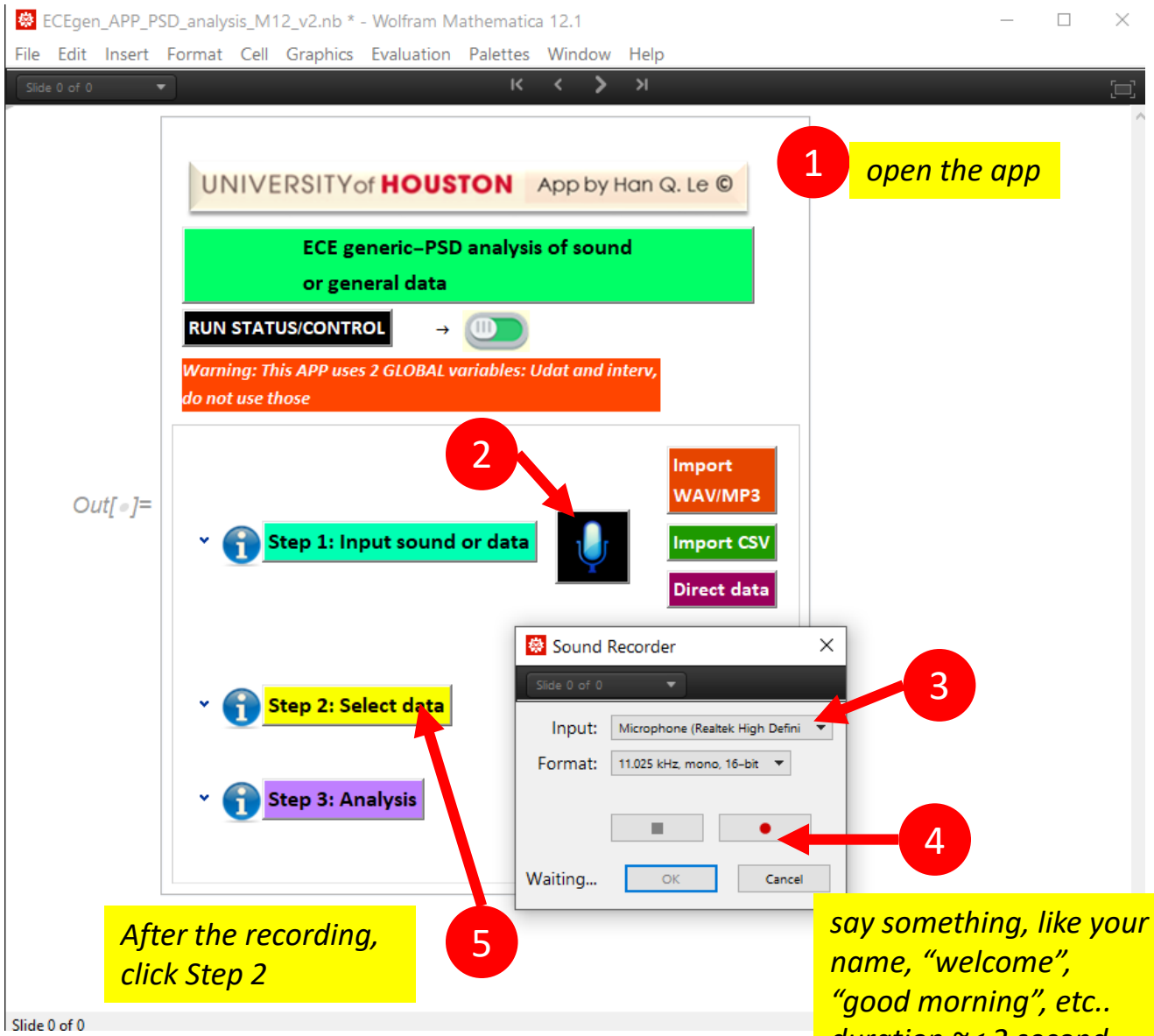
Homework 5

Follow instruction in the follow. Save your sound data and put in a report of what you do and what you interprete. In the conclusion, discuss your thought about spectral distortion: what you do is to apply a function (filter) to the Fourier spectrum of you recorded sound. If the function is not a constant throughout the whole frequency range, the sound output will be distorted.

This is similar to light in fiber. Each spectral component of light signal experiences different fiber propagation effect, hence, the light signal is distorted.



