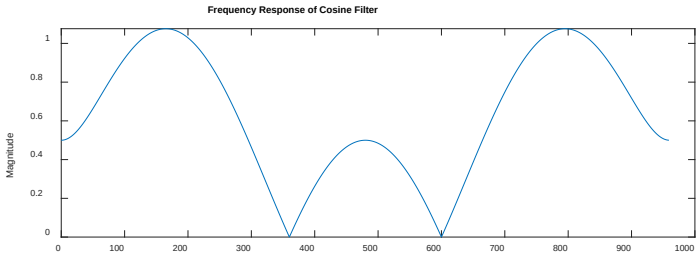
Version 1:
Sine filter: 0 0.7071 1.0000 0.7071
Cosine filter: 1.0000 0.7071 0.0000 -0.7071

Version 2:
Sine filter: 0.3827 0.9239 0.9239 0.3827
Cosine filter: 0.9239 0.3827 -0.3827 -0.9239

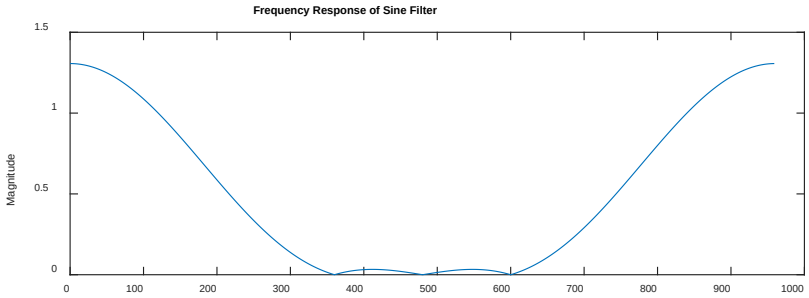
(b) Plot the frequency response of the filters and discuss them in terms of their effectiveness for eliminating non-120Hz components.

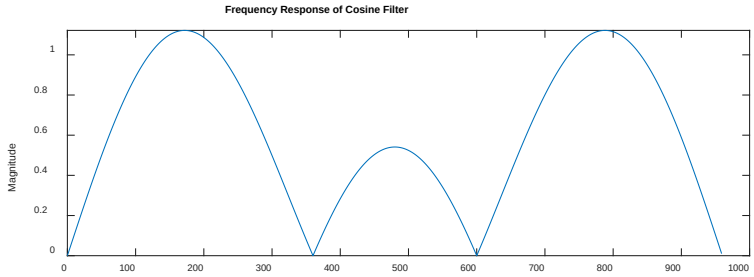
Version 1 filters:





Version 2 filters:



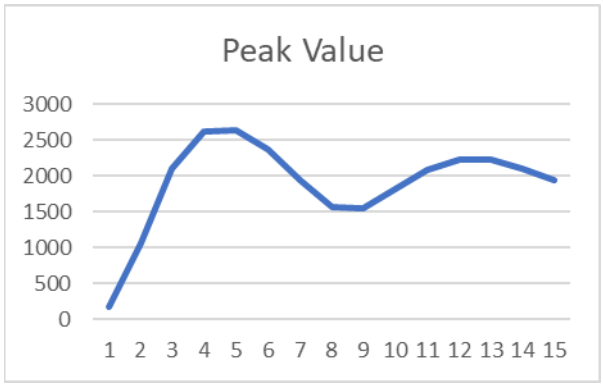


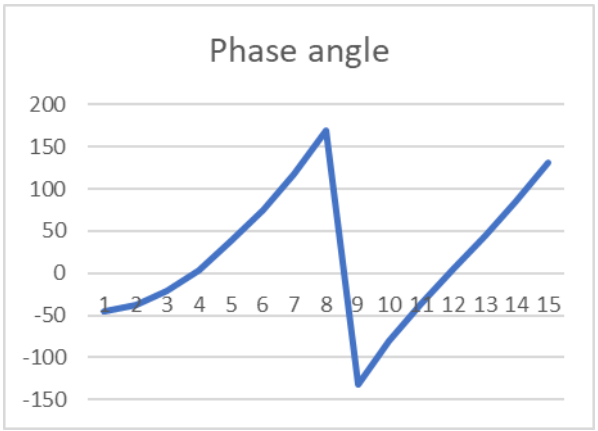
(c) Implement the filters designed in part (a) to estimate the successive peak values and phase angles of a voltage signal whose digitized samples taken at 960 Hz are given below. Plot the estimates.

Sample #	Digitized Voltage
1	348
2	1870
3	2526
4	1956
5	508
6	-971
7	-1628
8	-1102
9	267
10	1641
11	2184
12	1554
13	106
14	-1311
15	-1854

Phasor estimates – Version 1 filters

Window #					Real_Part	Imag_Part	Magnitude	Phase
1	0	0	0	348	123.0354	-123.035	173.9983	-44.99989
2	0	0	348	1870	835.1385	-661.139	1065.157	-38.36686
3	0	348	1870	2526	1951.1027	-770.032	2097.558	-21.53736
4	348	1870	2526	1956	2615.6823	143.5947	2619.621	3.1422397
5	1870	2526	1956	508	2050.6707	1648.464	2631.099	38.794518
6	2526	1956	508	-971	602.24675	2297.841	2375.452	75.313367
7	1956	508	-971	-1628	-881.476	1733.183	1944.459	116.95707
8	508	-971	-1628	-1102	-1546.9092	300.3151	1575.791	169.01294
9	-971	-1628	-1102	267	-1032.1816	-1155.48	1549.363	-131.7739
10	-1628	-1102	267	1641	324.06345	-1783.79	1812.985	-79.7031
11	-1102	267	1641	2184	1687.05105	-1228.76	2087.099	-36.06745
12	267	1641	2184	1554	2221.59225	164.2589	2227.656	4.2285992
13	1641	2184	1554	106	1586.6295	1555.177	2221.704	44.426328
14	2184	1554	106	-1311	138.91265	2104.921	2109.499	86.224082
15	1554	106	-1311	-1854	-1273.5054	1469.958	1944.889	130.90388





Phasor estimates – Version 2 filters

Window #					Real_Part	Imag_Part	Magnitude	Phase
1	0	0	0	348	66.5898	-160.759	174.0044	-67.49941
2	0	0	348	1870	373.90036	-930.436	1002.753	-68.10687
3	0	348	1870	2526	730.49335	-1458.12	1630.87	-63.38977
4	348	1870	2526	1956	1421.40547	-868.341	1665.656	-31.42082
5	1870	2526	1956	508	1712.27342	738.2454	1864.641	23.323199
6	2526	1956	508	-971	1224.59051	1892.514	2254.159	57.09414
7	1956	508	-971	-1628	252.578055	1938.635	1955.02	82.576752
8	508	-971	-1628	-1102	-637.42081	869.4565	1078.082	126.2458
9	-971	-1628	-1102	267	-937.67189	-672.544	1153.926	-144.3497
10	-1628	-1102	267	1641	-494.24729	-1772.07	1839.707	-105.584
11	-1102	267	1641	2184	406.187345	-1780.88	1826.617	-77.15147
12	267	1641	2184	1554	1207.39818	-698.433	1394.854	-30.04763
13	1641	2184	1554	106	1414.97428	829.6438	1640.262	30.384361
14	2184	1554	106	-1311	889.81552	1891.59	2090.427	64.807268
15	1554	106	-1311	-1854	-68.999945	1845.469	1846.758	92.14101