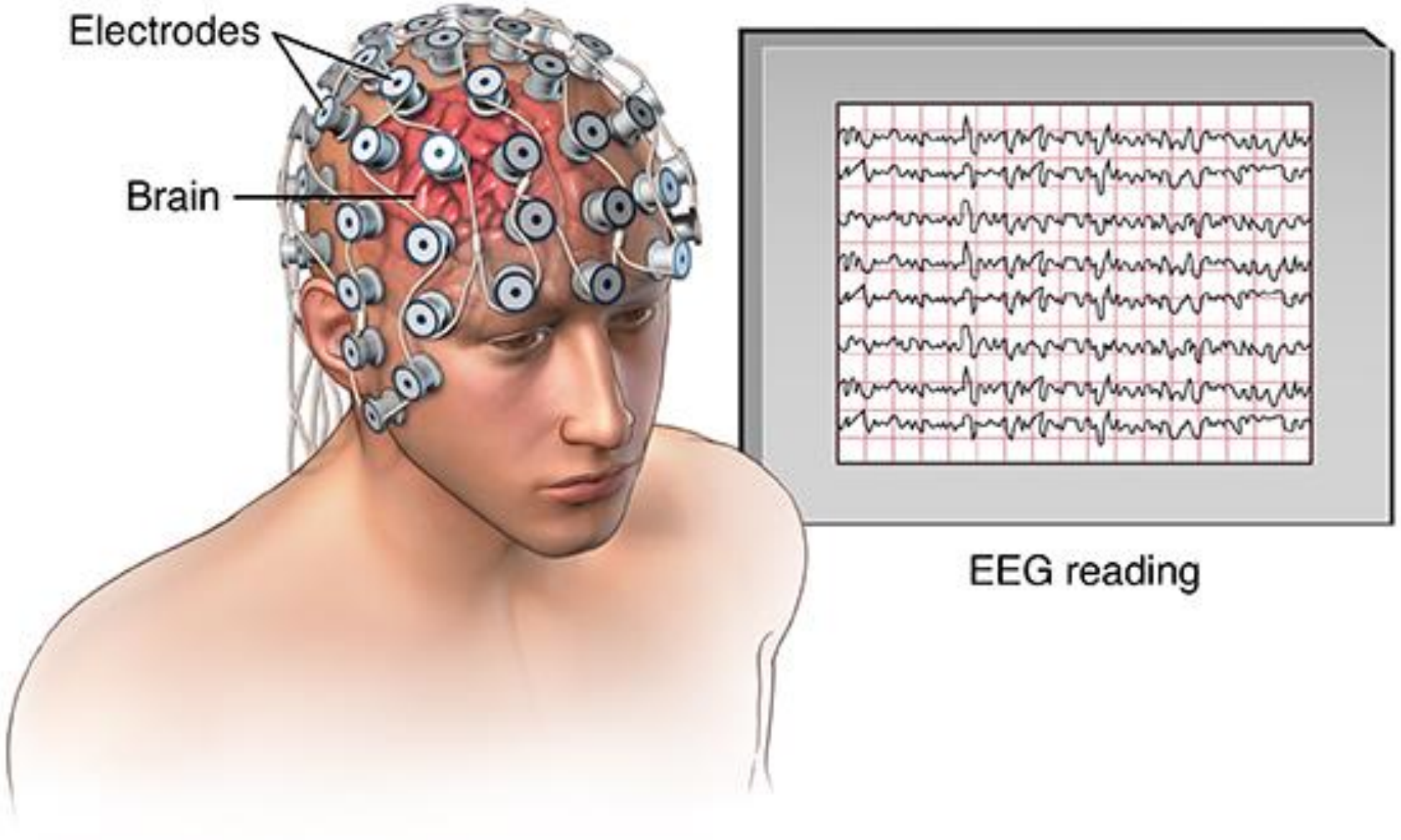
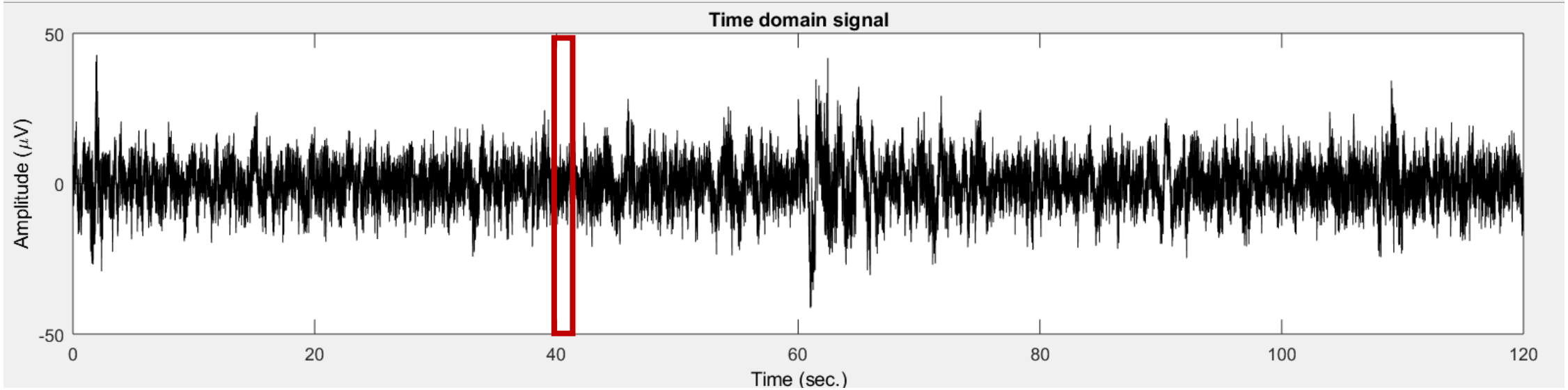
Learning to learn: Making sense of electrophysiology data

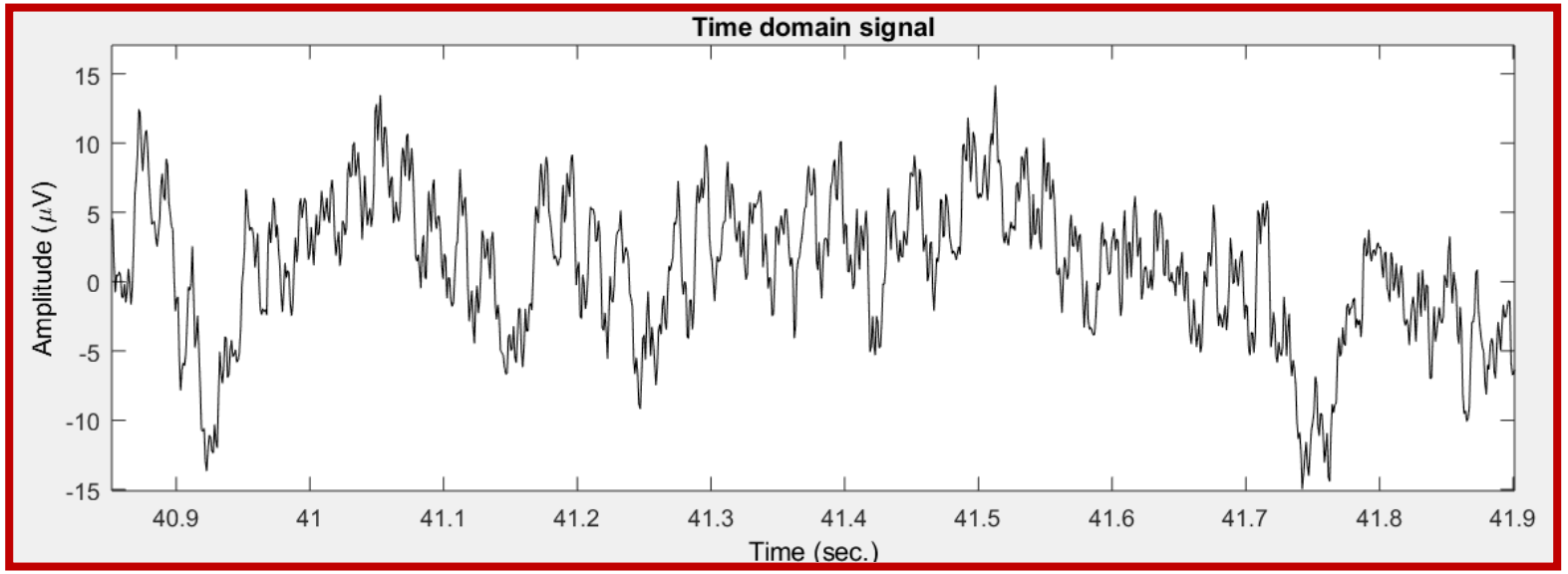
- **Human Physiology, University of Oregon, Eugene**
- **Presented by: Ryan Leriche**
- **Mentored by: Nicole Swann**

Electroencephalography (EEG)

[ih-lek-troh-en-**sef**-*uh*-l*uh*-graf-ee]




Time domain signal
Amplitude (μV)
50
0
-50
0
20
40
60
80
100
120
Time (sec.)