1 *open the app*

2

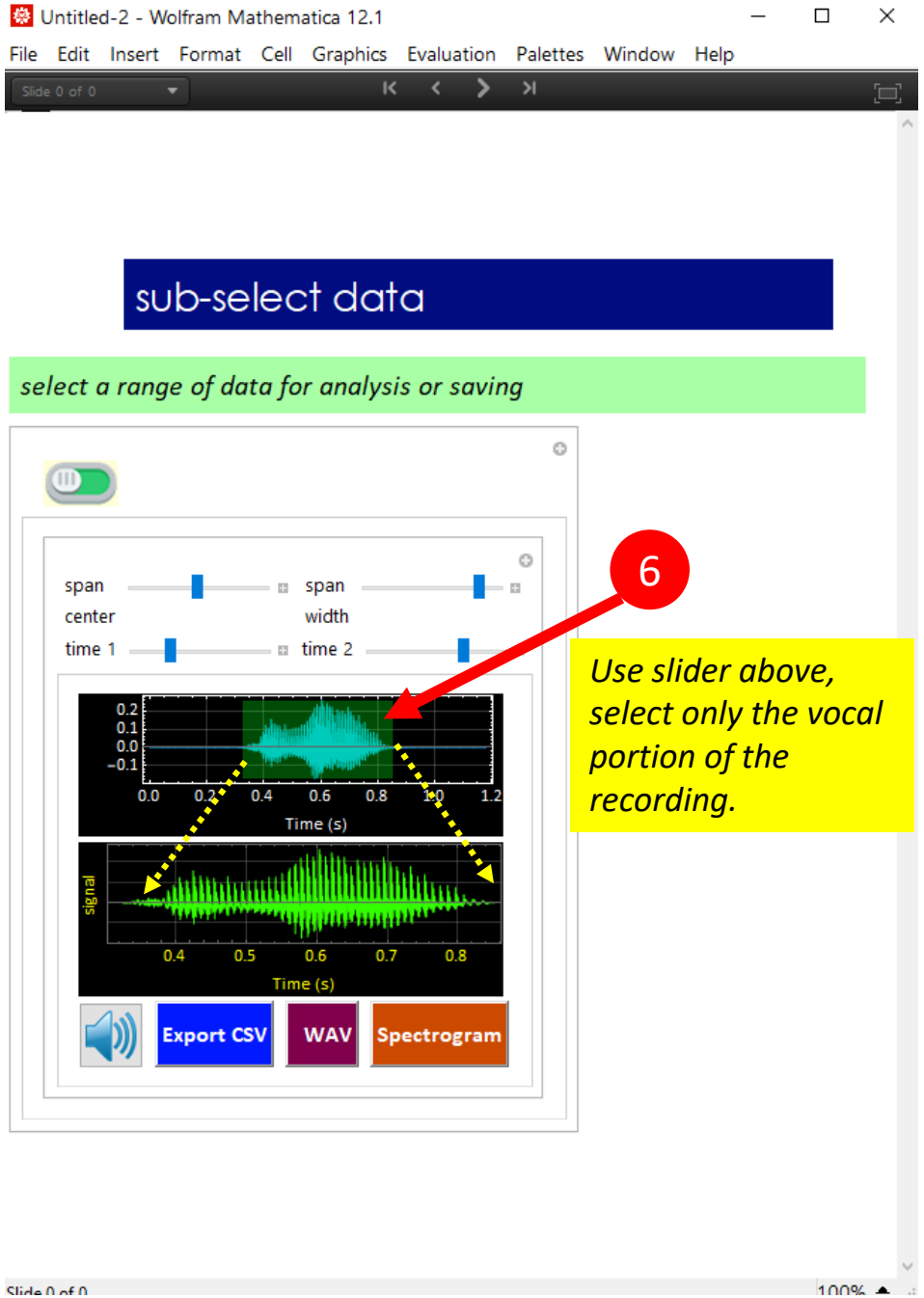
3

4

5

After the recording, click Step 2

say something, like your name, "welcome", "good morning", etc.. duration ~< 2 second



6

Use slider above, select only the vocal portion of the recording.

ECEgen_APP_PSD_analysis_M12_v2.nb * - Wolfram Mathematica 12.1

File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

Slide 0 of 0

UNIVERSITY of HOUSTON App by Han Q. Le ©

ECE generic–PSD analysis of sound or general data

RUN STATUS/CONTROL →

Warning: This APP uses 2 GLOBAL variables: Udat and interv, do not use those

Out[ ]=

1

Import WAV/MP3

Import CSV

Direct data

Step 1: Input sound or data

Step 2: Select data *# times data select window opened:* 1

Step 3: Analysis 7

ECEgen_APP_PSD_analysis_M12_v2.nb * - Wolfram Mathematica 12.1

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Slide 0 of 0

Step 3: Analysis

PSD Analysis→ **ON**

Signal conditioning

8

type in 2000

Low freq cutoff

Hi freq cutoff 2000

9

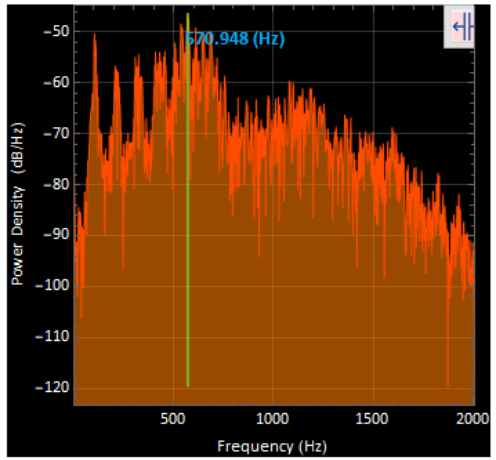
Out[ ]=

dB **Log freq.** **SAVE PSDplots**

10

low lim. hi lim

Frequency cursor



ECEgen_APP_PSD_analysis_M12_v2.nb * - Wolfram Mathematica 12.1

File Edit Insert Format Cell Graphics Evaluation Palettes Window Help

Slide 0 of 0

UNIVERSITY of HOUSTON App by Han Q. Le ©

ECE generic–PSD analysis of sound or general data

RUN STATUS/CONTROL →

Warning: This APP uses 2 GLOBAL variables: Udat and interv, do not use those

Out[ ]=

Import WAV/MP

Import C

Direct da

Step 1: Input sound or data

Step 2: Select data *# times data select window opened:* 1

Step 3: Analysis *# times filter window opened:* 1

10

PSD Analysis→ OFF

Signal conditioning

Low freq cutoff

Hi freq cutoff

Turn on power spectral density analysis after selec

Untitled-3 * - Wolfram Mathematica 12.1

File Edit Insert Format

Slide 0 of 0

this is the filter window

Signal conditioning 5-band Dirichlet window

11

→

connected/disconnected to data in PSD →
(should disconnect while editing the band filter

12

clear bands

save bands

band –pass fine tuning

Processed sound→

PSD plot→

once

continuous

dB

band1 span1 amp1 band2 span2 amp2 band3 span3 amp3 band4 span4 amp4 band5 span5 amp5

band being edited...

{{}}[1, 1]

select band for...

1 2 3 4 5

click to lock...

