EEG based action classification

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EEG

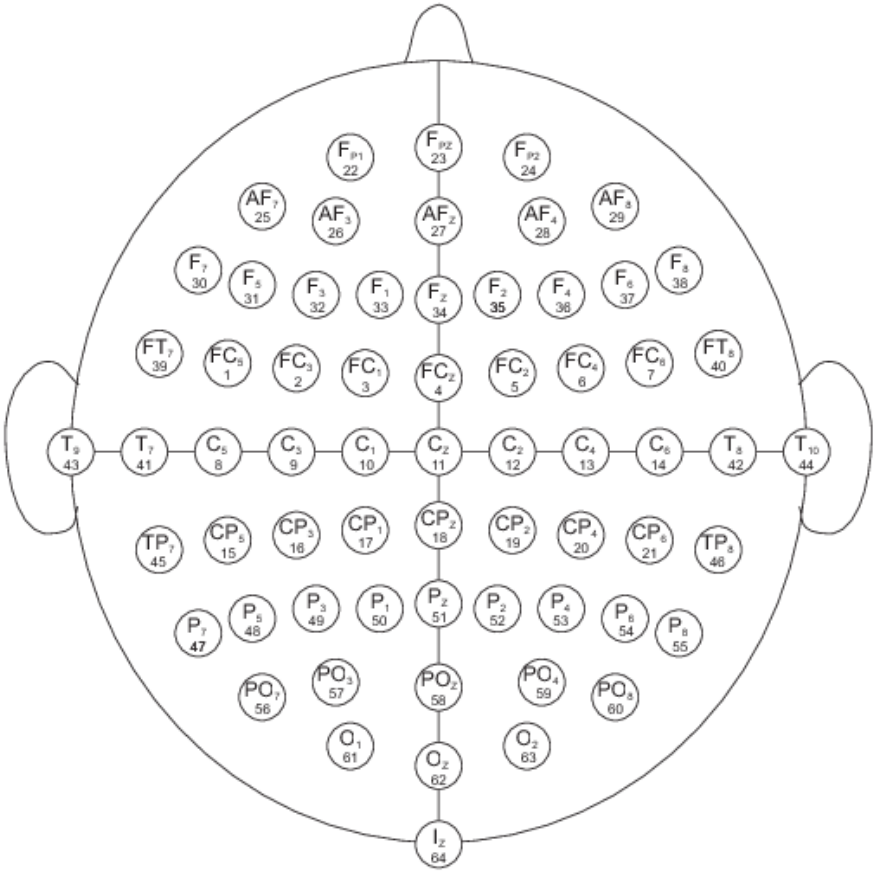
- The electroencephalogram, or EEG, consists of the **electrical activity** of relatively large neuronal populations that can be recorded from the scalp.
- Hans Berger (1873–1941) recorded the first human EEG in **1924**. He also invented the electroencephalogram, an invention described as "as one of the most surprising, remarkable, and momentous developments in the history of clinical neurology"
- Today **Event Related Potential**(ERP) measured using EEG is one of the most widely used method in cognitive neuroscience.

The Experiment

Trying to distinguish between kinesthetic imagination and actual motor movement.

