HW 2: Digital Signal Processing

4)

sigA:

A picture containing histogram

Description automatically generated

sigB:

A picture containing chart

Description automatically generated

sigC:

A picture containing graphical user interface

Description automatically generated

sigD:

Chart

Description automatically generated with medium confidence

Code (same for all cases other than “sigA” being replaced with “sigB,” “sigC,” “sigD”):

# FFT for sigA

t = [] # column 0

data1 = [] # column 1

data2 = [] # column 2

with open('sigA.csv') as f:

# open the csv file

reader = csv.reader(f)

for row in reader:

# read the rows 1 one by one

t.append(float(row[0])) # leftmost column

data1.append(float(row[1])) # second column

plt.plot(t, data1)

samplerate = len(data1)/t[-1]

print(samplerate)

print(len(data1))

# FFT for sigA

Fs = samplerate # sample rate

Ts = 1.0/Fs; # sampling interval

ts = np.arange(0,t[-1],Ts) # time vector

y = data1 # the data to make the fft from

n = len(y) # length of the signal

k = np.arange(n)

T = n/Fs

frq = k/T # two sides frequency range

frq = frq[range(int(n/2))] # one side frequency range

Y = np.fft.fft(y)/n # fft computing and normalization

Y = Y[range(int(n/2))]

fig, (ax1, ax2) = plt.subplots(2, 1)

ax1.plot(t,y,'b')

ax1.set\_xlabel('Time')

ax1.set\_ylabel('Amplitude')

ax2.loglog(frq,abs(Y),'b') # plotting the fft

ax2.set\_xlabel('Freq (Hz)')

ax2.set\_ylabel('|Y(freq)|')

plt.show()

5)

A picture containing histogram

Description automatically generated

A picture containing chart

Description automatically generated

A picture containing text

Description automatically generated

Chart

Description automatically generated

Code (same for all cases other than “sigA” being replaced with “sigB,” “sigC,” “sigD”):

# Low pass filter sigA

t = [] # column 0

data1 = [] # column 1

with open('sigA.csv') as f:

# open the csv file

reader = csv.reader(f)

for row in reader:

# read the rows 1 one by one

t.append(float(row[0])) # leftmost column

data1.append(float(row[1])) # second column

data = data1.copy()

x = 2000

newdata = []

for i in range(x):

data.insert(i, 0)

for j in range(len(data)-x):

sum = 0

for i in range(x):

sum = sum + data[j + i]

avg = sum/x

newdata.append(avg)

samplerate = len(data)/t[-1]

newsamplerate = len(newdata)/t[-1]

# FFT for sigA

Fs = samplerate # sample rate

Ts = 1.0/Fs; # sampling interval

ts = np.arange(0,t[-1],Ts) # time vector

y = data1 # the data to make the fft from

n = len(y) # length of the signal

k = np.arange(n)

T = n/Fs

frq = k/T # two sides frequency range

frq = frq[range(int(n/2))] # one side frequency range

Y = np.fft.fft(y)/n # fft computing and normalization

Y = Y[range(int(n/2))]

fig, (ax1, ax2) = plt.subplots(2, 1)

fig.suptitle('FFT plot of sigA with ' + str(x) + ' points averaged')

ax1.plot(t,y,'black')

ax1.set\_xlabel('Time')

ax1.set\_ylabel('Amplitude')

ax2.loglog(frq,abs(Y),'black') # plotting the fft

ax2.set\_xlabel('Freq (Hz)')

ax2.set\_ylabel('|Y(freq)|')

# plotting the new sample FFT

samplerate = len(newdata)/t[-1]

# FFT for sigA

Fs = samplerate # sample rate

Ts = 1.0/Fs; # sampling interval

ts = np.arange(0,t[-1],Ts) # time vector

y = newdata # the data to make the fft from

n = len(y) # length of the signal

k = np.arange(n)

T = n/Fs

frq = k/T # two sides frequency range

frq = frq[range(int(n/2))] # one side frequency range

Y = np.fft.fft(y)/n # fft computing and normalization

Y = Y[range(int(n/2))]

ax1.plot(t,y,'r')

ax1.set\_xlabel('Time')

ax1.set\_ylabel('Amplitude')

ax2.loglog(frq,abs(Y),'r') # plotting the fft

ax2.set\_xlabel('Freq (Hz)')

ax2.set\_ylabel('|Y(freq)|')

plt.show()

6)

Chart

Description automatically generated

A picture containing chart

Description automatically generated

Text

Description automatically generated with low confidenceChart, line chart

Description automatically generated

Code (same for all cases other than “sigA” being replaced with “sigB,” “sigC,” “sigD”):

# Low pass filtering with an IIR for sigA

t = [] # column 0

data1 = [] # column 1

with open('sigA.csv') as f:

# open the csv file

reader = csv.reader(f)

for row in reader:

# read the rows 1 one by one

t.append(float(row[0])) # leftmost column

data1.append(float(row[1])) # second column

data = data1.copy()

A = 0.997

B = 1-A

newdata = []

newdata.append(data[0])

for i in range(1, len(data)):

newdata.append(A\*newdata[i-1] + B\*data[i])

samplerate = len(data)/t[-1]

newsamplerate = len(newdata)/t[-1]