NOT FIXED

ydB

Power Density (dB/Hz)

-50 -60 -70 -80 -90 -100 -110

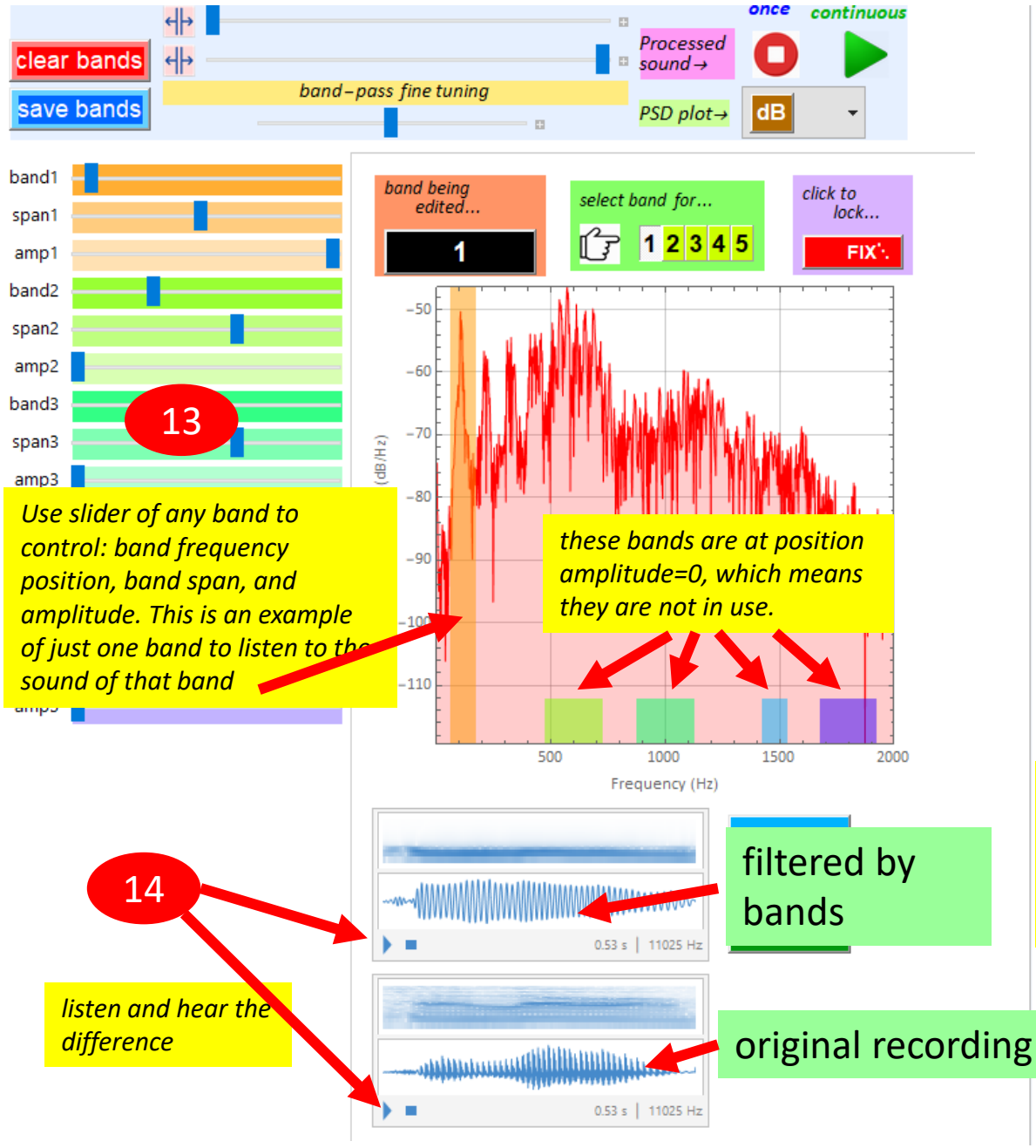
500 1000 1500 2000

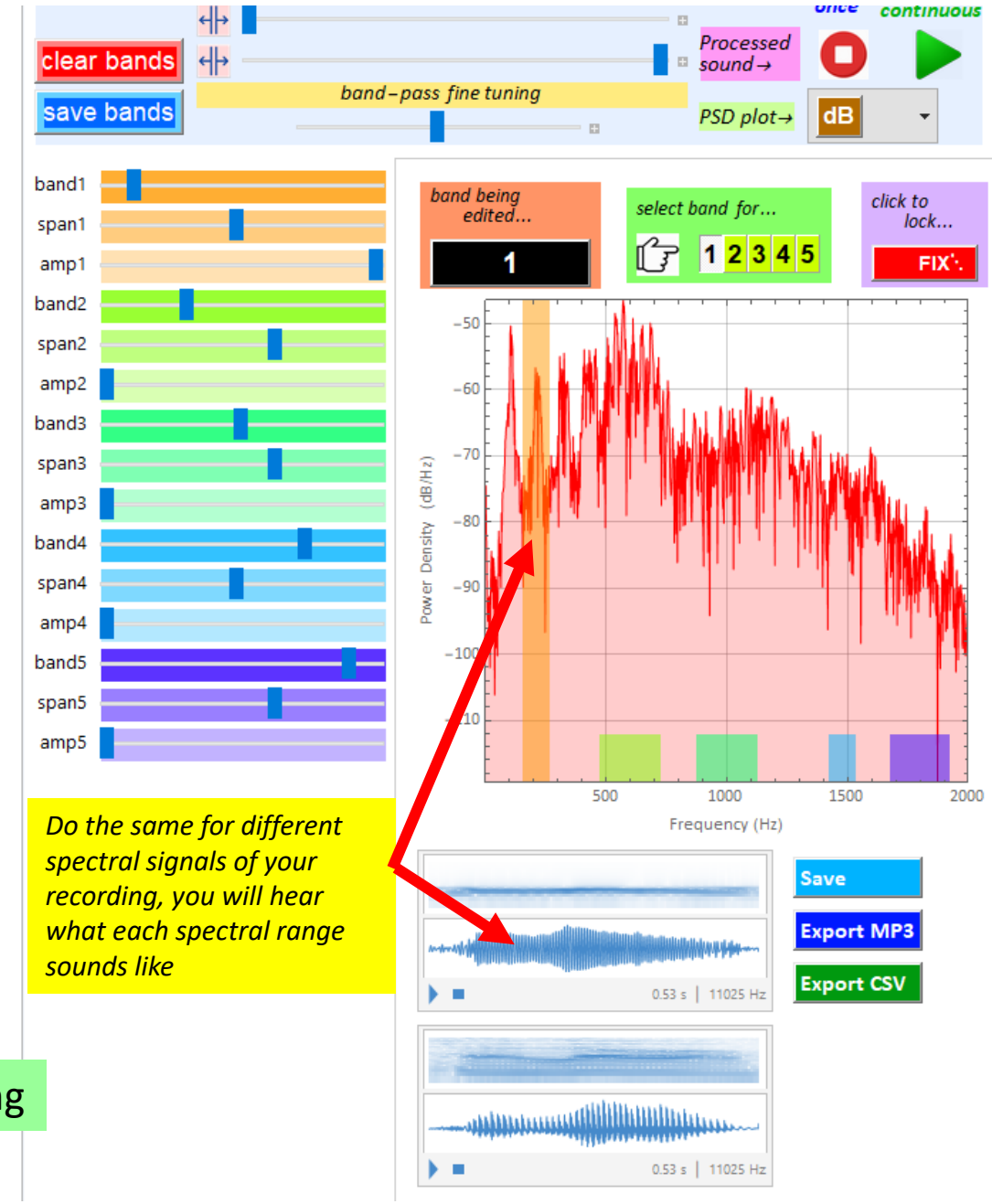
Frequency (Hz)