Dataset

- 64-channel EEG recorded using the BCI2000 system. Available at Physionet.
- Tasks included:
  - opening and closing of right or left fist
  - Imagination of opening and closing of right or left fist
  - Opening and closing of both fists or both feet
  - Imagination of opening and closing of both fists or both feet.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FP2 24
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AF3 26
AFZ 27
AF4 28
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F7 30
F5 31
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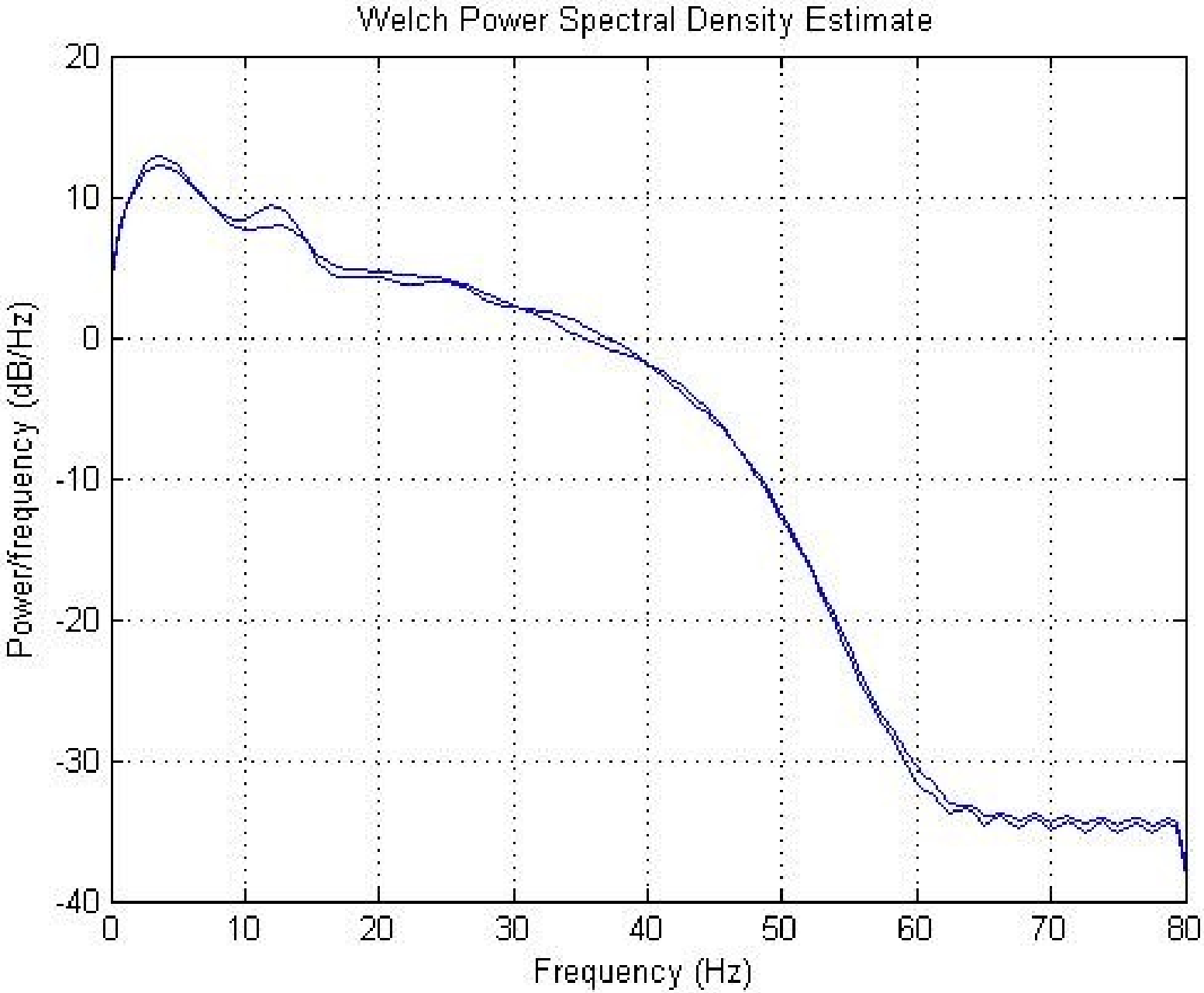
F2 35
F4 36
F6 37
F8 38
FT7 39
FC5 1
FC3 2
FC1 3
FCZ 4
FC2 5
FC4 6
FC6 7
FT8 40
T9 43
T7 41
C5 8
C3 9
C1 10
CZ 11
C2 12
C4 13
C6 14
T8 42
T10 44
TP7 45
CP5 15
CP3 16
CP1 17
CPZ 18
CP2 19
CP4 20
CP6 21
TP8 46
P7 47
P5 48
P3 49
P1 50
PZ 51
P2 52
P4 53
P6 54
P8 55
PO7 56
PO3 57
POZ 58
PO4 59
PO8 60
O1 61
OZ 62
O2 63
IZ 64

Assumptions/Simplifications

- It is generally believed that the motor activity takes place in the sensorimotor cortical areas of brain.
- For simplification, considered only the channels C3,C4 and Cz(reference electerode).
- Considered only the tasks related to movement of fists and the imagination of their movement.

- Previous studies have shown that the mu rhythm (8-13 Hz) is blocked prior and during hand movement.
- Power Spectral density study shows there is a significant gap between the actual and imagery motor tasks in the mu rhythm range.