Time domain signal
Amplitude (μV)
15
10
5
0
-5
-10
-15
40.9
41
41.1
41.2
41.3
41.4
41.5
41.6
41.7
41.8
41.9
Time (sec.)

plot

R2020

2-D line plot

collapse all in pa

Syntax

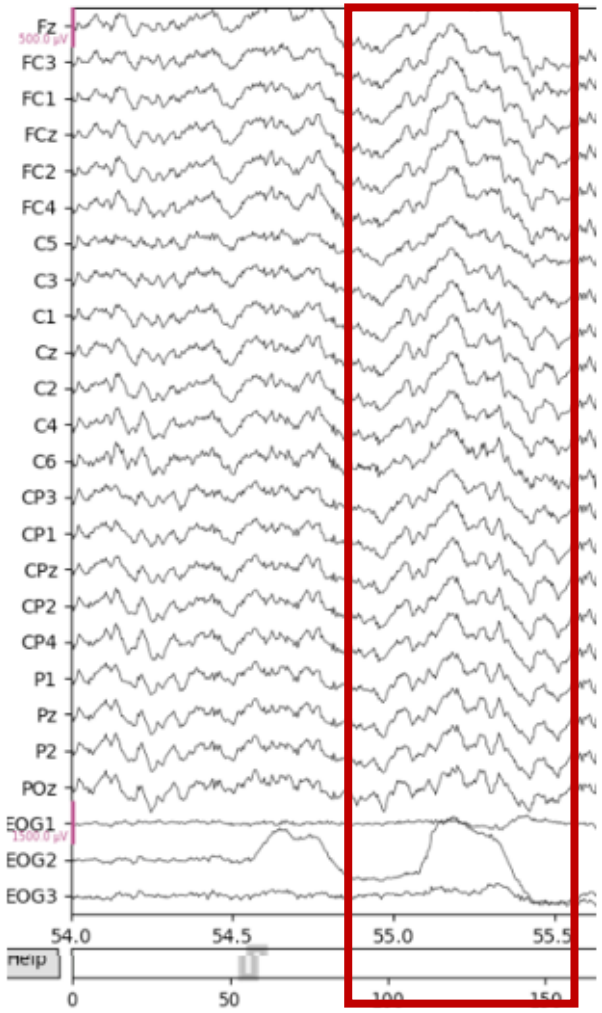
```
plot(X,Y)
plot(X,Y,LineSpec)
plot(X1,Y1,...,Xn,Yn)
plot(X1,Y1,LineSpec1,...,Xn,Yn,LineSpecn)

plot(Y)
plot(Y,LineSpec)

plot(__,Name,Value)
plot(ax,__)

h = plot(__)
```

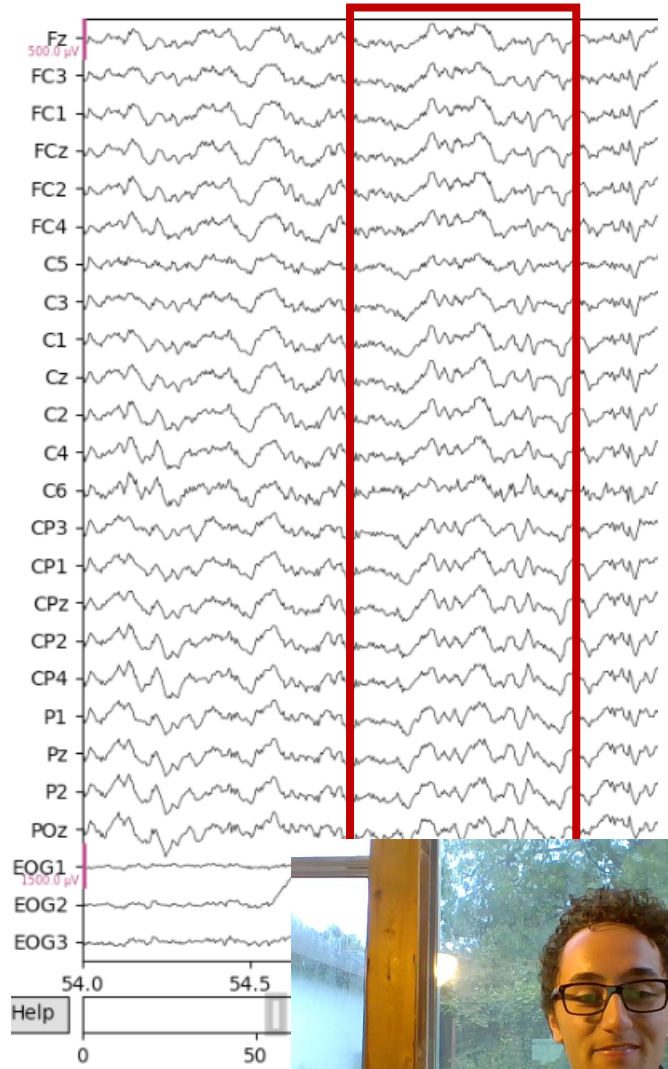
Description

`plot(X,Y)` creates a 2-D line plot of the data in `Y` versus the corresponding values in `X`.

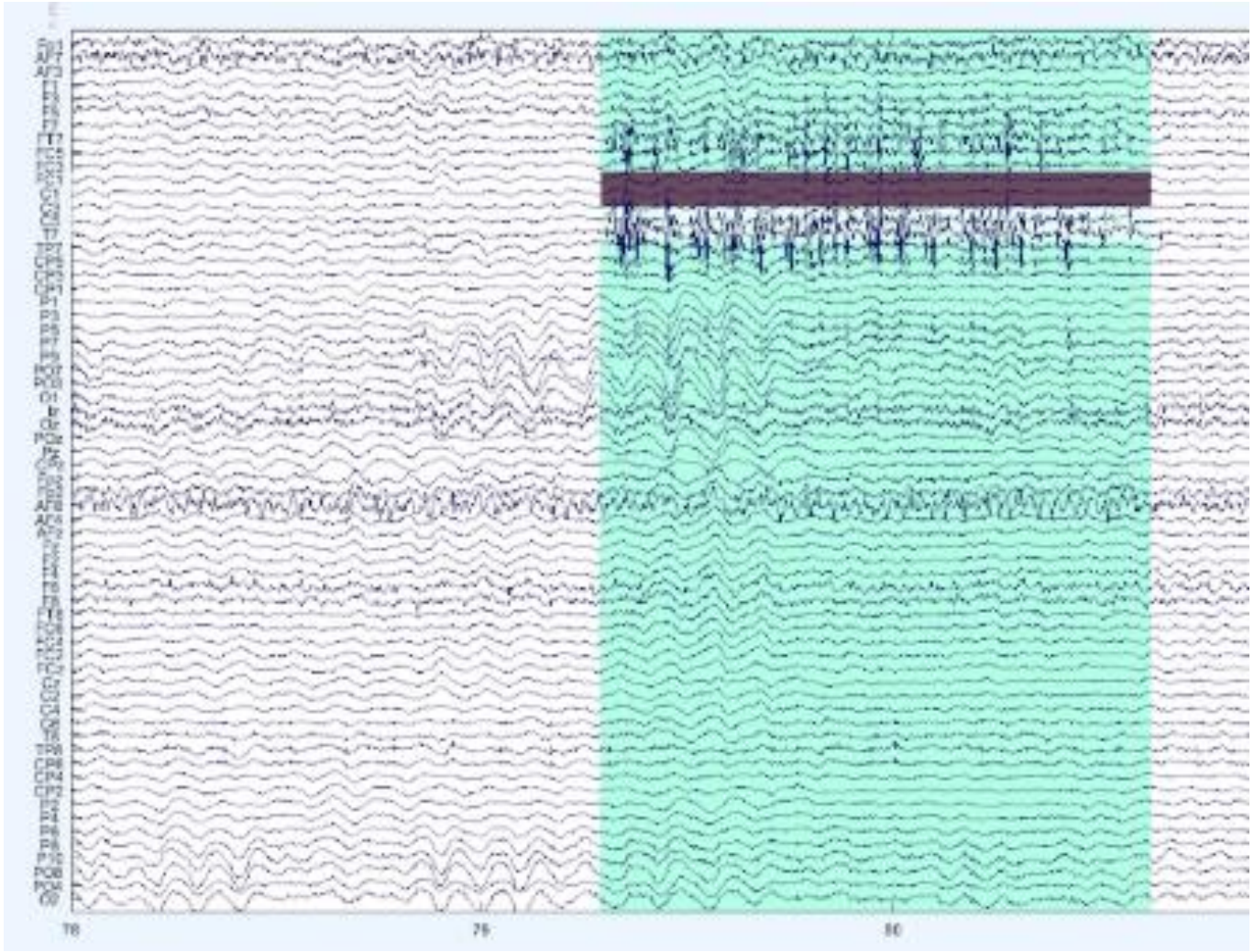
- If `X` and `Y` are both vectors, then they must have equal length. The `plot` function plots `Y` versus `X`.
- If `X` and `Y` are both matrices, then they must have equal size. The `plot` function plots columns of `Y` versus columns of `X`.
- If one of `X` or `Y` is a vector and the other is a matrix, then the matrix must have dimensions such that one of its dimensions equals the vector length. If the numb length, then the `plot` function plots each matrix column versus the vector. If the number of matrix columns equals the vector length, then the function plots eac the matrix is square, then the function plots each column versus the vector.