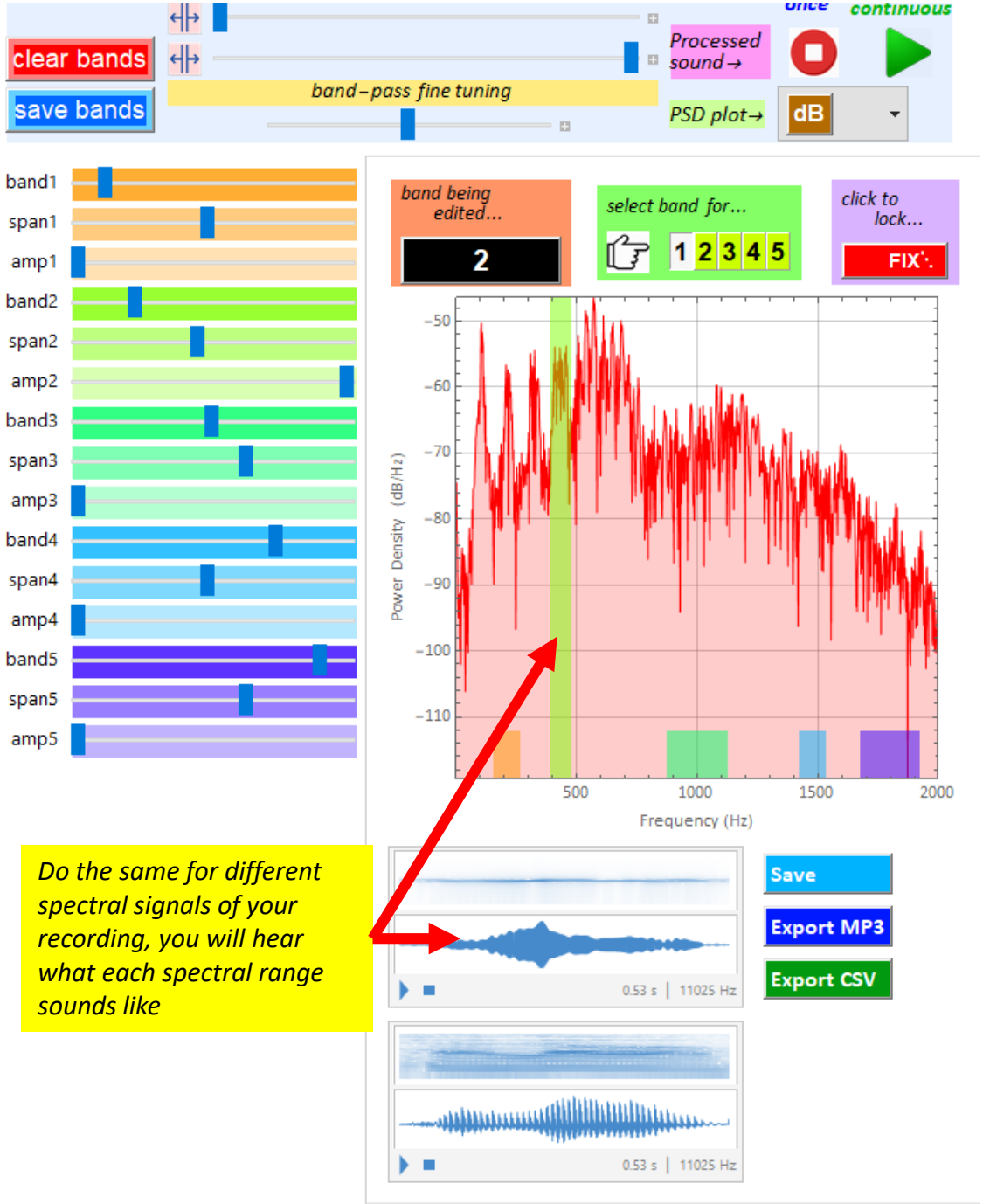
Slide 0 of 0

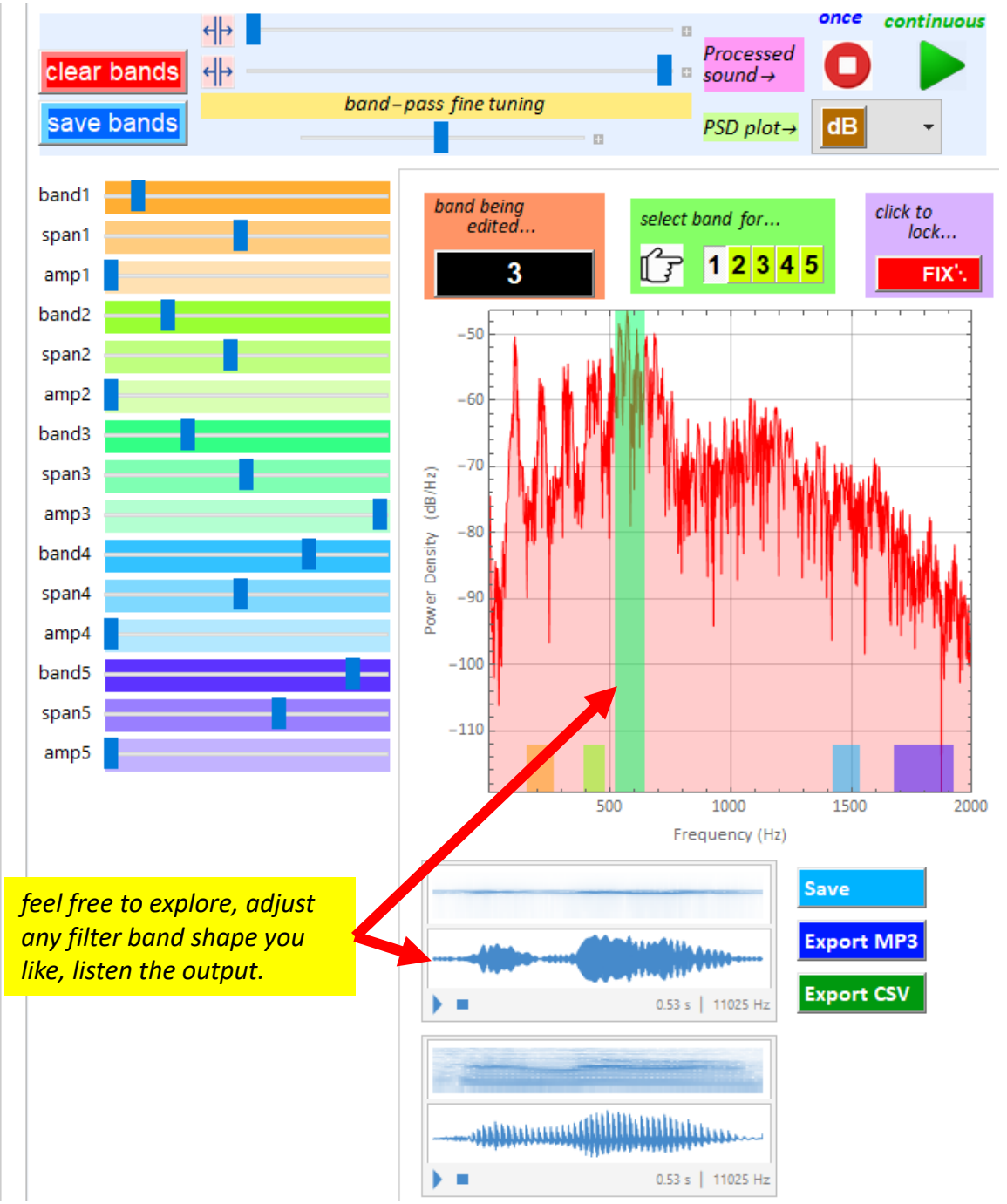
100%

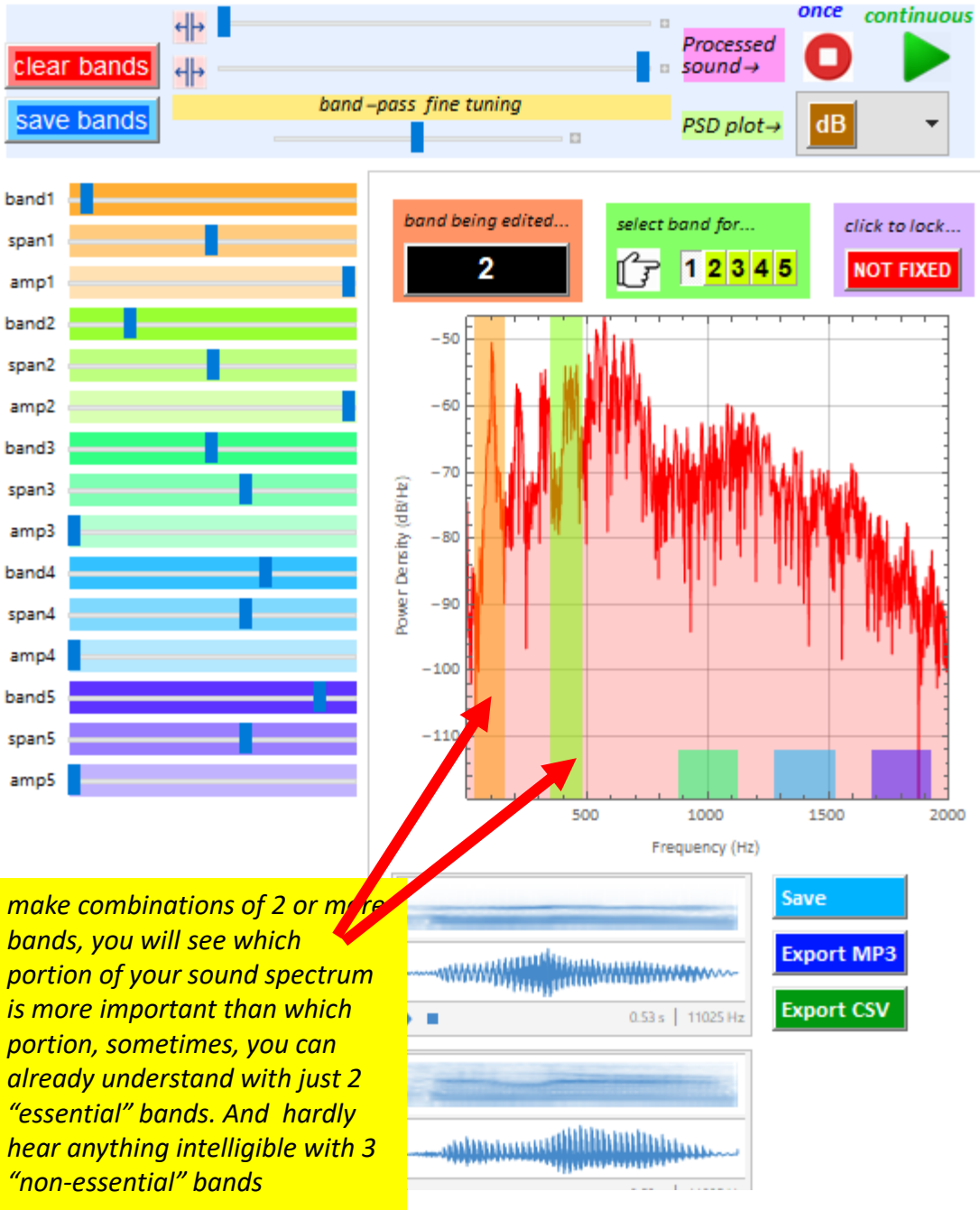
In the follow, if the sound filter window freezes and is not responsive, no need to restart or make new recording. Just close the filter window, restart from step 8 and 9.


