



Piotr S. Wawryka

Department of Biocybernetics and Biomedical Engineering

AGH University of Science and Technology

piotrwagh@gmail.com

27 – September – 2023

Agenda

What is **EMG**?

Measurements on Noraxon in Collegium Medicum

Signal processing methods

Acquisition

Segmentation

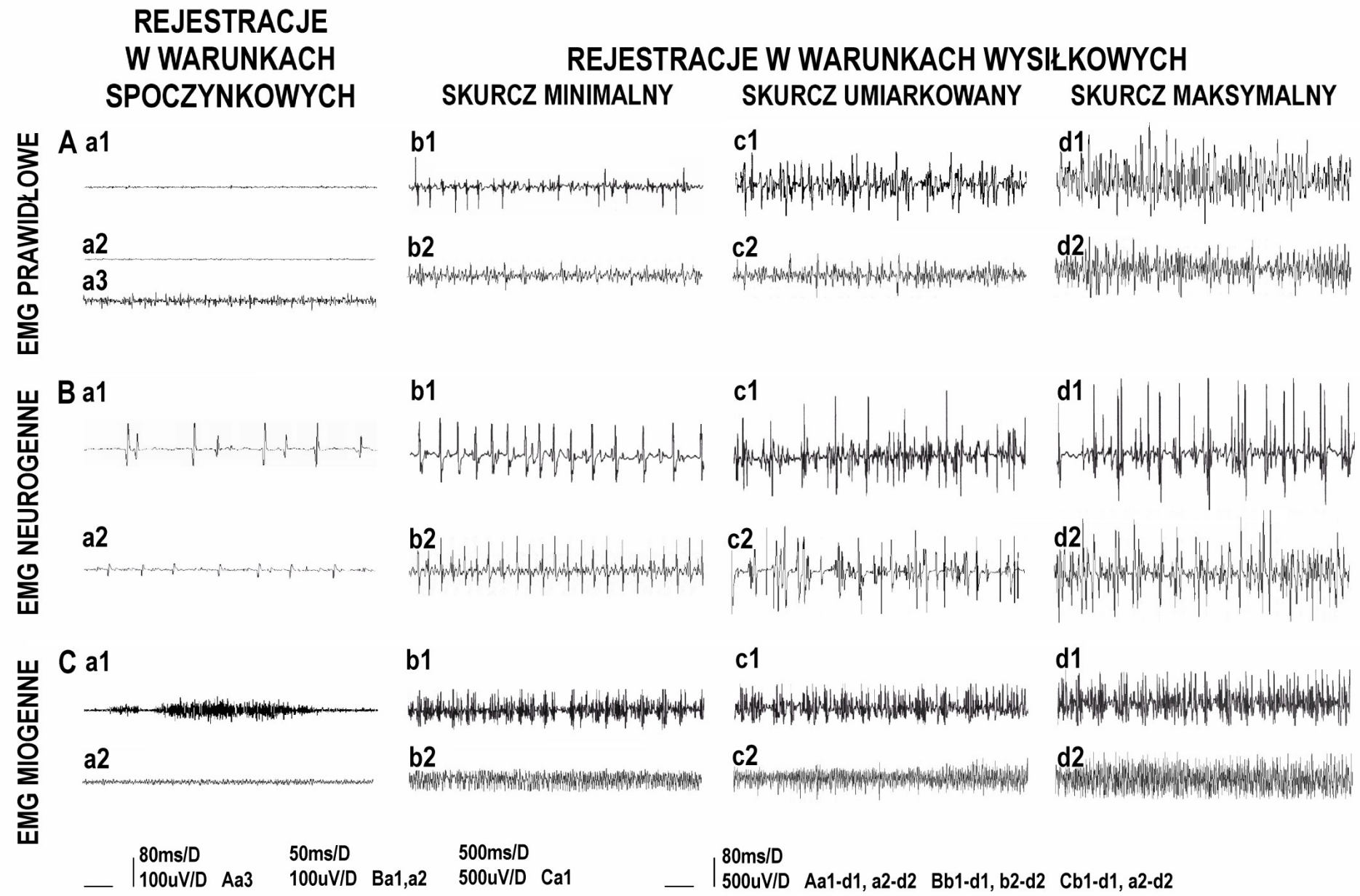
Harmonic analysis

Centroids

Minkowski distance

Categorization


Work
of
muscles





1. Devices in your configuration


Click on a hardware device to adjust settings. To add a device, click and drag the icon from the 'Available Devices' area. To remove a device, drag the icon back to the 'Available Devices' area.



Ultium EMG

2. Select EMG Channels and Sensors

Click muscles and biomechanical sensors on map at the left to assign them to the channels in the table below.

| # |  Channel | * | Side | Name | Sensor | Amplitude | Units |
|---|---|---|------|-------------|--------|-----------|-------|
| | <input type="checkbox"/> EMG 1 | * | | | EMG | | |
| 1 | <input checked="" type="checkbox"/> EMG 2 | * | RT | BRACHIOR... | EMG | 500 | uV |
| | <input type="checkbox"/> EMG 3 | * | | | EMG | | |
| 2 | <input checked="" type="checkbox"/> EMG 4 | * | RT | BICEPS BR. | EMG | 500 | uV |
| | <input type="checkbox"/> EMG 5 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 6 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 7 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 8 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 9 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 10 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 11 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 12 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 13 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 14 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 15 | * | | | EMG | | |
| | <input type="checkbox"/> EMG 16 | * | | | EMG | | |
| | <input type="checkbox"/> Switch 1 | * | | | Switch | | |