Welch Power Spectral Density Estimate
Power/frequency (dB/Hz)
Frequency (Hz)
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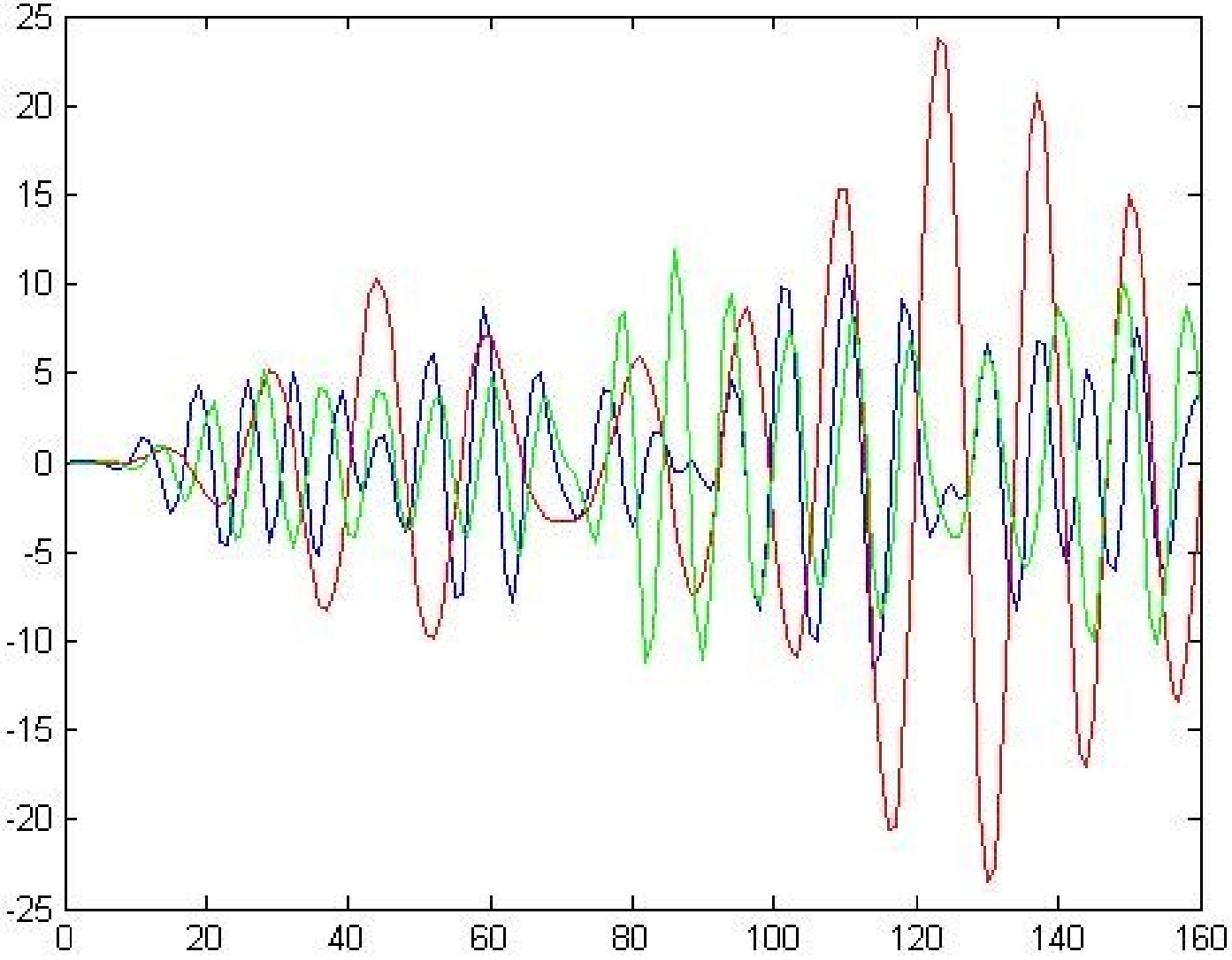
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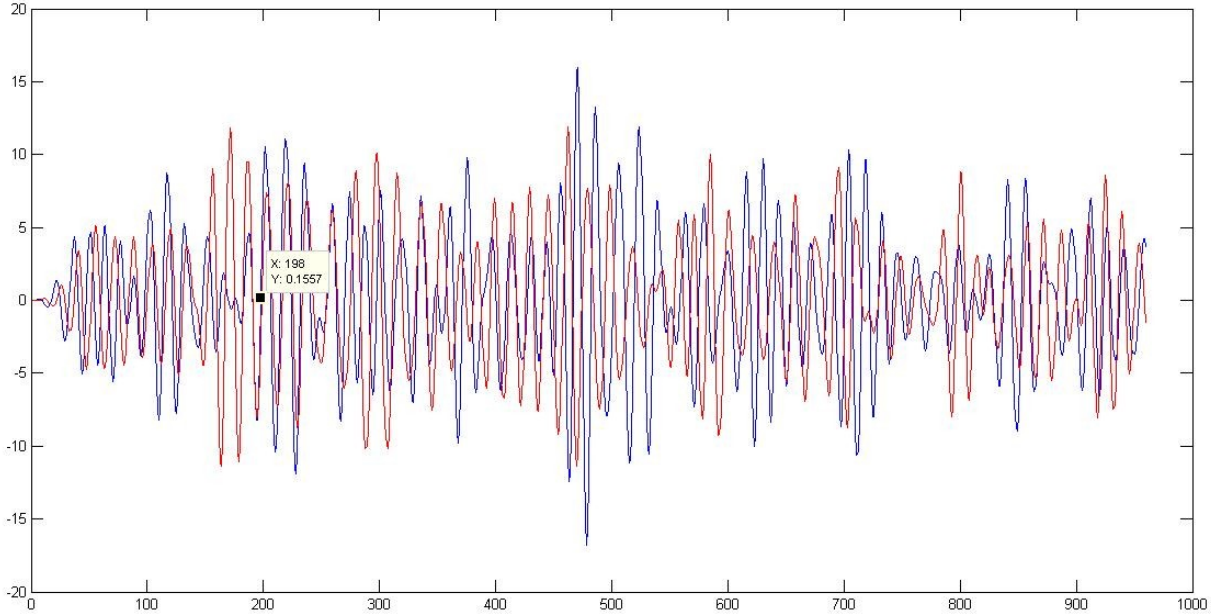