clear bands
save bands
band–pass fine tuning
Processed sound→
PSD plot→
dB
once
continuous
band1
span1
amp1
band2
span2
amp2
band3
span3
amp3
13
band being edited...
1
select band for...
1 2 3 4 5
click to lock...
FIX
Use slider of any band to control: band frequency position, band span, and amplitude. This is an example of just one band to listen to the sound of that band
these bands are at position amplitude=0, which means they are not in use.
Frequency (Hz)
14
filtered by bands
original recording
listen and hear the difference
0.53 s | 11025 Hz

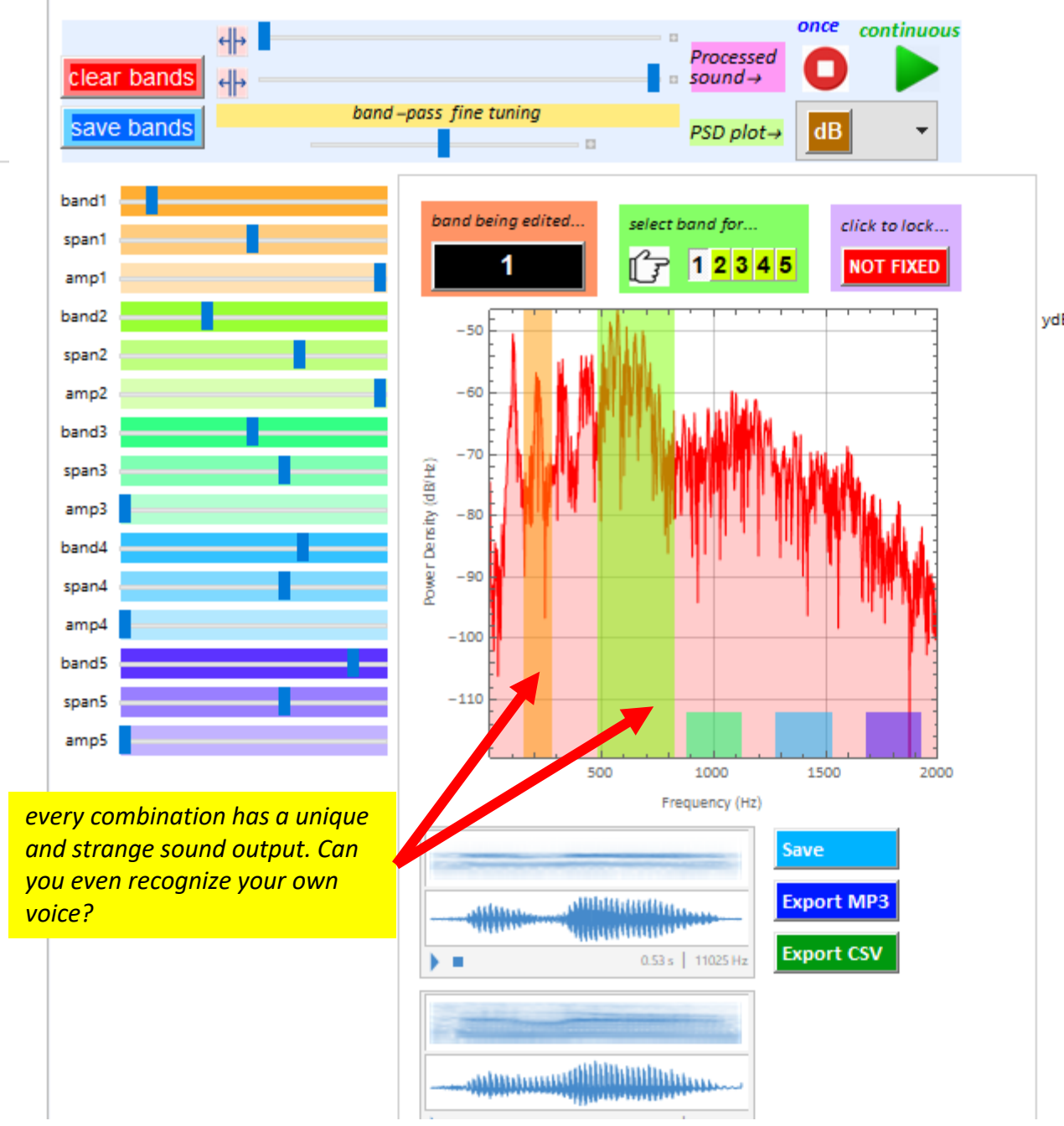

clear bands
save bands
band–pass fine tuning
Processed sound→
PSD plot→
dB
once
continuous
band1
span1
amp1
band2
span2
amp2
band3
span3
amp3
band4
span4
amp4
band5
span5
amp5
band being edited...
1
select band for...
1 2 3 4 5
click to lock...
FIX
Power Density (dB/Hz)
Frequency (Hz)
Do the same for different spectral signals of your recording, you will hear what each spectral range sounds like
Save
Export MP3
Export CSV
0.53 s | 11025 Hz


clear bands
save bands
band–pass fine tuning
Processed sound→
PSD plot→
dB
once
continuous
band1
span1
amp1
band2
span2
amp2
band3
span3
amp3
band4
span4
amp4
band5
span5
amp5
band being edited...
2
select band for...
1 2 3 4 5
click to lock...
FIX
Power Density (dB/Hz)
Frequency (Hz)
Save
Export MP3
Export CSV
0.53 s | 11025 Hz
0.53 s | 11025 Hz
Do the same for different spectral signals of your recording, you will hear what each spectral range sounds like

