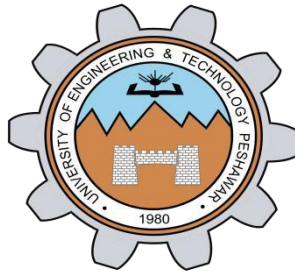


Lab Report No 3



Fall 2021

Digital Signal Processing lab

Submitted By:

Name: Muhammad Ali

Registration No: 19PWCSE1801

Section: A

Date: 17,12,2021

Department of Computer Systems Engineering

University of Engineering and Technology Peshawar

Spectral Analysis Workflow: -

Workflow of this course is to import the signal and then preprocess for furthering operation.

Task 1

Task 2

Task 3

Task 4

Notice that the first row of harp now starts at 2000 seconds

TASK

Plot the preprocessed HARP signal

Hint See Solution Reset

Submit Next task

Test Results: **Correct!**

✓ Is the x-axis data correct?

✓ Is the y-axis data correct?

Further Practice

HOME LIVE EDITOR VIEW

Text

Code

Control

Task

Reflector

Section Break

Run Section

Run and Advance

Run to End

Run

Step

Stop

preprocessing.mlx

Preprocess signals

Instructions are in the task pane to the left. Complete and submit each task one at a time.

This code sets up the activity

```
1 Ts = readmatrix("seismicstation_ts.csv")
2 harp = readtimetable("harp.csv","SampleRate",1/Ts(1))
3 plot(harp.Time, harp.Signal)
```

Task 1

```
4 tstart = seconds(2000)
5 tend = seconds(4000)
```

Task 2

```
8 timeLimits=timerange(tstart,tend)
```

Task 3

```
10 harp=harp(timeLimits,:)
```

Task

```
12 plot(harp.Time, harp.Signal)
```

harp = 100000x1 timetable

	Time	Signal
1	2000 sec	-252810
2	2000.02 sec	-254636
3	2000.04 sec	-256436
4	2000.06 sec	-258199
5	2000.08 sec	-259970
6	2000.1 sec	-261711
7	2000.12 sec	-263434
8	2000.14 sec	-265144
9	2000.16 sec	-266854

Preprocessing Signals: -

Task 1

Task 2

Task 3

Task 4

Further Practice

Now you can easily compare the power spectrum for the seismic signal from each station. All three signals have very similar low frequencies, but only the signal from the Mount Wrangell station contains significant high-frequency content.

This is a strong indication that the low-frequency content in the Mount Wrangell signal will match the PAX and HARP signals. In the next chapter, you'll filter the Mount Wrangell signal to keep only the low-frequency content.

Before filtering, you'll create a time-frequency plot of the Mount Wrangell signal to investigate the spectrum further.

Next section >

HOME LIVE EDITOR VIEW

TEXT CODE SECTION RUN

Customize power spectrum plot

Instructions are in the task pane to the left. Complete and submit each task one at a time.

This code sets up the activity.

```
1 load quakes
2 pspectrum(quakes,"FrequencyLimits",[0 1])
```

Task 1

```
3 [p,f] = pspectrum(quakes)
```

Task 2

```
5 semilogx(f,p)
```

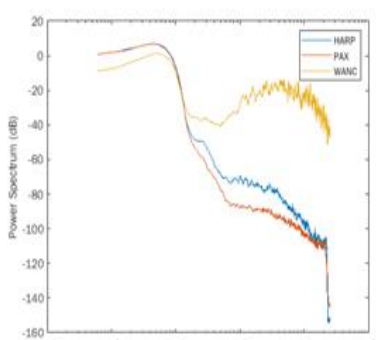
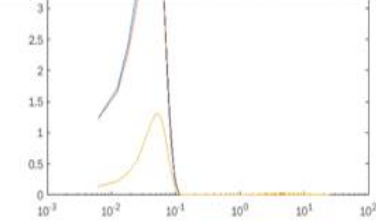
Task 3

```
7 semilogx(f,db(p,"power"))
```

Task 4

```
9 legend("HARP","PAX","WANC")
10 xlabel("Frequency (Hz)")
11 ylabel("Power Spectrum (dB)")
12
```

Further Practice



Task 1

Task 2

Task 3

Task 4

Further Practice

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Task 1

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```

Task 4

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9 legend("HARP","PAX","WANC")
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12
```

Further Practice



Spectral Analysis: -

The screenshot displays the MATLAB Signal Processing Onramp interface. The browser address bar shows the URL: `matlabacademy.mathworks.com/R2021b/portal.html?course=signalprocessing#chapter=4&lesson=4§ion=1`. The course progress bar indicates "Signal Processing Onramp (66% complete)".

The left sidebar lists tasks: Task 2, Task 3, Task 4, and Task 5. Task 5 is selected, showing instructions: "There isn't a `MinThreshold` option for the `cwt` function, but you can have the same effect by setting the colormap limits." and a code snippet: `caxis([a b])`. A task box prompts: "Set the colormap limits from 0 to 2." with a "Submit" button.

The main workspace shows a script editor with the following code:

```
1 load quakes
2 quakes

Task 1
3 pspectrum(quakes.WANC, quakes.Time, "spectrogram")

Task 2
4 pspectrum(quakes.WANC, quakes.Time, "spectrogram", "Fre

Task 3
5 pspectrum(quakes.WANC, quakes.Time, "spectrogram", "Fre
```

Two plots are visible on the right: a "spectrogram" plot showing frequency (Hz) vs. time (minutes) with a colorbar for "Power (dB)", and a "Magnitude Scalogram" plot showing frequency (Hz) vs. time (minutes) with a colorbar for "Magnitude".

Filtering: -

Now the spectrogram contains more details, but the area around the bands is still quite noisy.

There are more options you can set while creating spectrograms, but you can also try different time-frequency visualization methods.

You can create scalograms with the `cwt` function.