Measurements



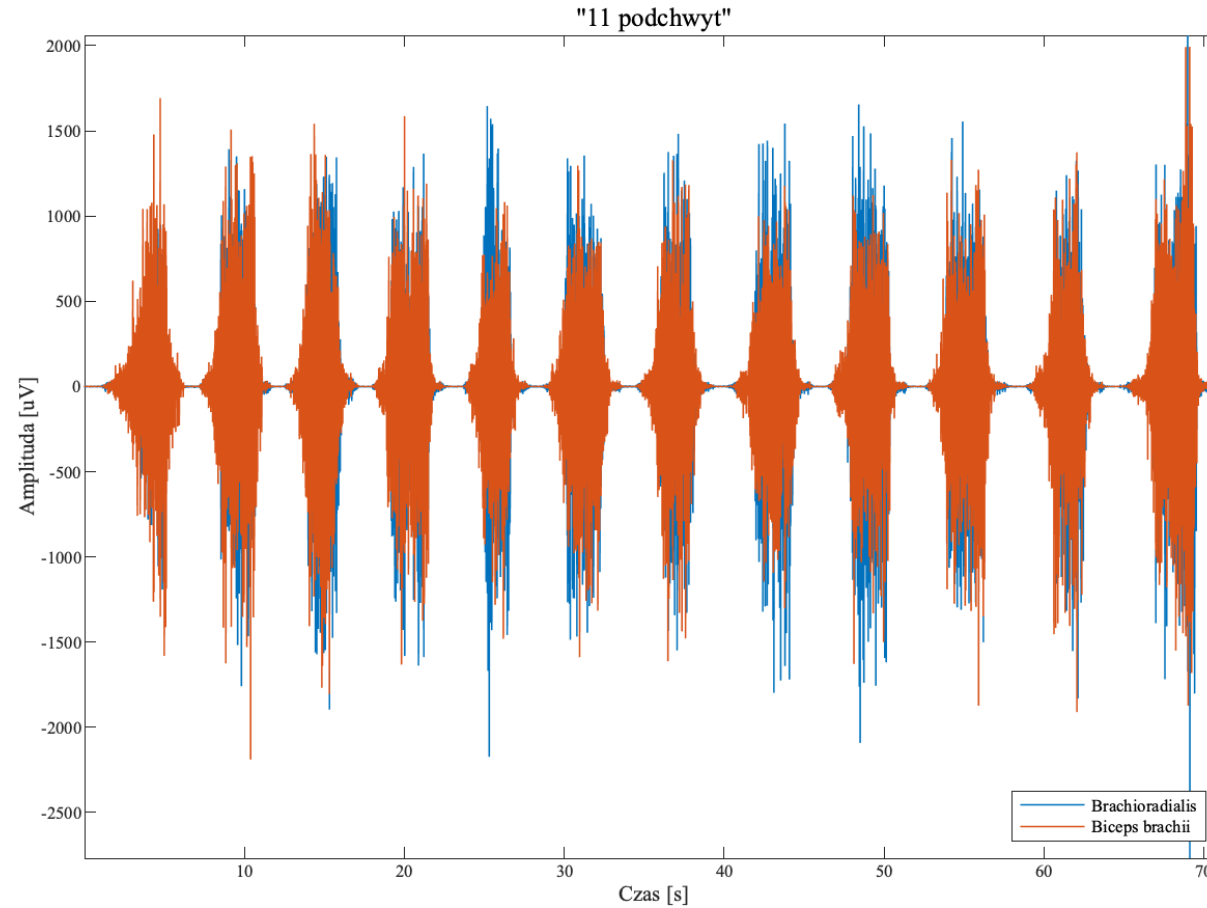
Uchwyt pośredni



Podchwyt

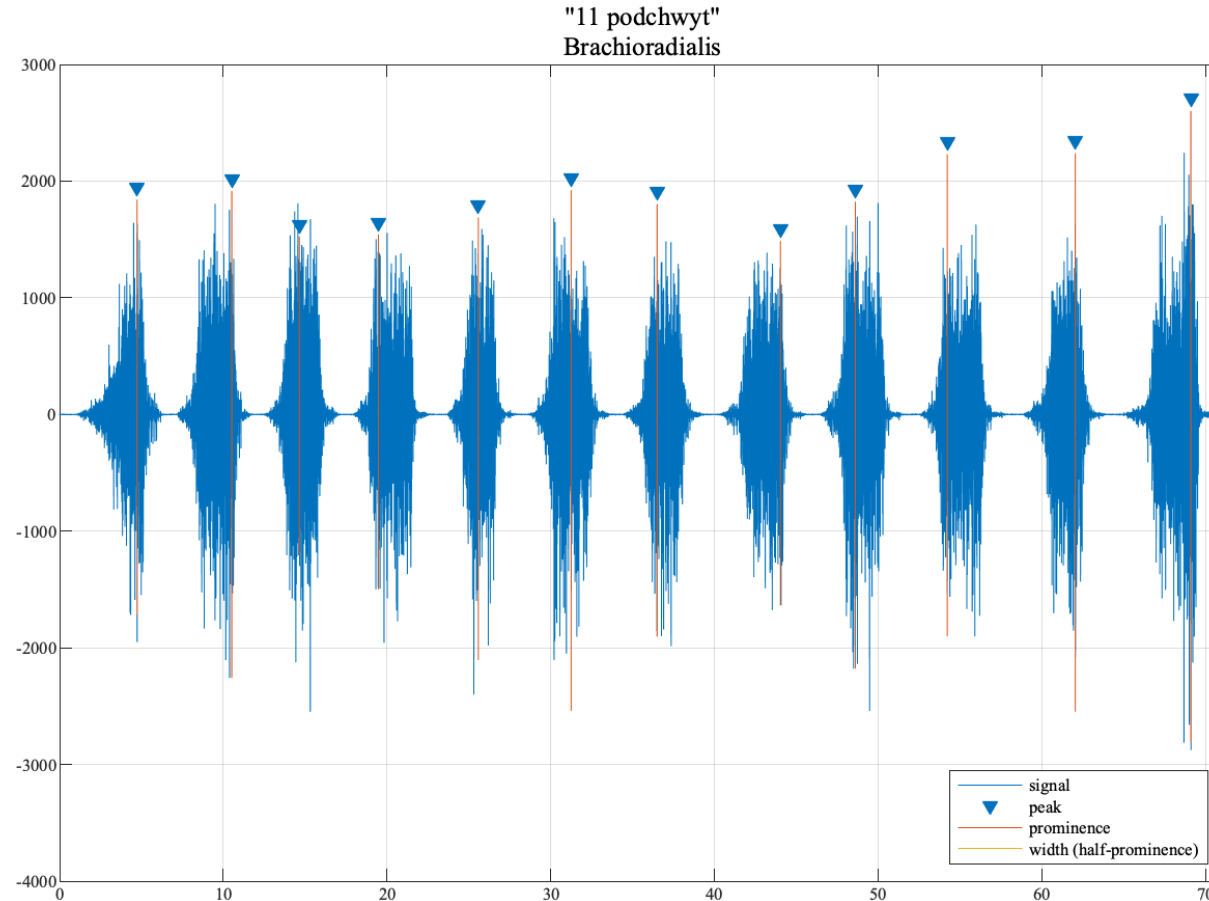
Duration: min. 2 s and 1 second of delay, series of 10 repetitions