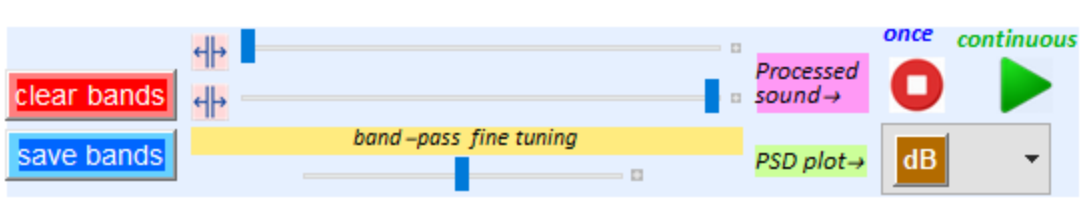

clear bands
save bands
band–pass fine tuning
Processed sound→
PSD plot→
dB
once
continuous
band1
span1
amp1
band2
span2
amp2
band3
span3
amp3
band4
span4
amp4
band5
span5
amp5
band being edited...
3
select band for...
1 2 3 4 5
click to lock...
FIX
Power Density (dB/Hz)
Frequency (Hz)
Save
Export MP3
Export CSV
0.53 s | 11025 Hz
0.53 s | 11025 Hz
feel free to explore, adjust any filter band shape you like, listen the output.

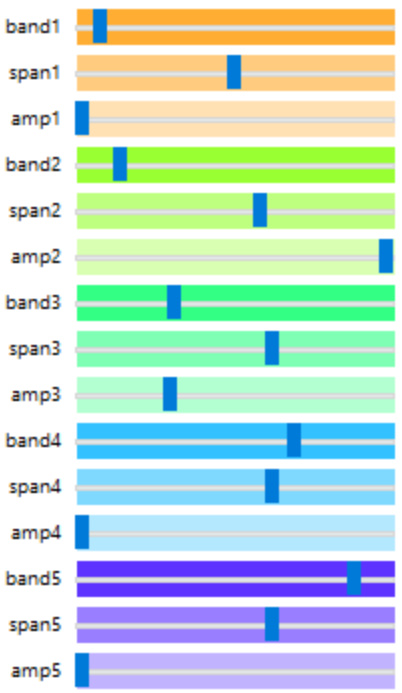


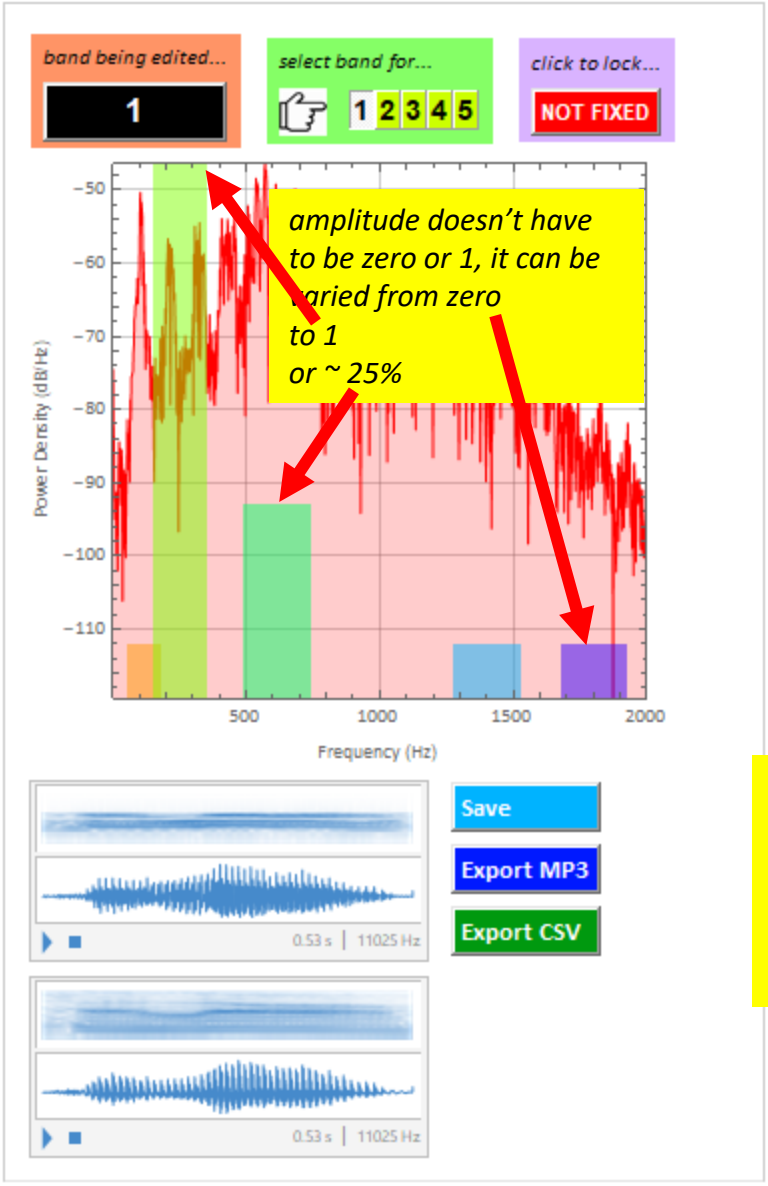
make combinations of 2 or more bands, you will see which portion of your sound spectrum is more important than which portion, sometimes, you can already understand with just 2 "essential" bands. And hardly hear anything intelligible with 3 "non-essential" bands