```
cwt(sig, fs)
```

The first input is the signal, and the second input is the sample rate.

You can also set the frequency limits with the `cwt` function.

```
cwt(sig, fs, ...
    "FrequencyLimits", [a b])
```

Lab Report No 3 | Signal Processing Onramp | 70% complete | Muhammad Ali

matlabacademy.mathworks.com/R2021b/portal.html?course=signalprocessing#chapter=4&lesson=4§ion=1

Apps | Gmail | YouTube | Maps | Classroom | Reading list

← EXIT COURSE | Signal Processing Onramp (70% complete) | Muhammad Ali | ? |

Spectral Analysis > Create Time-Frequency Plots | PREVIOUS | NEXT →

Task 2

Task 3

Task 4

Task 5

There isn't a `MinThreshold` option for the `cwt` function, but you can have the same effect by setting the colormap limits.

```
caxis([a b])
```

Notice that the scalogram colorbar shows the magnitude, not the power. You'll use a limit in the blue range since the other colors are not very visible on the plot.

TASK
Set the colormap limits from 0 to 2.

Hint | See Solution | Reset | Submit | Next task

Test Results: **Correct!**

HOME | LIVE EDITOR | VIEW

Text | B I U M | Code | Control | Task | Refactor | Run Section | Run and Advance | Run to End | Run | Step | Stop

spectscalo.mlx

Task 3

```
5 pspectrum(quakes.WANC, quakes.Time, "spectrogram", "Fre
```

Task 4

```
6 cwt(quakes.WANC, 1/0.02, "FrequencyLimits", [2 10])
```

Task 5

```
8 caxis([0 2])
```

Further Practice

9

COMMAND WINDOW

UTF-8 | LF | script | Ln 8 Col 11

62°F Haze | ENG | 6:51 PM | UK | 12/16/2021

Lab Report No 3 | Signal Processing Onramp | 83% complete | Muhammad Ali

matlabacademy.mathworks.com/R2021b/portal.html?course=signalprocessing#chapter=5&lesson=3§ion=1

Apps | Gmail | YouTube | Maps | Classroom | Reading list

← EXIT COURSE | Signal Processing Onramp (83% complete) | Muhammad Ali | ? |

Filtering > Bandpass Filter | PREVIOUS | NEXT →

Task 1

Task 2

Task 3

Task 4

Further Practice

The earth scientists thought that the earthquake in Sumatra triggered the earthquakes in Alaska. Using filtering, they were able to compare the low frequency and high frequency signals from the Mount Wrangell seismometer. This provided a rare opportunity for them to confirm the relationship between two distant earthquakes.

If you scroll through the plot, you can see that each high frequency pulse occurs near a peak in the low frequency waves.

Bandpass

32.20.1 sec

-0.37701

HOME | LIVE EDITOR | VIEW

Title | B I U M | Code | Control | Task | Refactor | Run Section | Run and Advance | Run to End | Run | Step | Stop

flitband.mlx

```
5 legend("HARP", "PAX", "WANC", "Lowpass WANC", "Location")
6 xlabel("Frequency (Hz)")
7 ylabel("Power Spectrum (dB)")
```

Task 1

```
8 bandpass(quakes(:, "WANC"), [2 10]);
```

Task 2

```
9 bandWANC = bandpass(quakes(:, "WANC"), [2 10]);
```

Task 3

```
10 compfilt = timetable(bandWANC.Time, bandWANC.WANC, qua
```

COMMAND WINDOW

UTF-8 | LF | script |

62°F Haze | ENG | 9:37 PM | UK | 12/16/2021

Signal Measurement: -

Here I Extract information from signals which is filter by lowpass highpass.

The screenshot shows the MATLAB Signal Processing Onramp interface. The left sidebar contains the course navigation and task instructions for Task 5. The main workspace is divided into a code editor and a figure window. The code editor shows the following code:

```
Task 1
[p,f,t]=pspectrum(quakes.WANC,quakes.Time,"spectrogr

Task 2
psum=sum(p);
plot(t,psum)

Task 3
pwr=db(psum,"power")
plot(t,pwr)
```

The figure window displays two plots: a spectrogram and a power spectrum plot. The power spectrum plot shows a peak at approximately 1614 Hz, with the value -6.161430920687451 displayed. The task instructions on the left state: "The default options find too many local extrema. You can modify the options to find just the earthquakes." and "If you already knew how many earthquakes to find, you could enter that value for the maximum number of extrema. In most cases, you won't know the number of extrema already, so instead, you can tweak the prominence and separation options." The task goal is to "Increase the minimum prominence option to 10".

The screenshot shows the MATLAB Signal Processing Onramp interface with the 'Find Local Extrema' dialog box open. The dialog box has the following settings:

- maxIndices = Local maxima in pwr
- Select data: Input data = pwr, X-axis = t
- Define local extrema: Extrema type = Maxima, Flat selection = Center, Max. num. extrema = 520, Min. prominence = 10, Min. separation = 0, Prominence window = Centered
- Display results: (checkbox checked)

The figure window displays two plots: a spectrogram and a power spectrum plot. The power spectrum plot shows a peak at approximately 1614 Hz, with the value -6.161430920687451 displayed. The task instructions on the left state: "The default options find too many local extrema. You can modify the options to find just the earthquakes." and "If you already knew how many earthquakes to find, you could enter that value for the maximum number of extrema. In most cases, you won't know the number of extrema already, so instead, you can tweak the prominence and separation options." The task goal is to "Increase the minimum prominence option to 10".