ICA removes eye blinks





Kurtosis/Extrema helps remove muscle artifacts



EEGLAB Wiki

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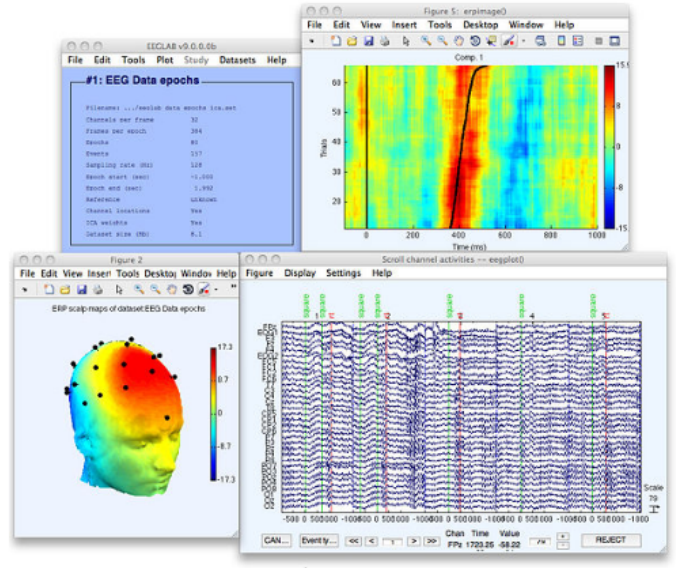
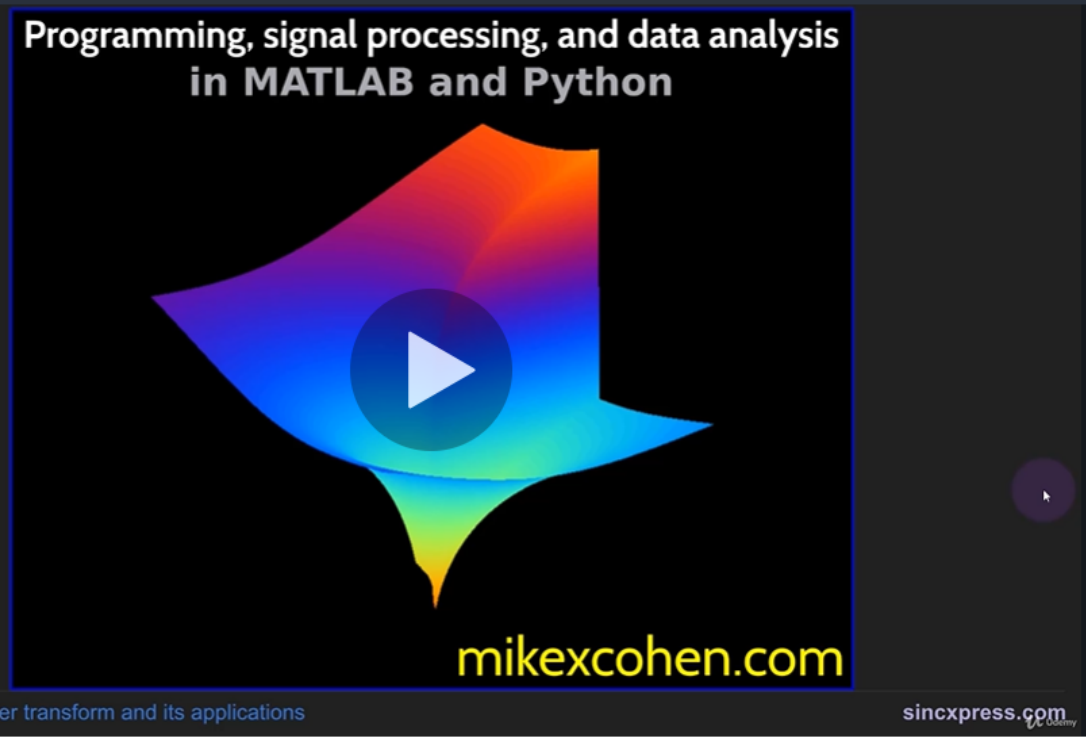


Links and Documentation

Download EEGLAB

- EEGLAB hardware and software recommendations
- Download EEGLAB as zip file
- Download EEGLAB from GIT
- Download a compiled version of EEGLAB
- EEGLAB extensions/plug-ins
- EEGLAB revision history
- Bugs and Suggestions

Useful EEGLAB documentation pages



Overview | Q&A | Bookmarks | Announcements

About this course

Learn the Fourier transform in MATLAB and Python, and its applications in digital signal processing and image processing

Course content

- [x] 23. Amplitude spectrum vs. power spectrum — 7min
- [x] 24. A note about terminology of Fourier features — 5min

Section 4: The discrete inverse Fourier transform
3 / 3 | 18min

Section 5: The fast Fourier transform
5 / 5 | 24min

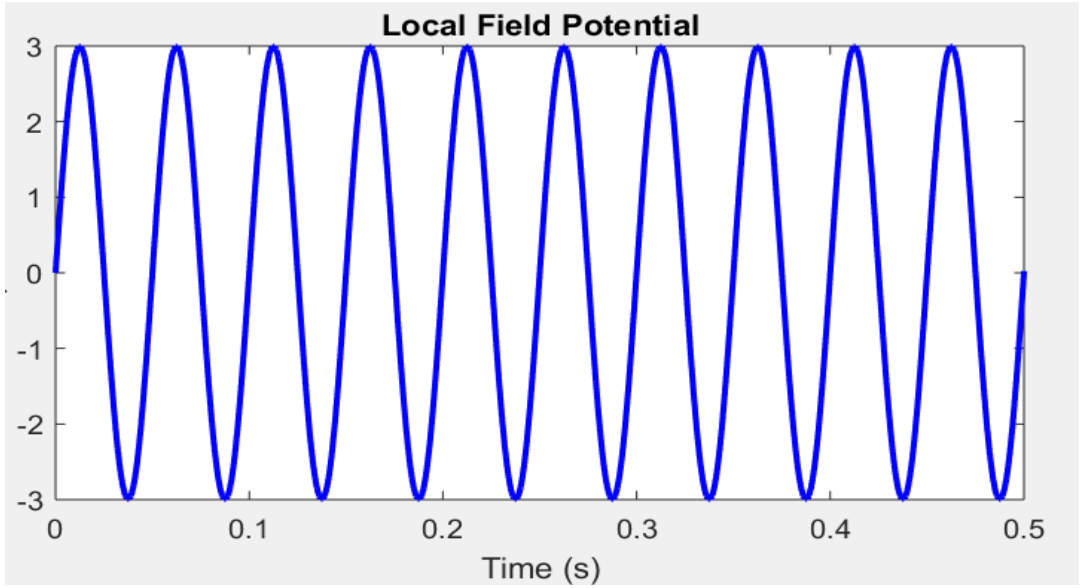
Section 6: Frequency resolution and zero padding
5 / 6 | 48min

Section 7: Aliasing, stationarity, and violations
7 / 7 | 1hr 6min

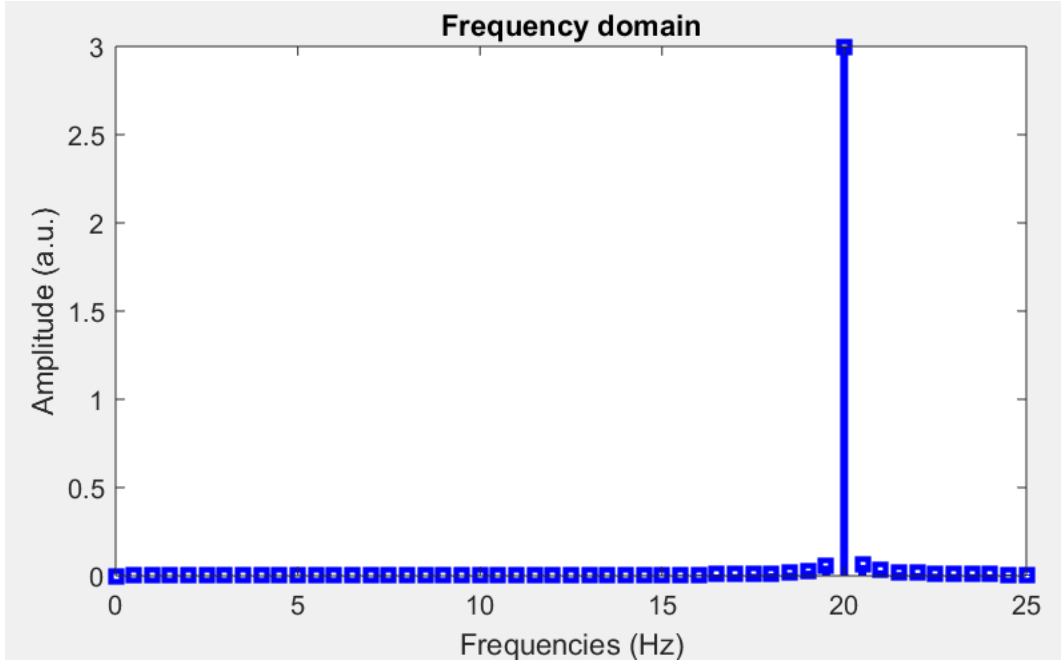
Section 8: 2D Fourier transform
2 / 2 | 11min