Acquisition



Series of 10 repetitions for Radialis and Biceps muscle

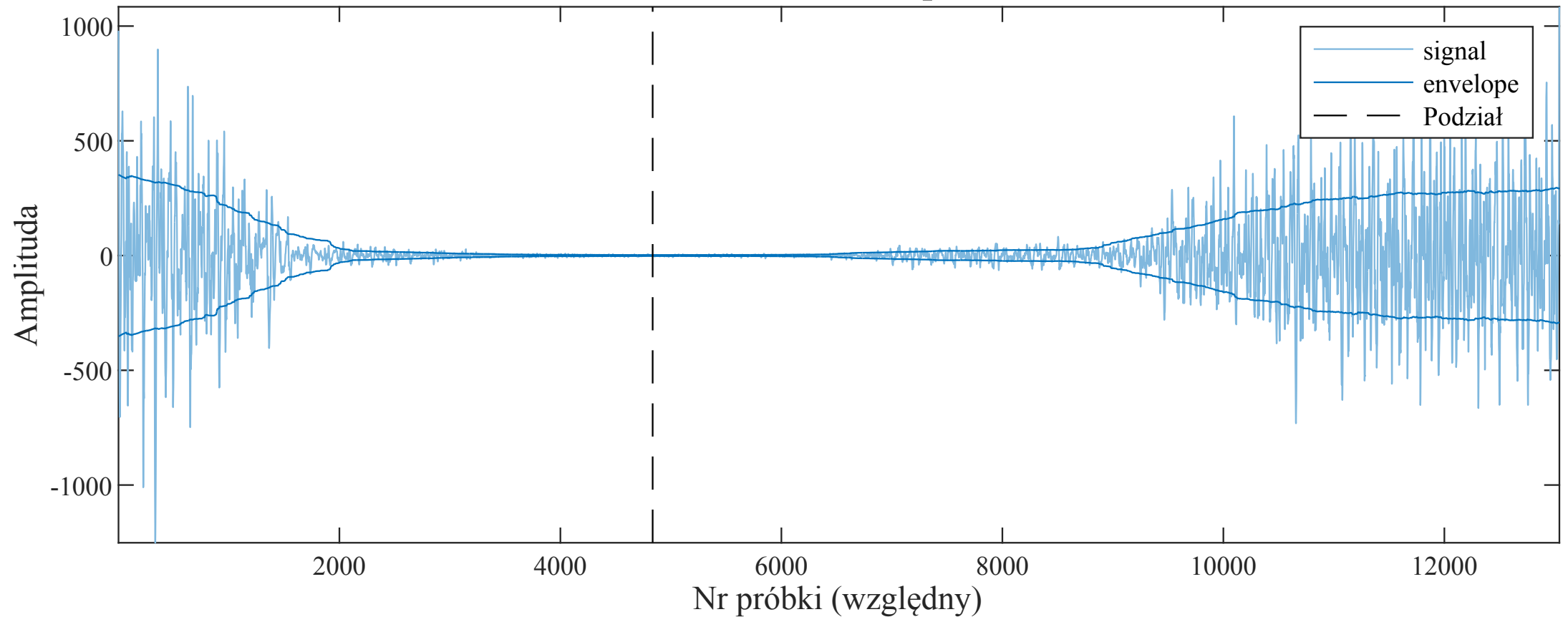
Segmentation



Series of 10 repetitions for Radialis and Biceps muscle

Segmentation

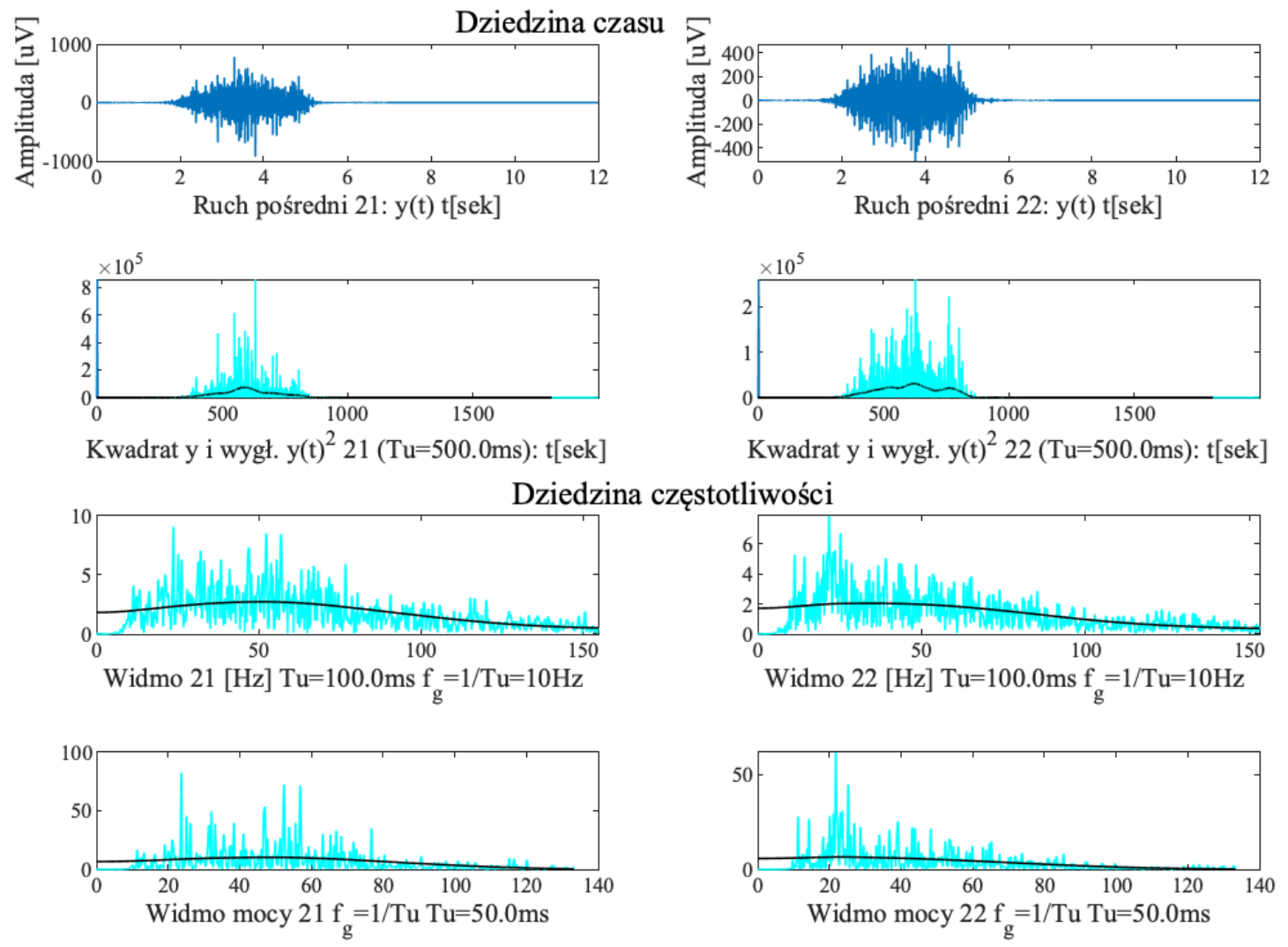
RMS Envelope



Series of 10 repetitions for Radialis and Biceps muscle

Harmonic analysis

Biceps brachii 270

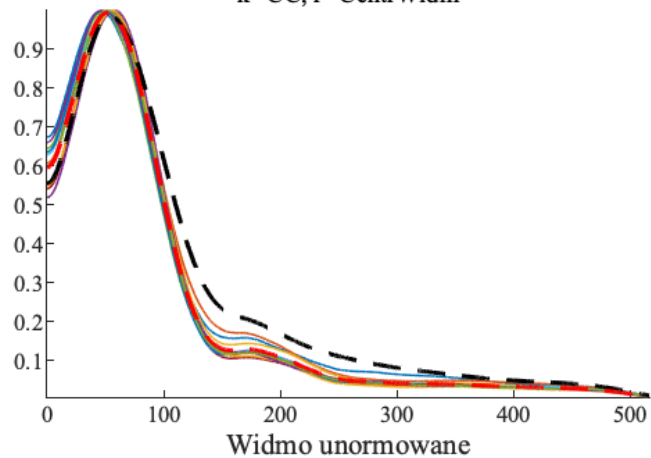


Centroids

Widma wewnątrzgrupowe, ćwiczenie "11 podchwyt"