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Y: 0.1557
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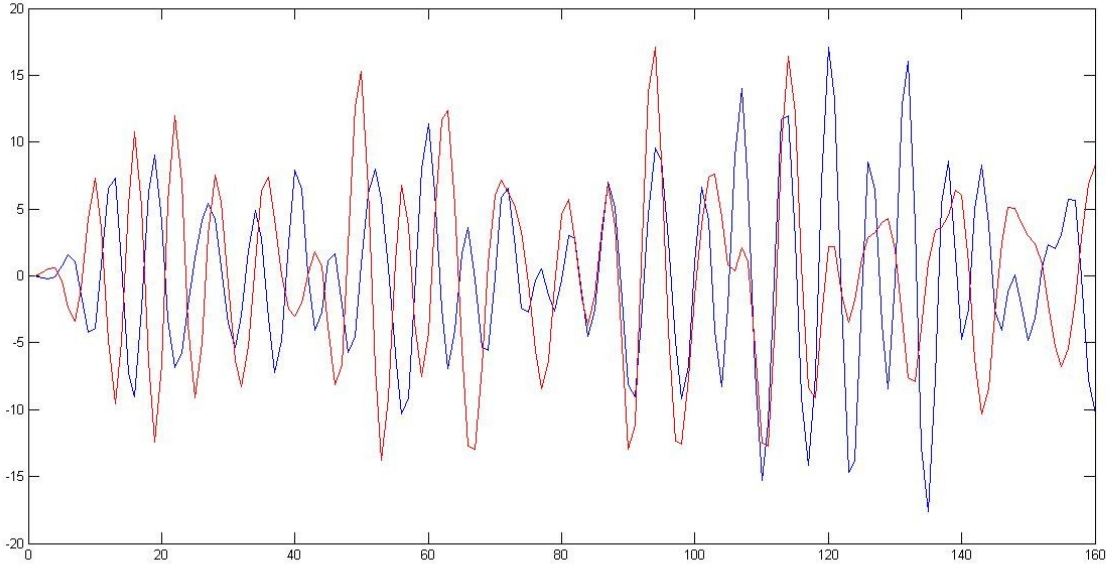
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Additions/Modifications