Section 9: A transform
8 / 8 | 42min

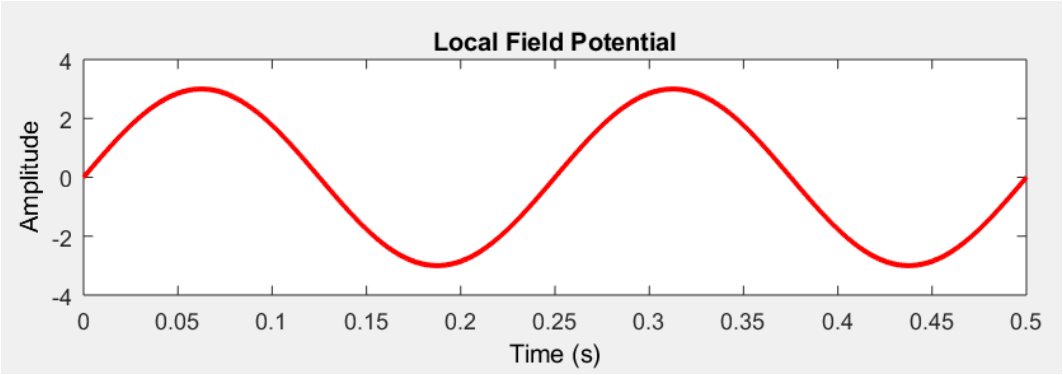
What *in the world* is the frequency domain?