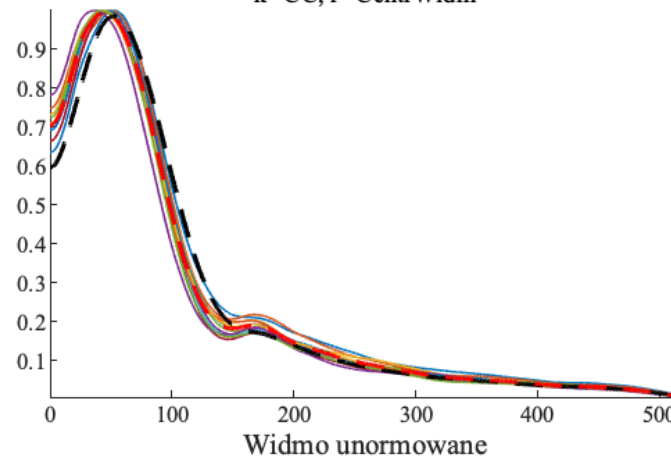
Brachioradialis

k--CC, r--CentrWidm

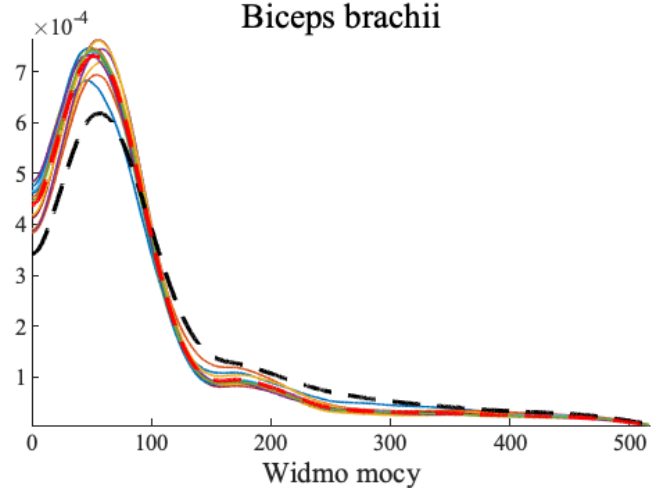


Biceps brachii

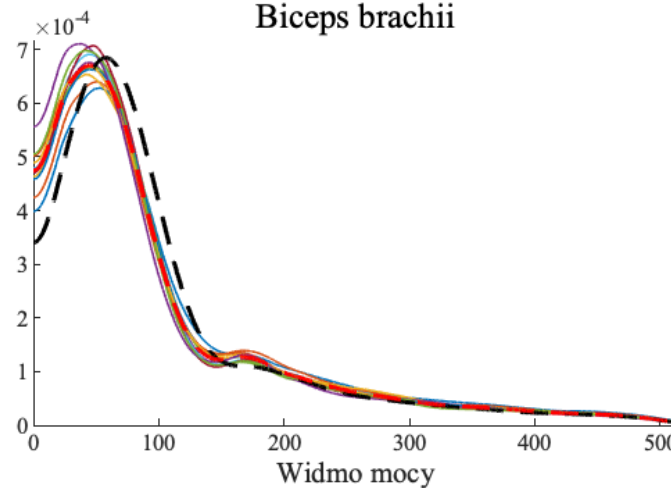
k--CC, r--CentrWidm



Biceps brachii

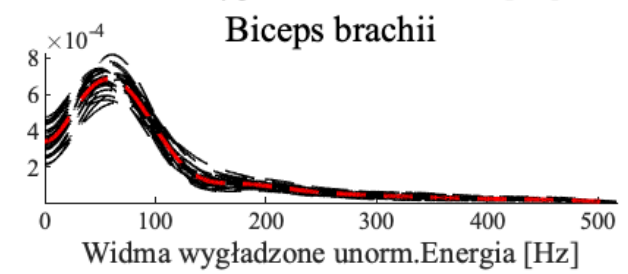
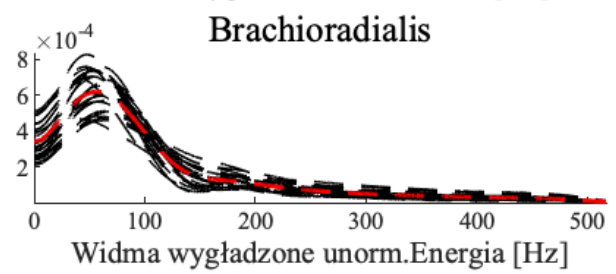
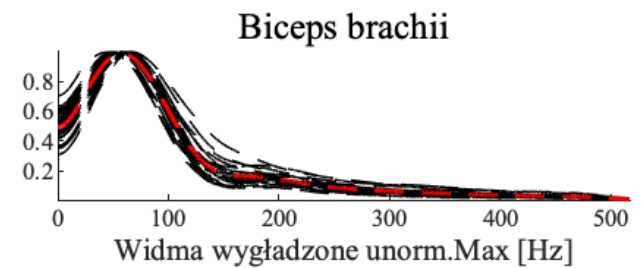
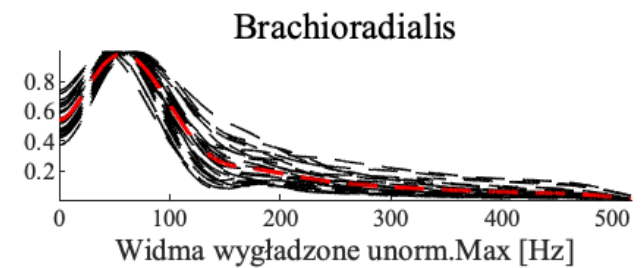
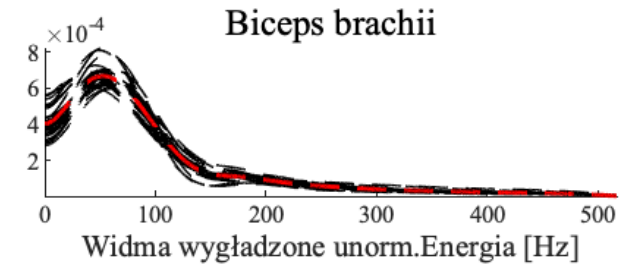
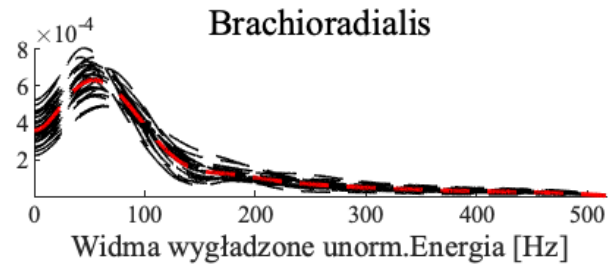
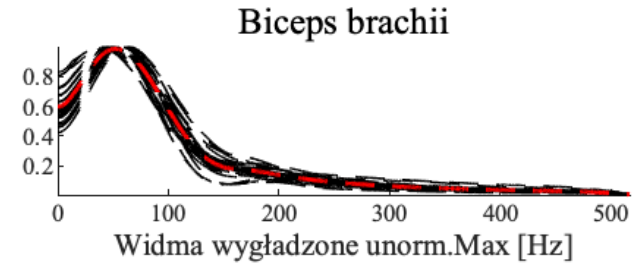
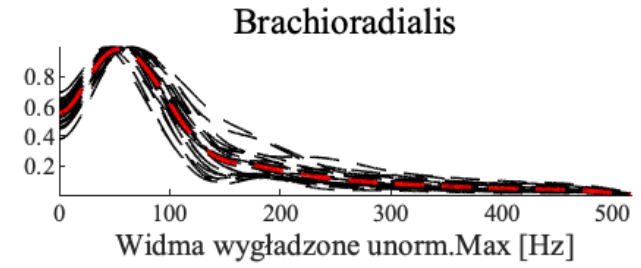