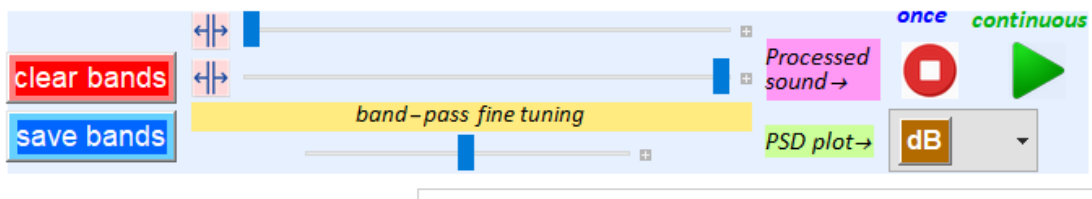


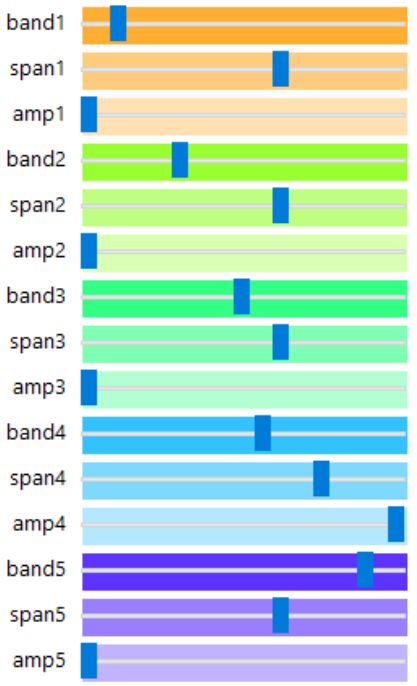
every combination has a unique and strange sound output. Can you even recognize your own voice?

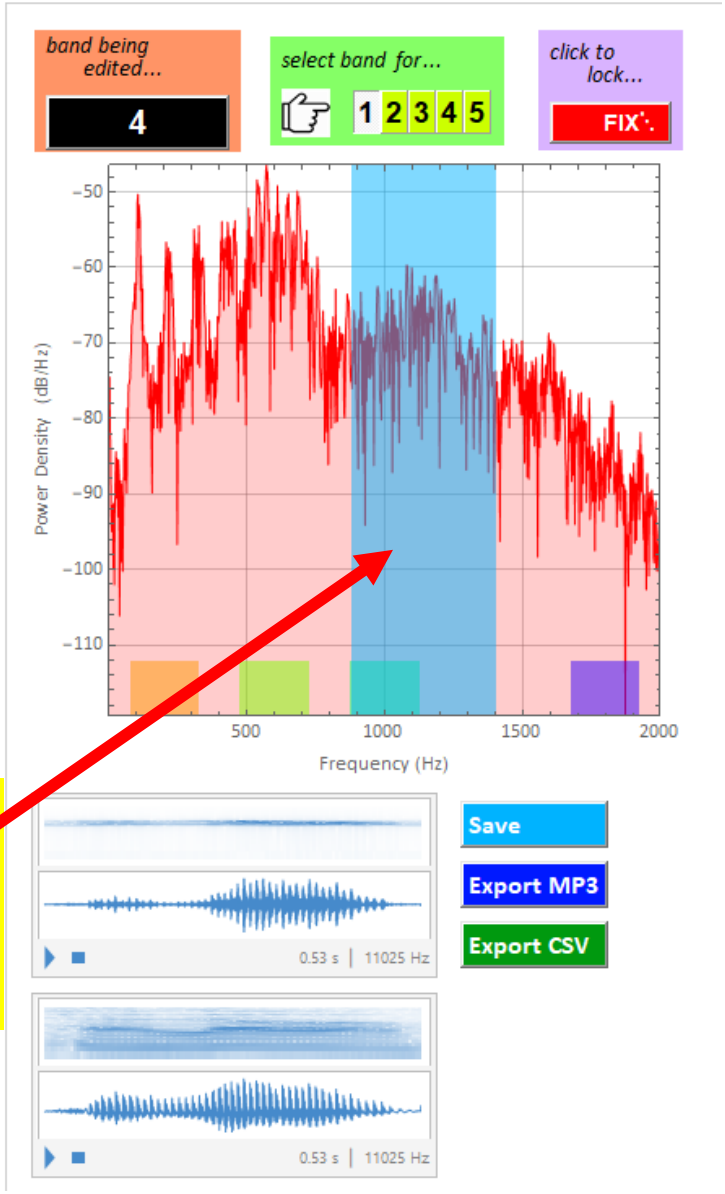

clear bands
save bands
band–pass fine tuning
Processed sound→
PSD plot→
once
continuous
dB


band1
span1
amp1
band2
span2
amp2
band3
span3
amp3
band4
span4
amp4
band5
span5
amp5


band being edited...
1
select band for...
1 2 3 4 5
click to lock...
NOT FIXED
amplitude doesn't have to be zero or 1, it can be varied from zero to 1 or ~ 25%
Power Density (dB/Hz)
Frequency (Hz)
Save
Export MP3
Export CSV
0.53 s | 11025 Hz


clear bands
save bands
band–pass fine tuning
Processed sound→
PSD plot→
once
continuous
dB


band1
span1
amp1
band2
span2
amp2
band3
span3
amp3
band4
span4
amp4
band5
span5
amp5


band being edited...
4
select band for...
1 2 3 4 5
click to lock...
FIX'.
Power Density (dB/Hz)
Frequency (Hz)
you might be surprised. This band has 20 dB lower power density, that is 100 times less power than the most powerful spectral band, yet it may sound intelligible.
Save
Export MP3
Export CSV
0.53 s | 11025 Hz