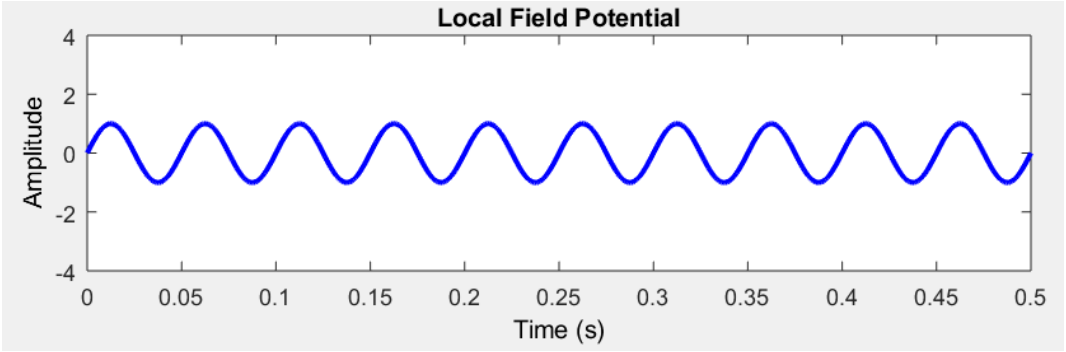
Fourier Transform →



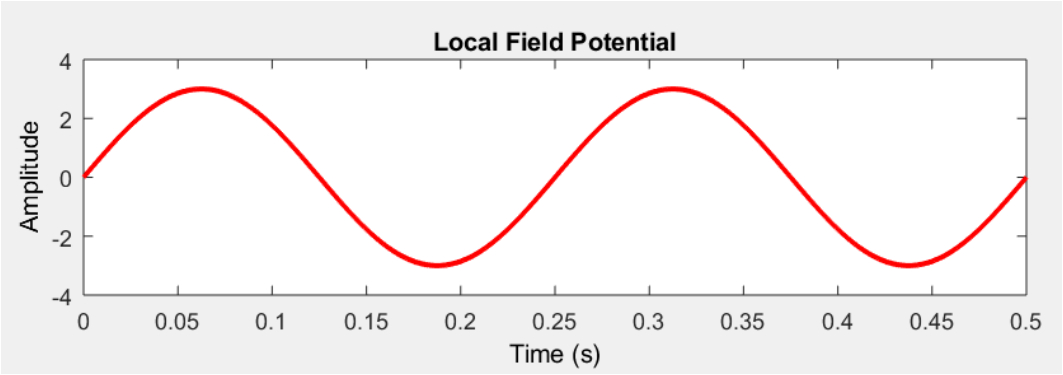
Time domain → Frequency domain



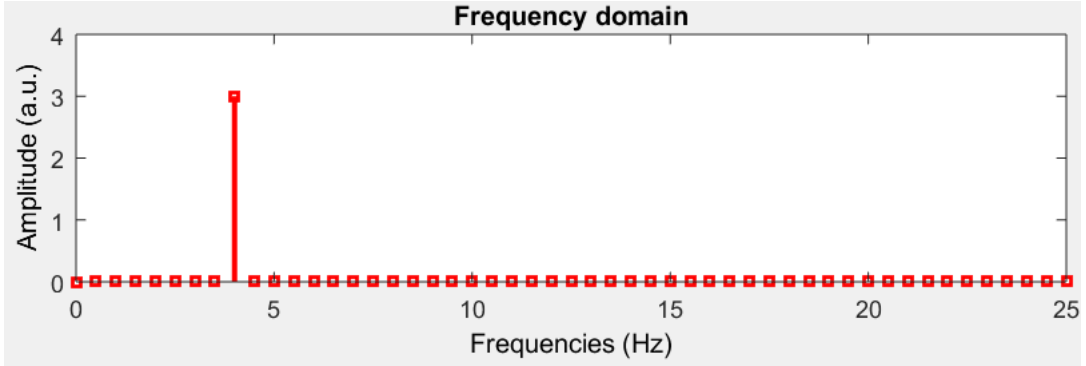
Fourier Transform

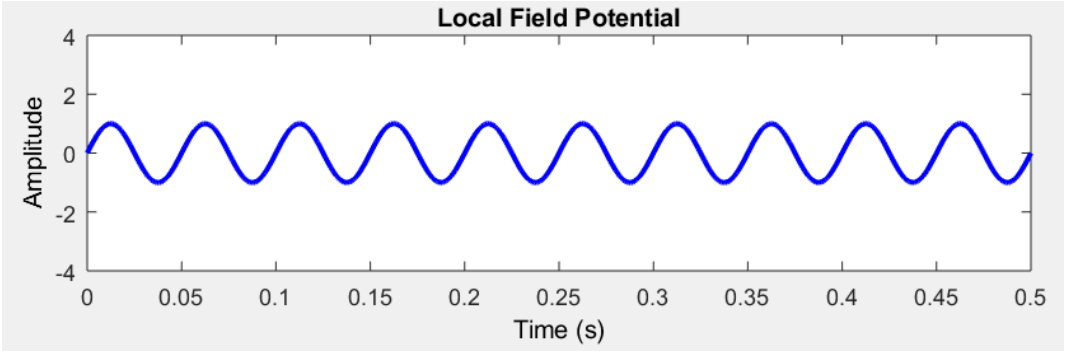


Fourier Transform

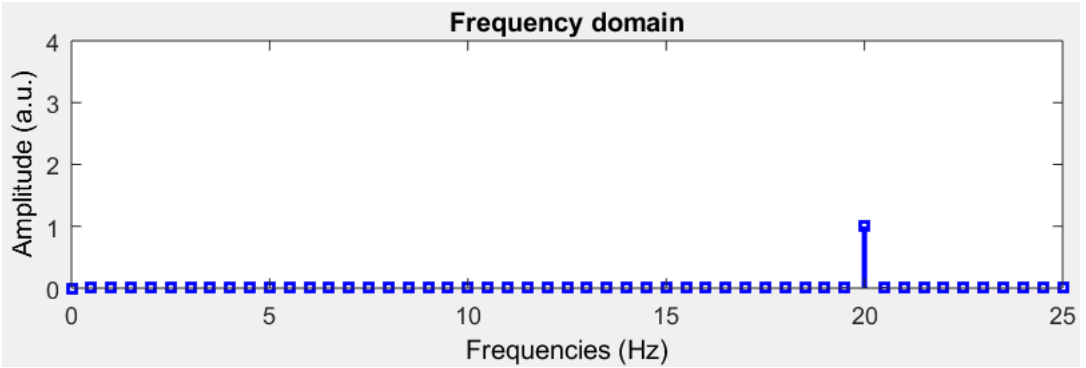


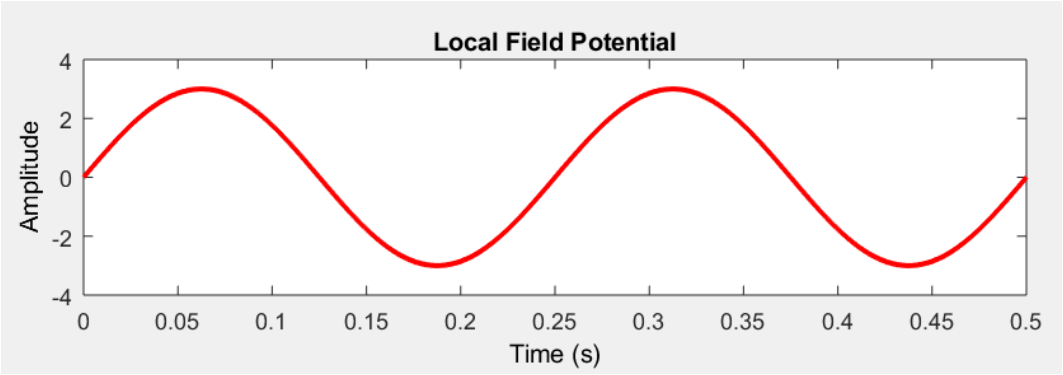
Fourier Transform



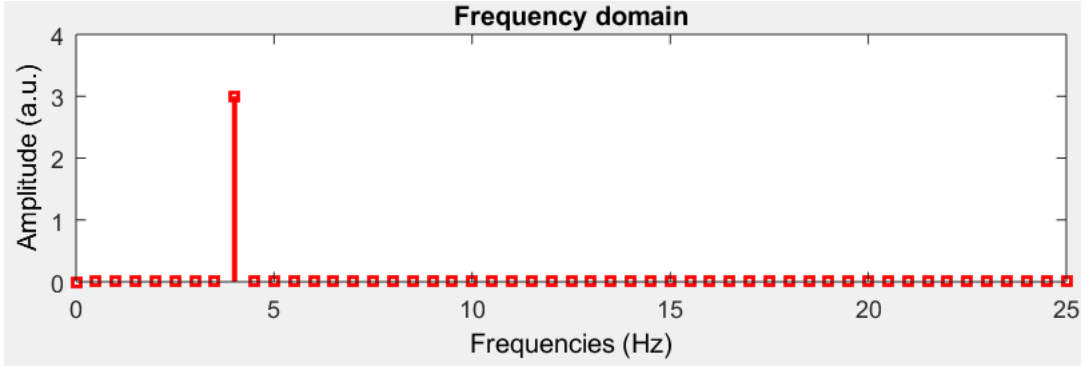


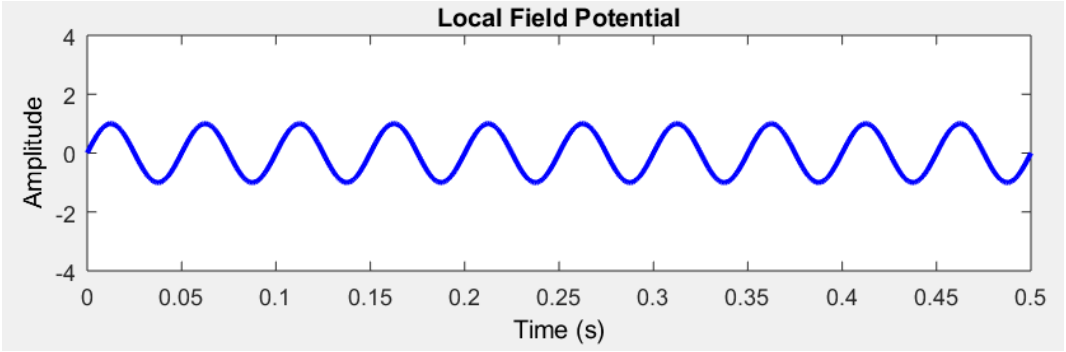
Fourier Transform



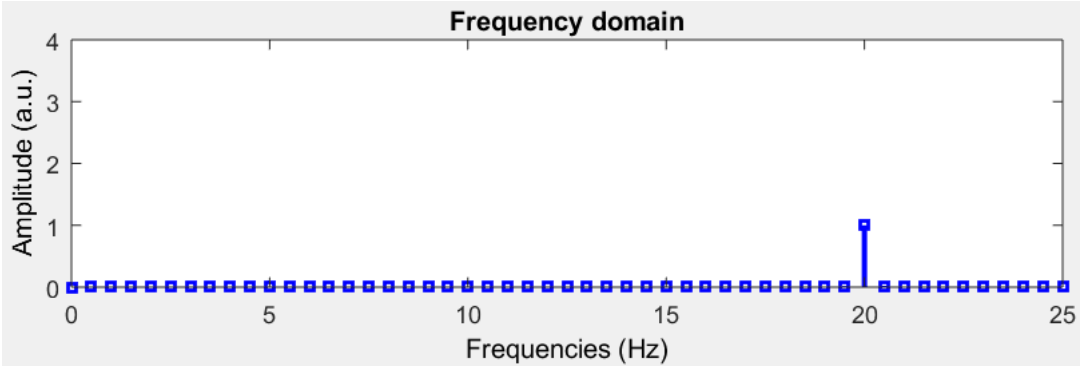