Biceps brachii

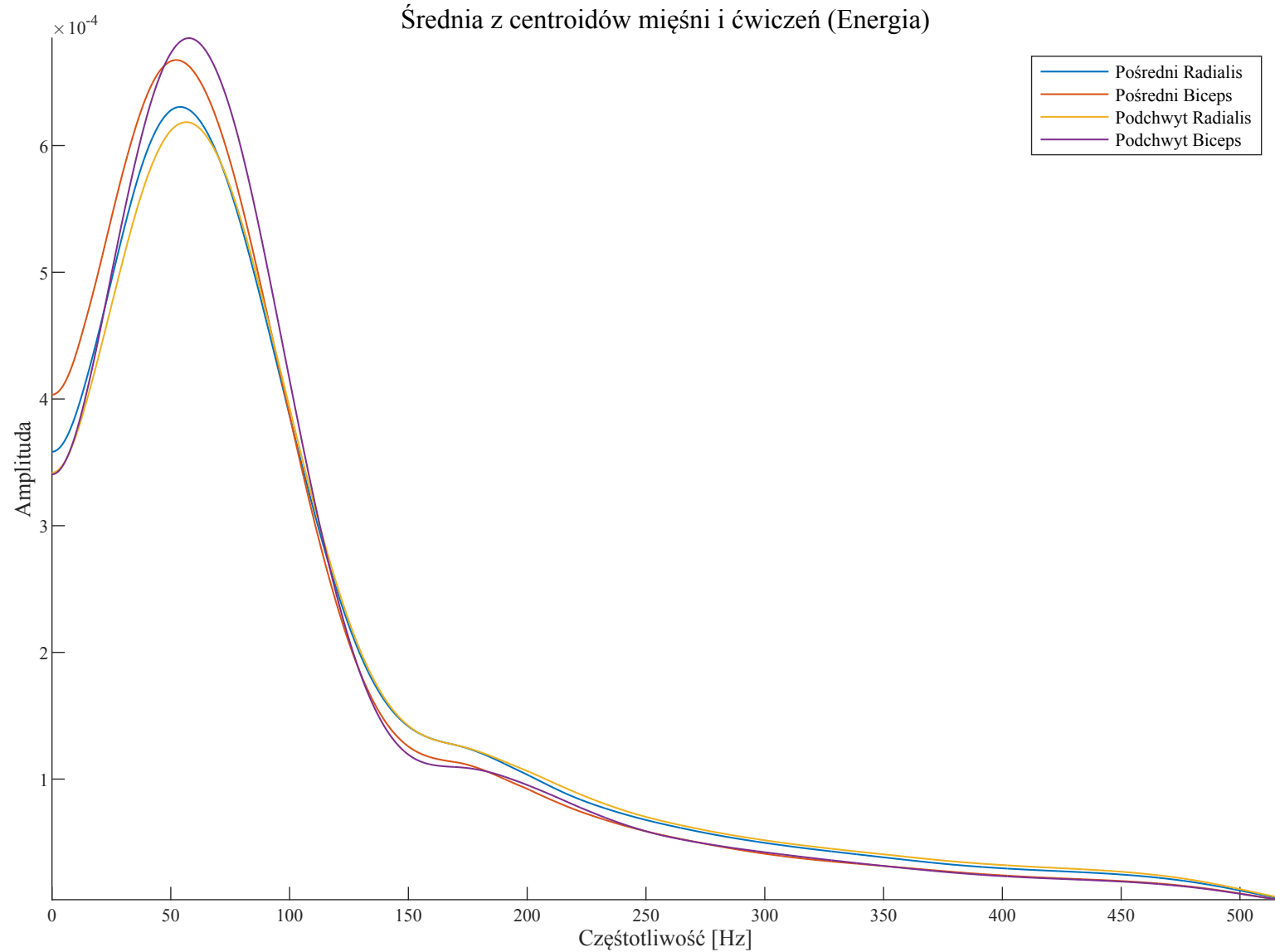


Centroids

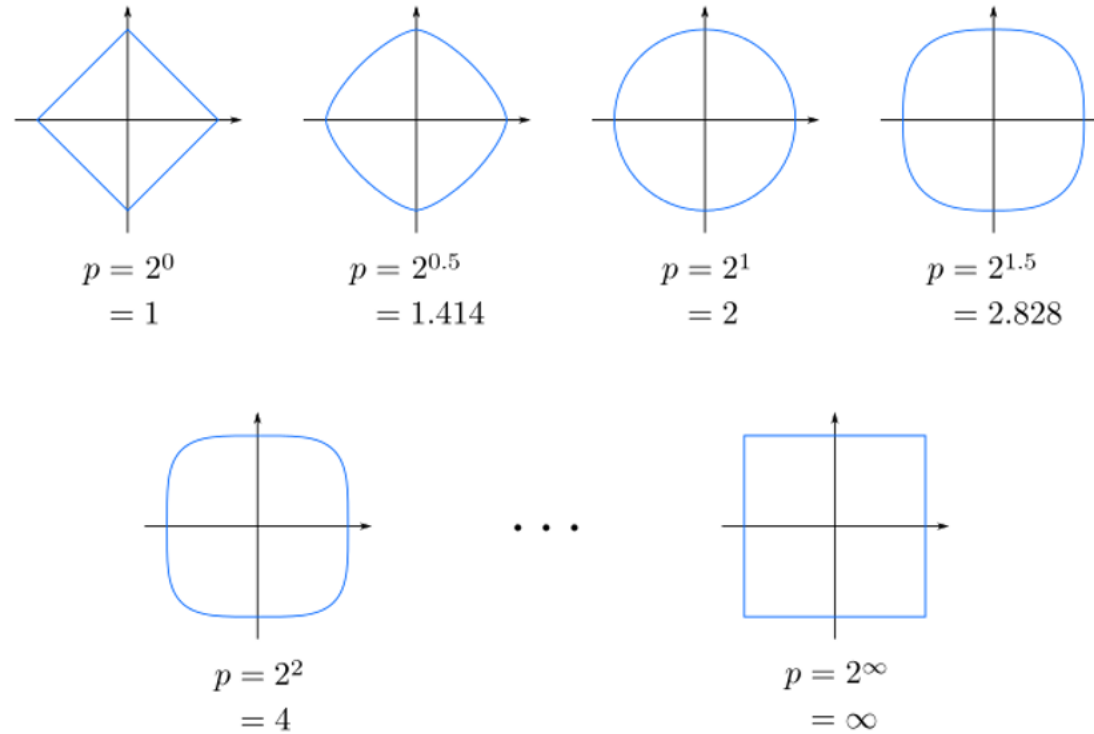
Centroidy z wszystkich ćwiczeń (55) pośredni(1:4) i podchwyt(5:8)