- A classifier to be made from data from a large number of subjects using machine learning.
- Feet movement, contrary to hand movement shows a positive spike in mu rhythm. This can be used to distinguish it.

Thank You!

Questions?

References

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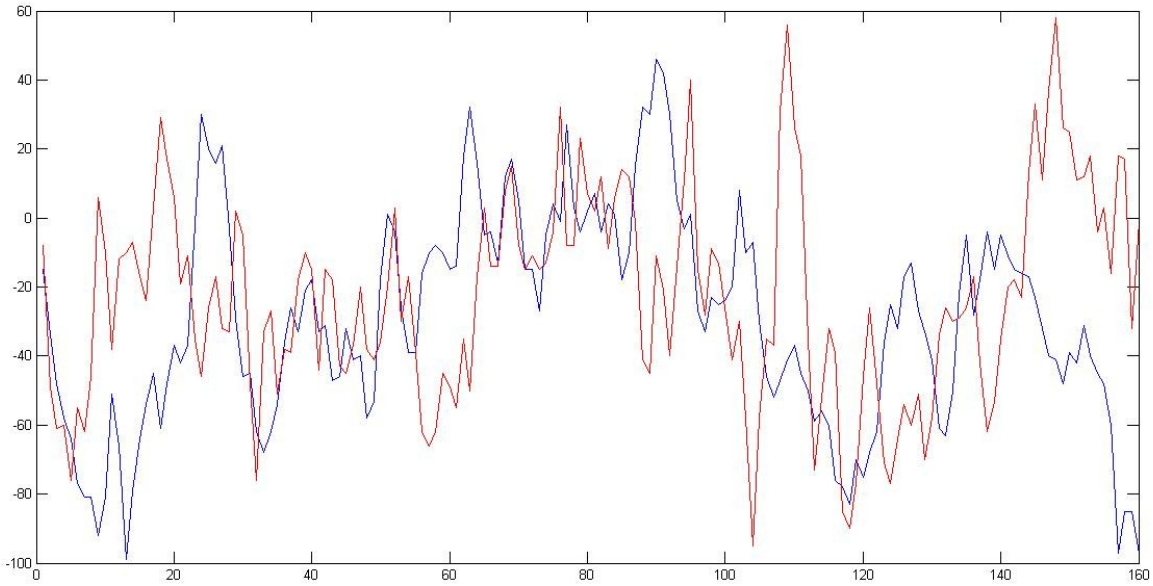
- http://www.sciencedirect.com/science/article/pii/S0304394097008896
- http://www.sciencedirect.com/science/article/pii/S1388245799001418
- http://www.ai.rug.nl/~lambert/projects/BCI/literature/serious/non-invasive/BCI-eeg-mu-and-beta-rhythm-topographies-with-movement-imagery-and-actual-movement.pdf
- http://edu.technion.ac.il/haptech/publications/Publications_files/Imagery_motor_actions_2005.pdf
- mathworks.in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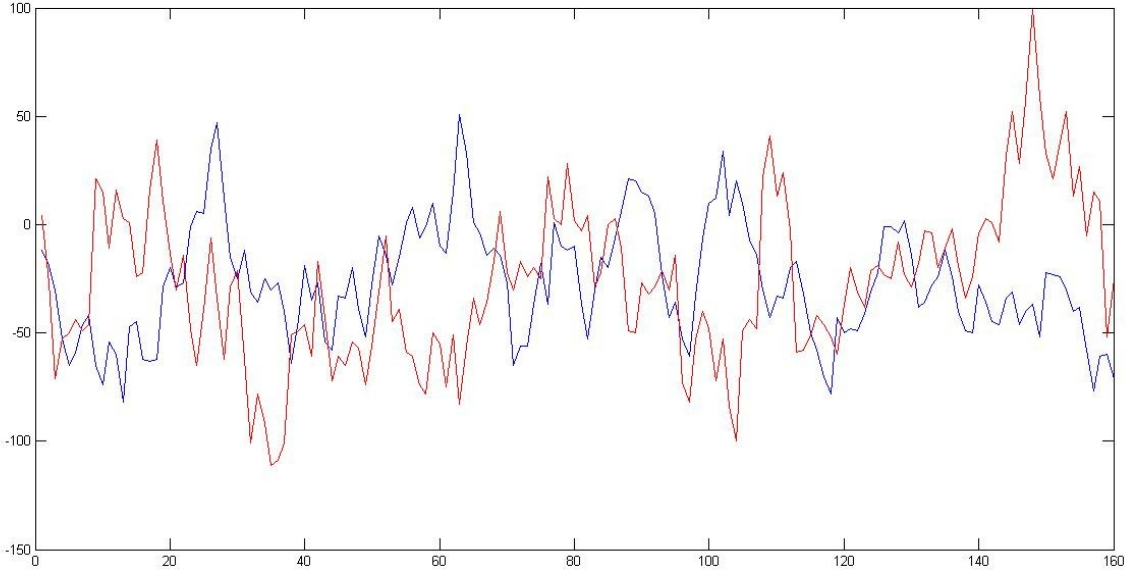
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