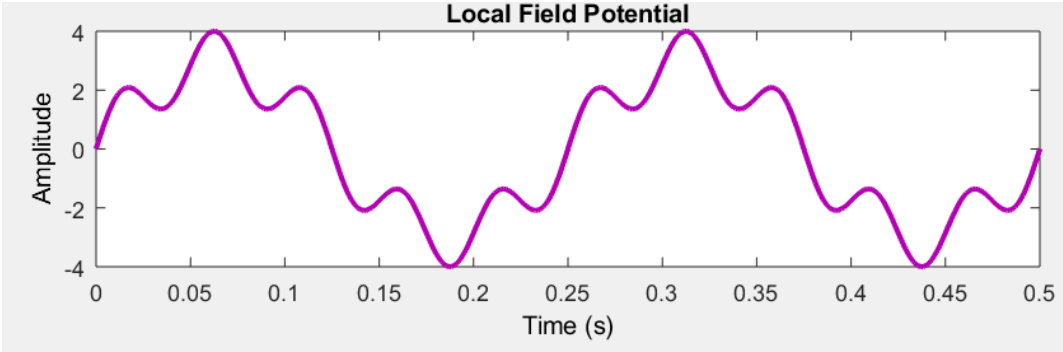
Fourier Transform

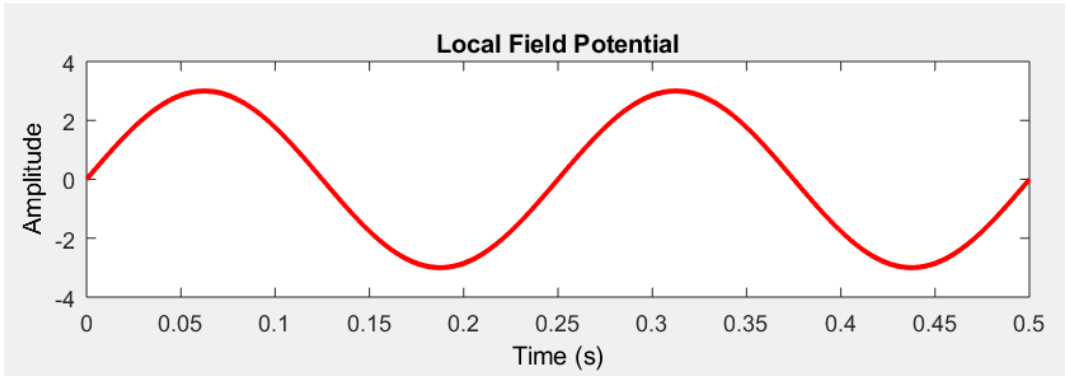




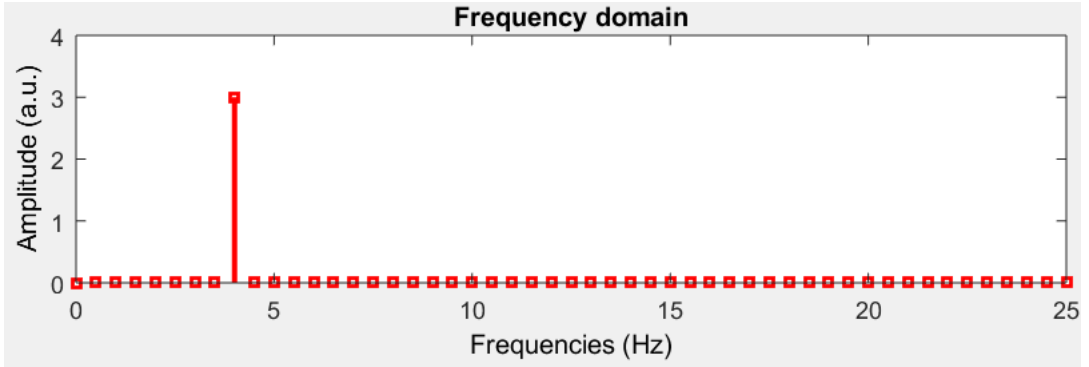
Fourier Transform

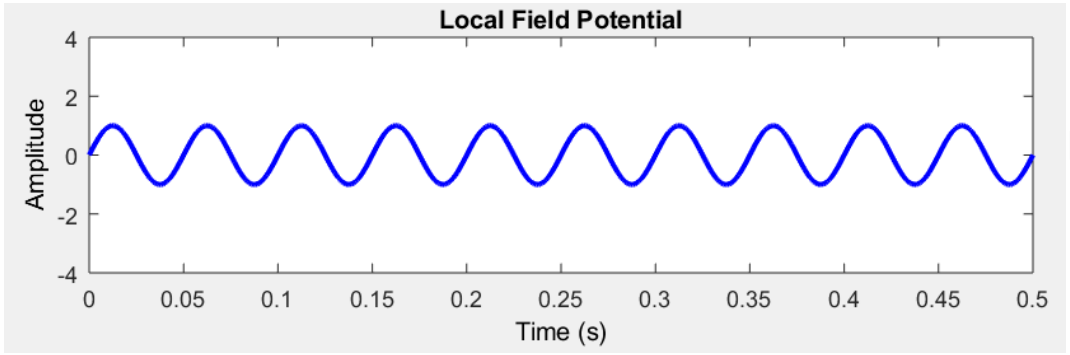




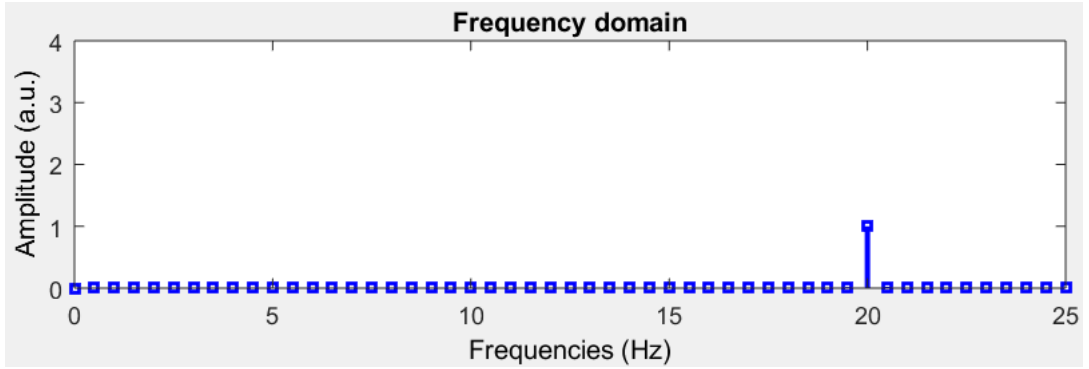


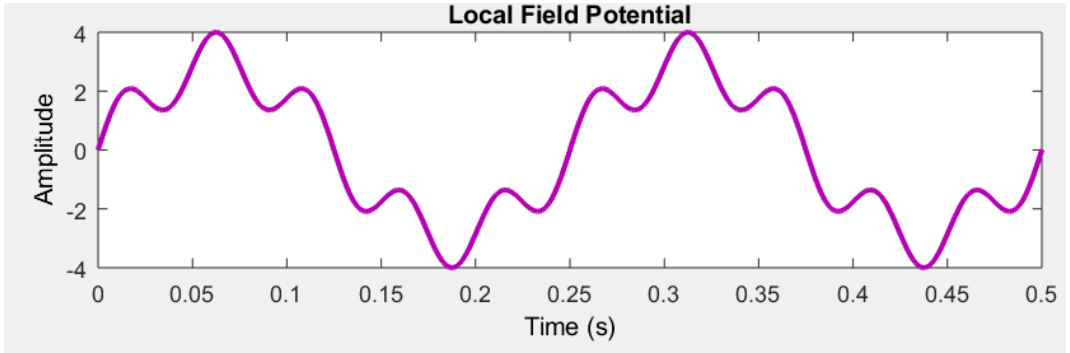
Fourier Transform





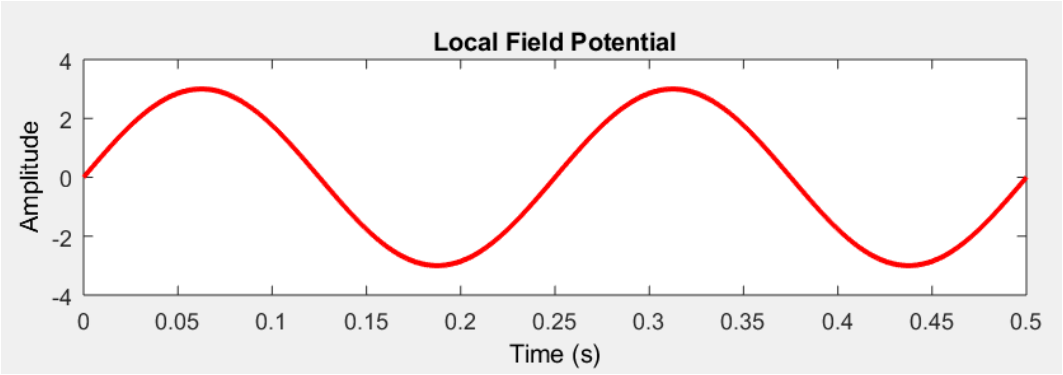
Fourier Transform



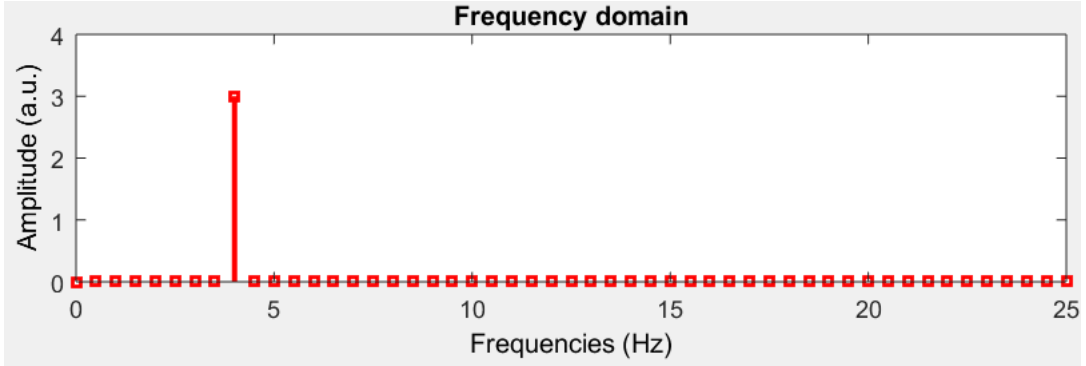


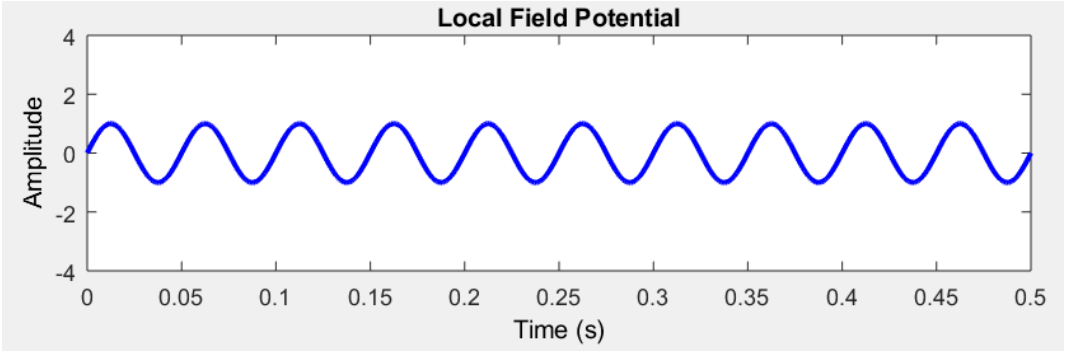
Fourier Transform

?