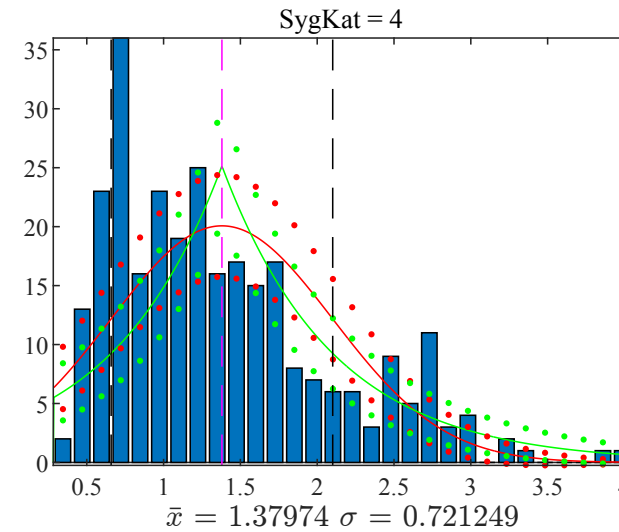
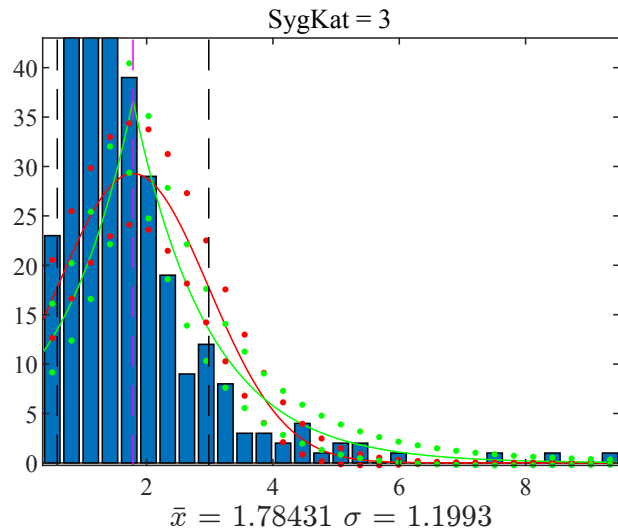
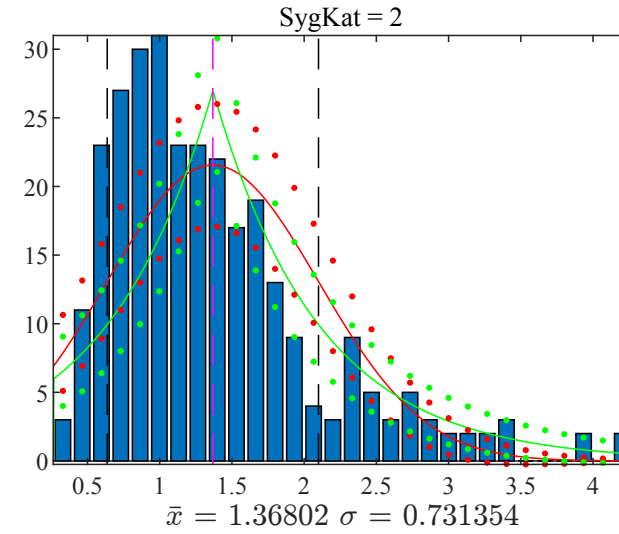
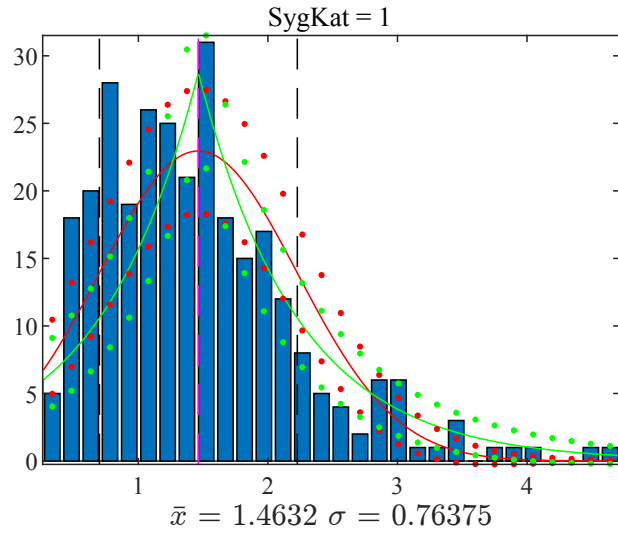
Centroids