# FFT for sigA

Fs = samplerate # sample rate

Ts = 1.0/Fs; # sampling interval

ts = np.arange(0,t[-1],Ts) # time vector

y = data1 # the data to make the fft from

n = len(y) # length of the signal

k = np.arange(n)

T = n/Fs

frq = k/T # two sides frequency range

frq = frq[range(int(n/2))] # one side frequency range

Y = np.fft.fft(y)/n # fft computing and normalization

Y = Y[range(int(n/2))]

fig, (ax1, ax2) = plt.subplots(2, 1)

fig.suptitle('FFT plot of sigA with A = ' + str(A) + ' and B = '+ str(B)+ '')

ax1.plot(t,y,'black')

ax1.set\_xlabel('Time')

ax1.set\_ylabel('Amplitude')

ax2.loglog(frq,abs(Y),'black') # plotting the fft

ax2.set\_xlabel('Freq (Hz)')

ax2.set\_ylabel('|Y(freq)|')

# plotting the new sample FFT

samplerate = len(newdata)/t[-1]

# plotting the new sample FFT

samplerate = len(newdata)/t[-1]

# FFT for sigA

Fs = samplerate # sample rate

Ts = 1.0/Fs; # sampling interval

ts = np.arange(0,t[-1],Ts) # time vector

y = newdata # the data to make the fft from

n = len(y) # length of the signal

k = np.arange(n)

T = n/Fs

frq = k/T # two sides frequency range

frq = frq[range(int(n/2))] # one side frequency range

Y = np.fft.fft(y)/n # fft computing and normalization

Y = Y[range(int(n/2))]

ax1.plot(t,y,'r')

ax1.set\_xlabel('Time')

ax1.set\_ylabel('Amplitude')

ax2.loglog(frq,abs(Y),'r') # plotting the fft

ax2.set\_xlabel('Freq (Hz)')

ax2.set\_ylabel('|Y(freq)|')

plt.show()

7)

A picture containing text

Description automatically generated

A picture containing text

Description automatically generated

Text

Description automatically generated

Chart, line chart

Description automatically generated

Code (same for all cases other than “sigA” being replaced with “sigB,” “sigC,” “sigD”):

NOTE: FOR CLARITY, WEIGHTS HAVE BEEN REMOVED AND REPLACED WITH “**……”** ACTUAL WEIGHTS ARE LISTED BELOW FOR EACH DATA SAMPLE

# Low pass filter sigA

# sampling rate 10,000

t = [] # column 0

data1 = [] # column 1

with open('sigA.csv') as f:

# open the csv file

reader = csv.reader(f)

for row in reader:

# read the rows 1 one by one

t.append(float(row[0])) # leftmost column

data1.append(float(row[1])) # second column

weights = …..

data = data1.copy()

x = len(weights)

newdata = []

for i in range(x):

data.insert(i, 0)

for j in range(len(data)-x):

sum = 0

for i in range(x):

sum = sum + weights[i]\*data[j + x - i]

newdata.append(sum)

samplerate = len(data)/t[-1]

newsamplerate = len(newdata)/t[-1]

# plt.plot(t,data1)

# plt.plot(t,newdata)

# FFT for sigD

Fs = samplerate # sample rate

Ts = 1.0/Fs; # sampling interval

ts = np.arange(0,t[-1],Ts) # time vector

y = data1 # the data to make the fft from

n = len(y) # length of the signal

k = np.arange(n)

T = n/Fs

frq = k/T # two sides frequency range

frq = frq[range(int(n/2))] # one side frequency range

Y = np.fft.fft(y)/n # fft computing and normalization

Y = Y[range(int(n/2))]

fig, (ax1, ax2) = plt.subplots(2, 1)

fig.suptitle('Low Pass FIR plot of sigA with 461 weights, 100Hz cutoff frequency, 100Hz bandwidth, Blackman Window')

ax1.plot(t,y,'black')

ax1.set\_xlabel('Time')

ax1.set\_ylabel('Amplitude')

ax2.loglog(frq,abs(Y),'black') # plotting the fft

ax2.set\_xlabel('Freq (Hz)')

ax2.set\_ylabel('|Y(freq)|')

# plotting the new sample FFT

samplerate = len(newdata)/t[-1]

# FFT for sigD

Fs = samplerate # sample rate

Ts = 1.0/Fs; # sampling interval

ts = np.arange(0,t[-1],Ts) # time vector

y = newdata # the data to make the fft from

n = len(y) # length of the signal

k = np.arange(n)

T = n/Fs

frq = k/T # two sides frequency range

frq = frq[range(int(n/2))] # one side frequency range

Y = np.fft.fft(y)/n # fft computing and normalization

Y = Y[range(int(n/2))]

ax1.plot(t,y,'r')

ax1.set\_xlabel('Time')

ax1.set\_ylabel('Amplitude')

ax2.loglog(frq,abs(Y),'r') # plotting the fft

ax2.set\_xlabel('Freq (Hz)')

ax2.set\_ylabel('|Y(freq)|')

plt.show()

Weights for sigA:

weights = [

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0.000000022609304456,

0.000000092137658127,

0.000000210376981500,

0.000000378074907886,

0.000000594900325696,

0.000000859416815111,

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