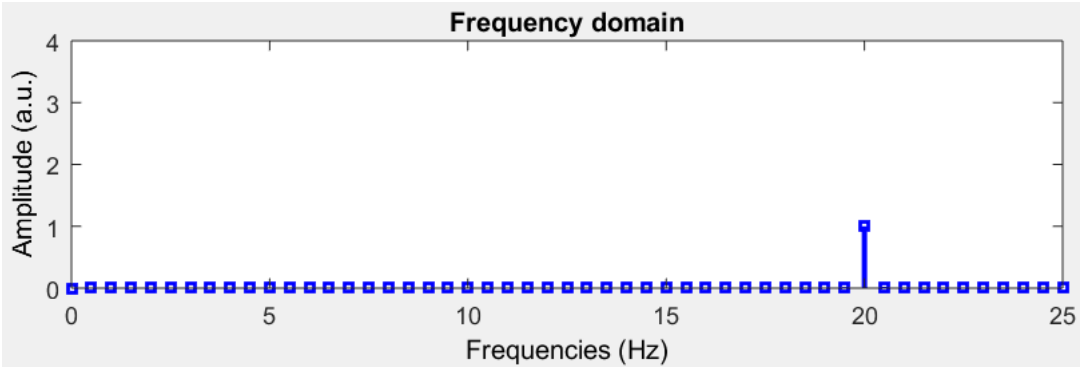


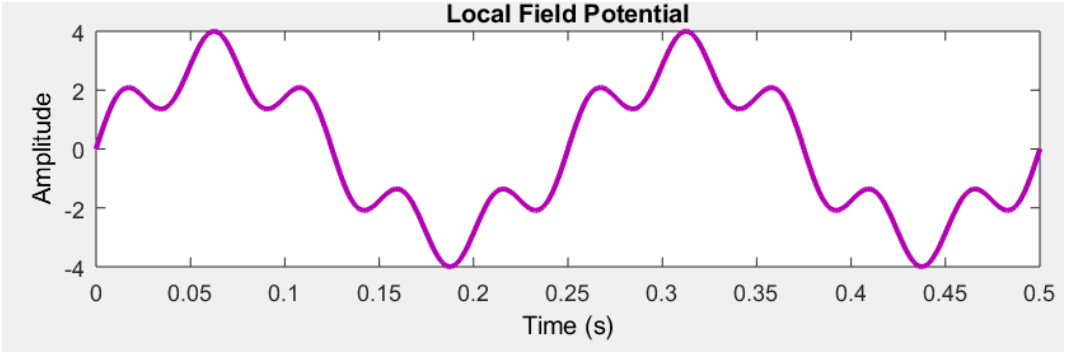
Fourier Transform



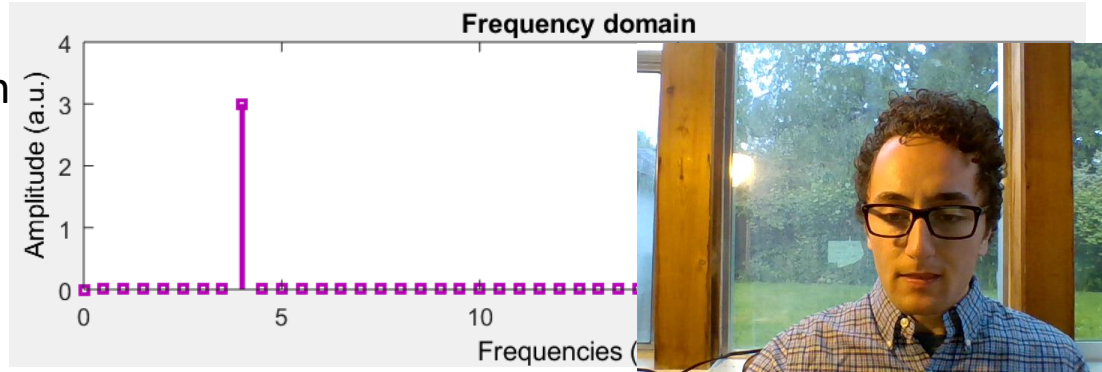


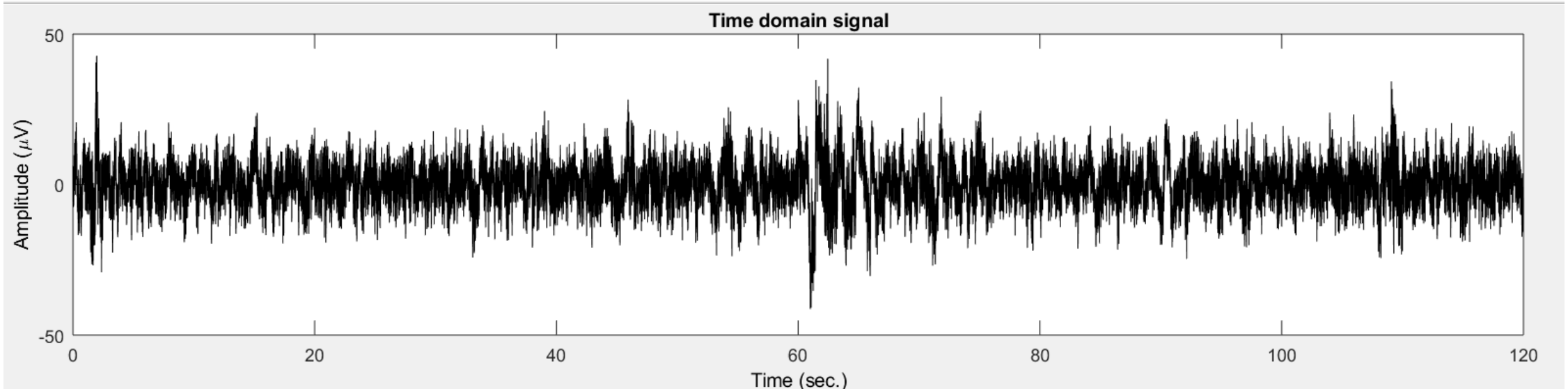
Fourier Transform



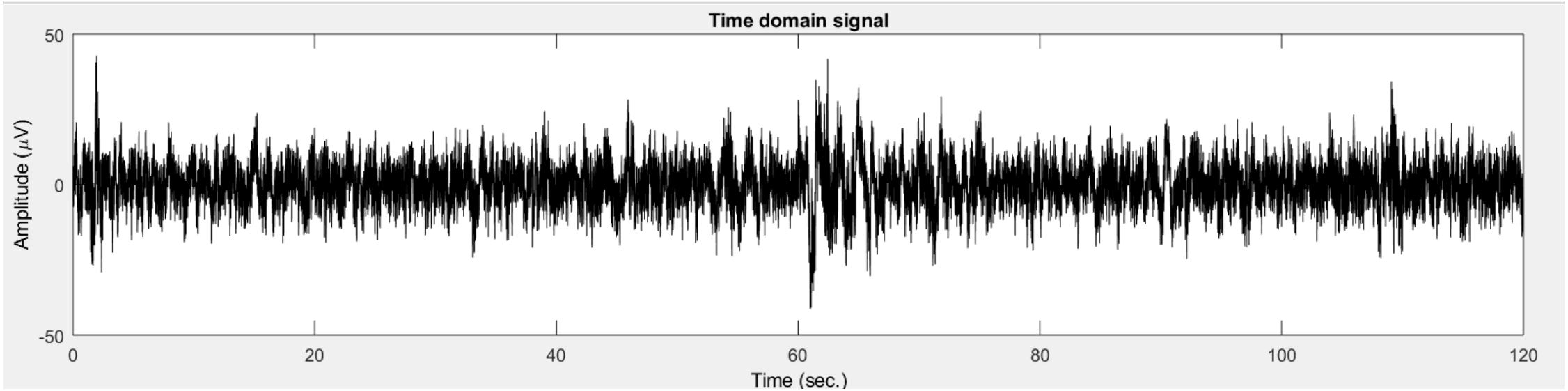


Fourier Transform

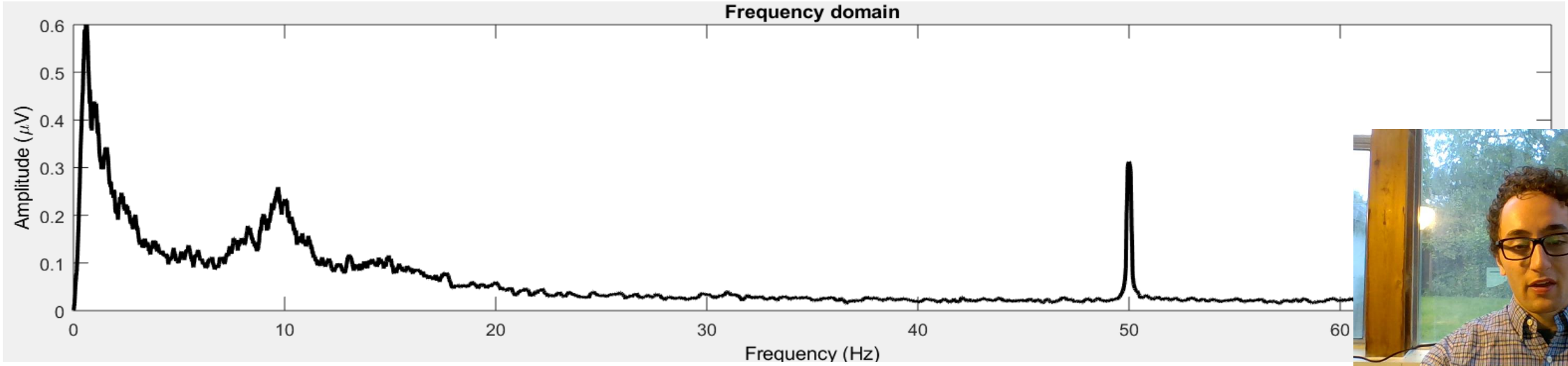


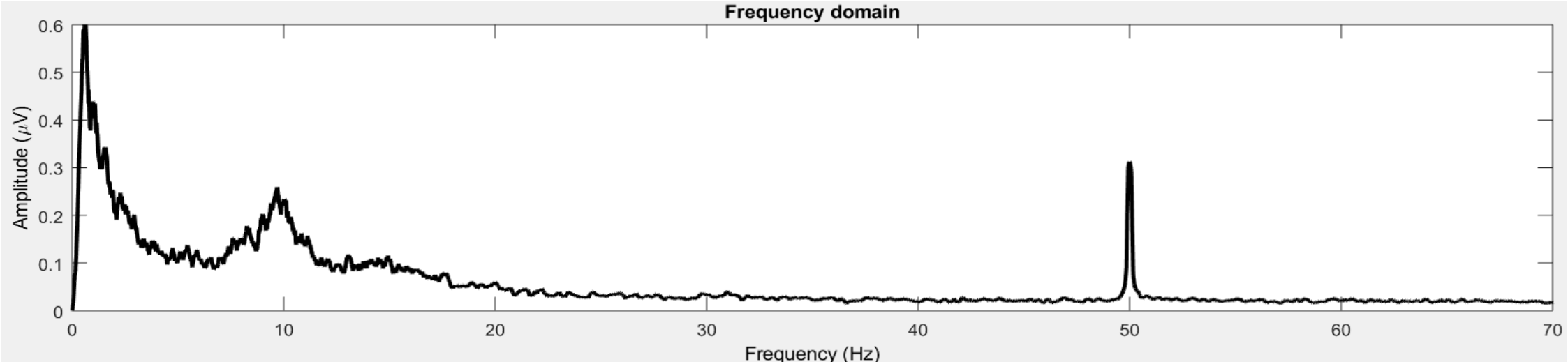


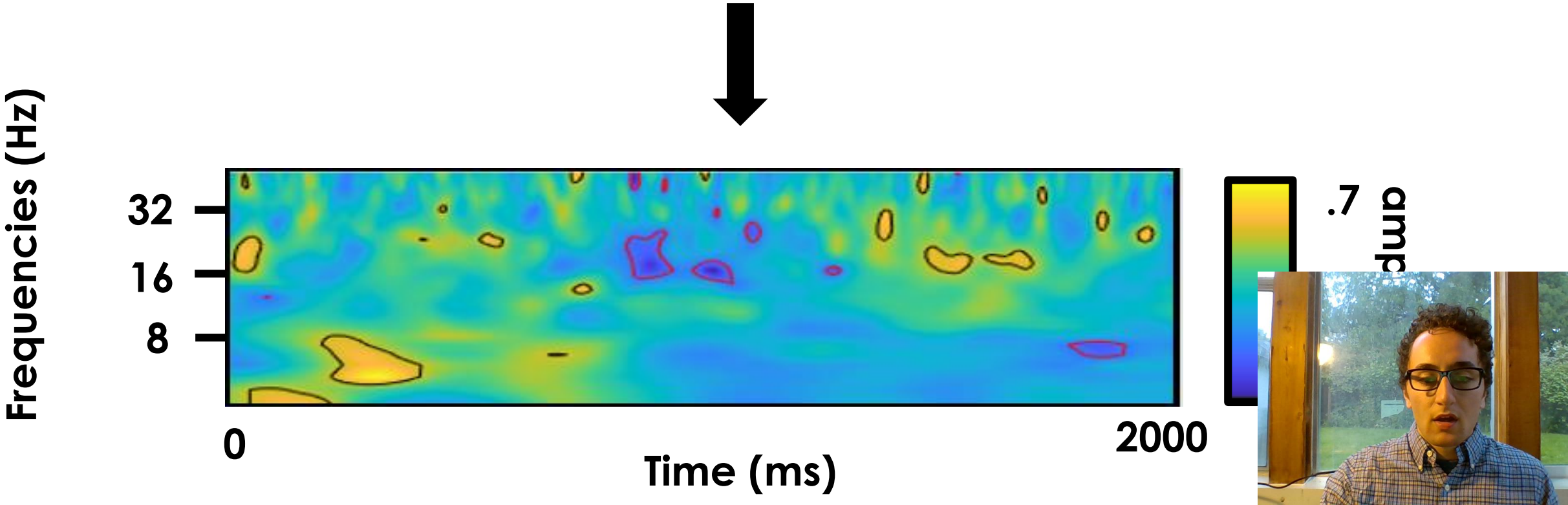
Fourier Transform

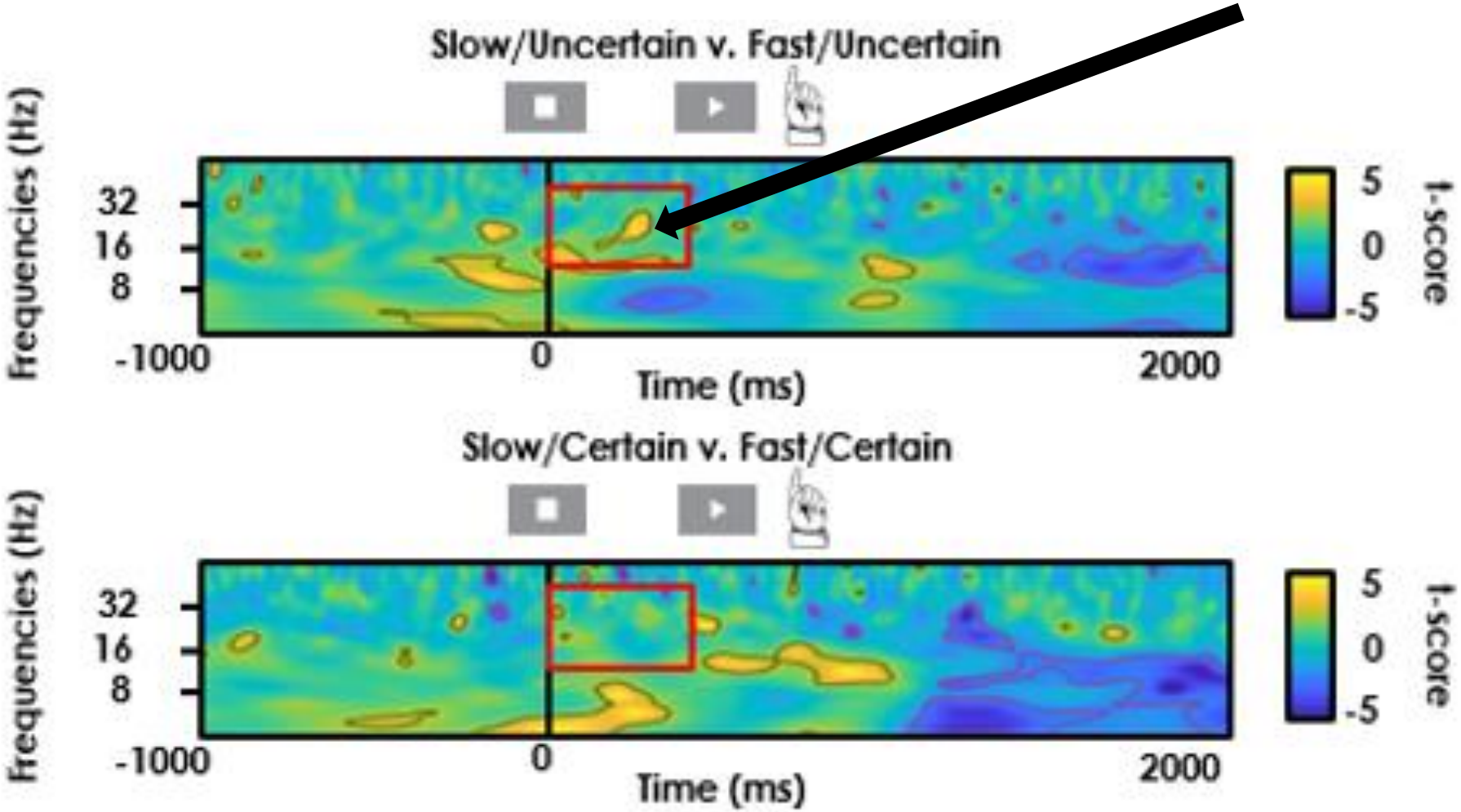


Fourier Transform




Frequency domain
Amplitude (μV)
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
Frequency (Hz)


Frequencies (Hz)
32
16
8
0
2000
Time (ms)
.7


Slow/Uncertain v. Fast/Uncertain
Frequencies (Hz)
32
16
8
-1000
0
2000
Time (ms)
5
0
-5
t-score
Slow/Certain v. Fast/Certain
Frequencies (Hz)
32
16
8
-1000
0
2000
Time (ms)
5
0
-5
t-score

Nonparametric statistical testing of EEG- and MEG-data ☆ ☆☆

Eric Maris [a, b] ✉, Robert Oostenveld [b]

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https://doi.org/10.1016/j.jneumeth.2007.03.024

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Single-trial normalization for event-related spectral decomposition reduces sensitivity to noisy trials

***Romain Grandchamp*[1,2] * *and Arnaud Delorme*[1,2,3]**

[1] *Centre de Recherche Cerveau et Cognition, Paul Sabatier University, Toulouse, France*
[2] *Centre de Recherche Cerveau et Cognition, UMR5549, CNRS, Toulouse, France*
[3] *Swartz Center for Computational Neuroscience, Institute for Neural Computation, University of California San Diego, La Jolla, CA, USA*

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plot

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plot R2020

2-D line plot collapse all in pa

Syntax

```
plot(X,Y)
plot(X,Y,LineSpec)
plot(X1,Y1,...,Xn,Yn)
plot(X1,Y1,LineSpec1,...,Xn,Yn,LineSpecn)

plot(Y)
plot(Y,LineSpec)

plot( __ ,Name,Value)
plot(ax, __ )

h = plot( __ )
```

Description

exam

`plot(X,Y)` creates a 2-D line plot of the data in `Y` versus the corresponding values in `X`.

- If `X` and `Y` are both vectors, then they must have equal length. The `plot` function plots `Y` versus `X`.
- If `X` and `Y` are both matrices, then they must have equal size. The `plot` function plots columns of `Y` versus columns of `X`.
- If one of `X` or `Y` is a vector and the other is a matrix, then the matrix must have dimensions such that one of its dimensions equals the vector length. If the number of matrix rows equals the vector length, then the `plot` function plots each matrix column versus the vector. If the number of matrix columns equals the vector length, then the function plots each matrix row versus the vector. If the matrix is square, then the function plots each column versus the vector.