Minkowski distance

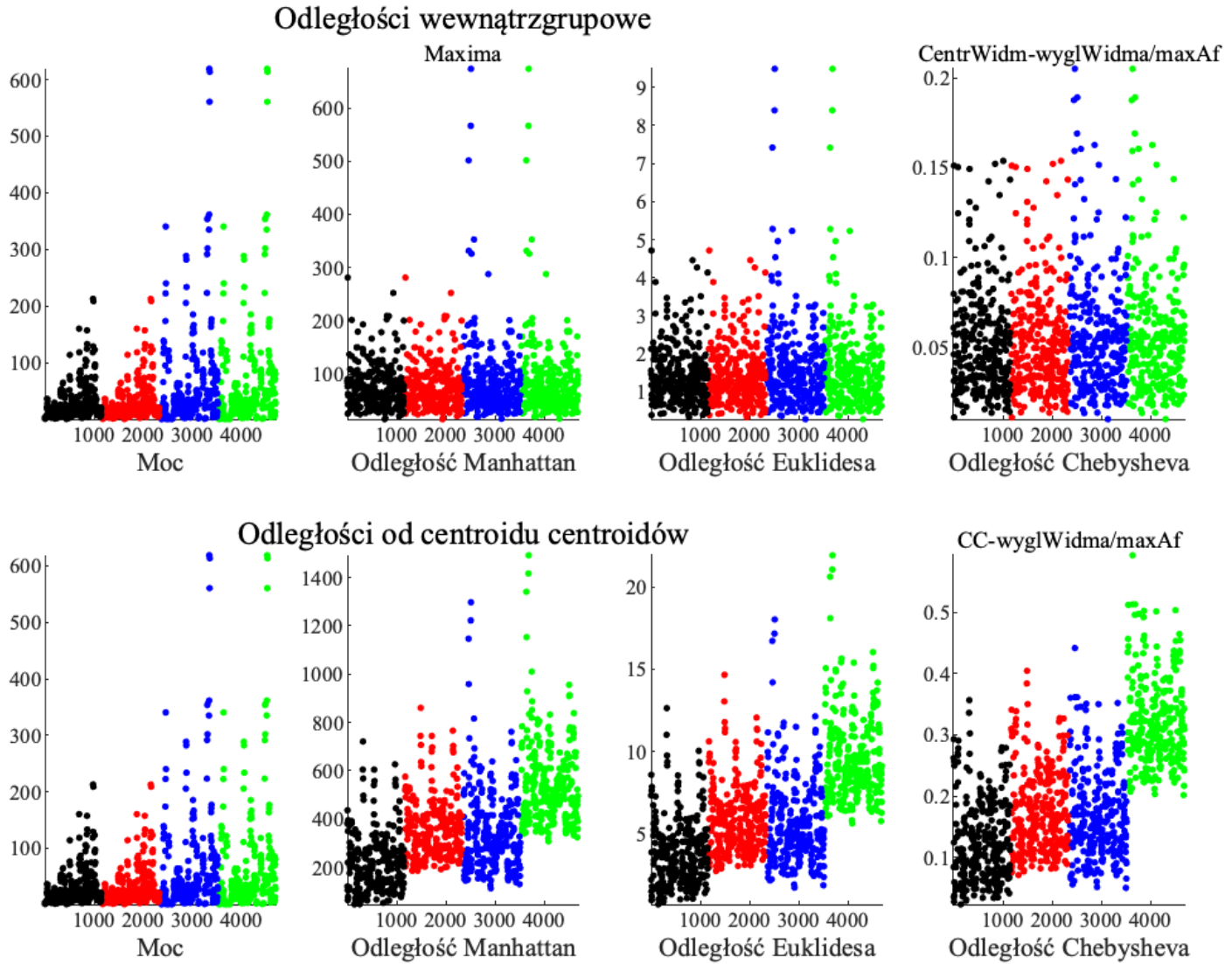


Minkowski distance



mięśnie / treningi (PS/BR-k, PS/BB-r PC/BR-b PC/BR-g)

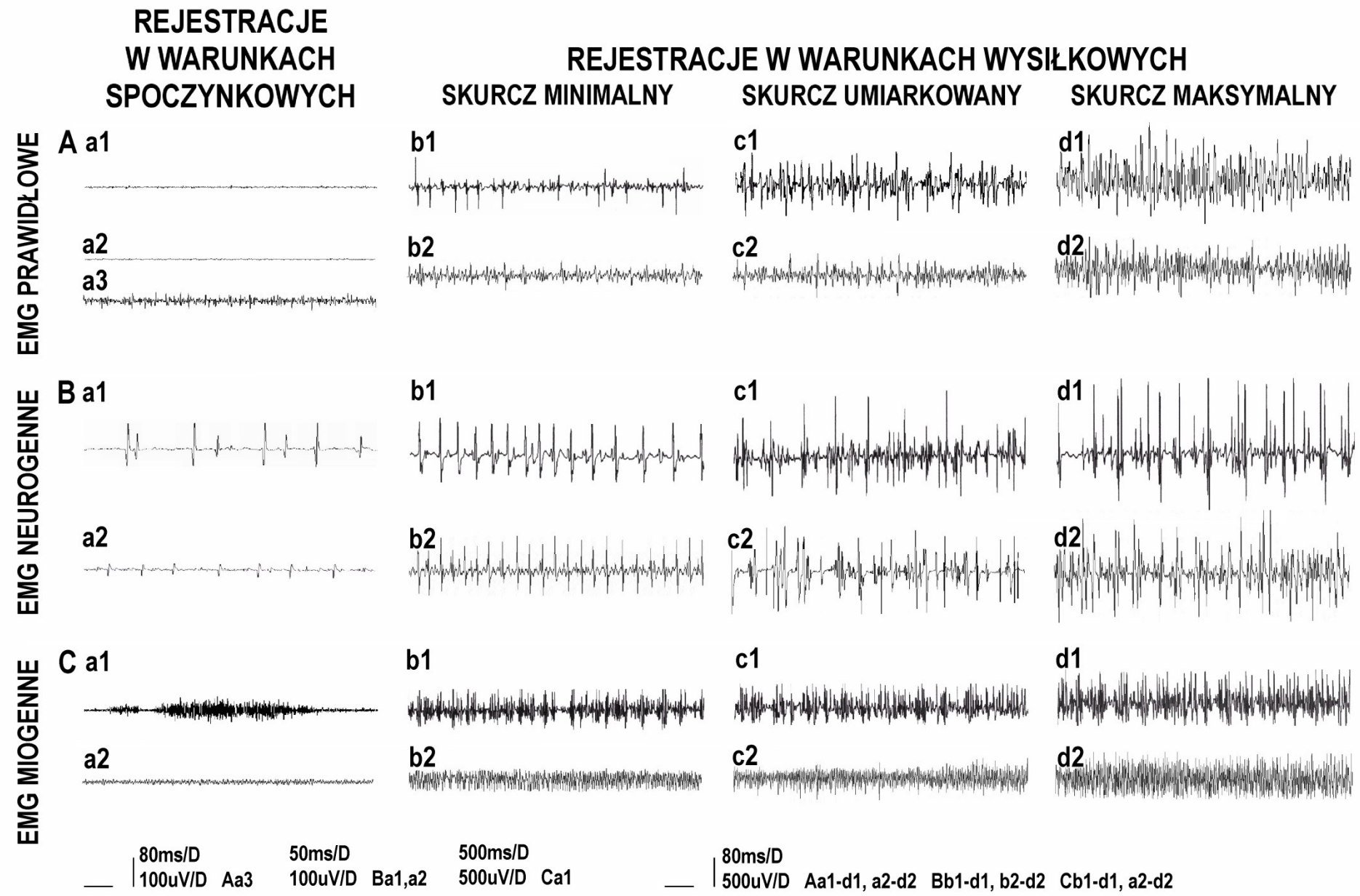
Categorization



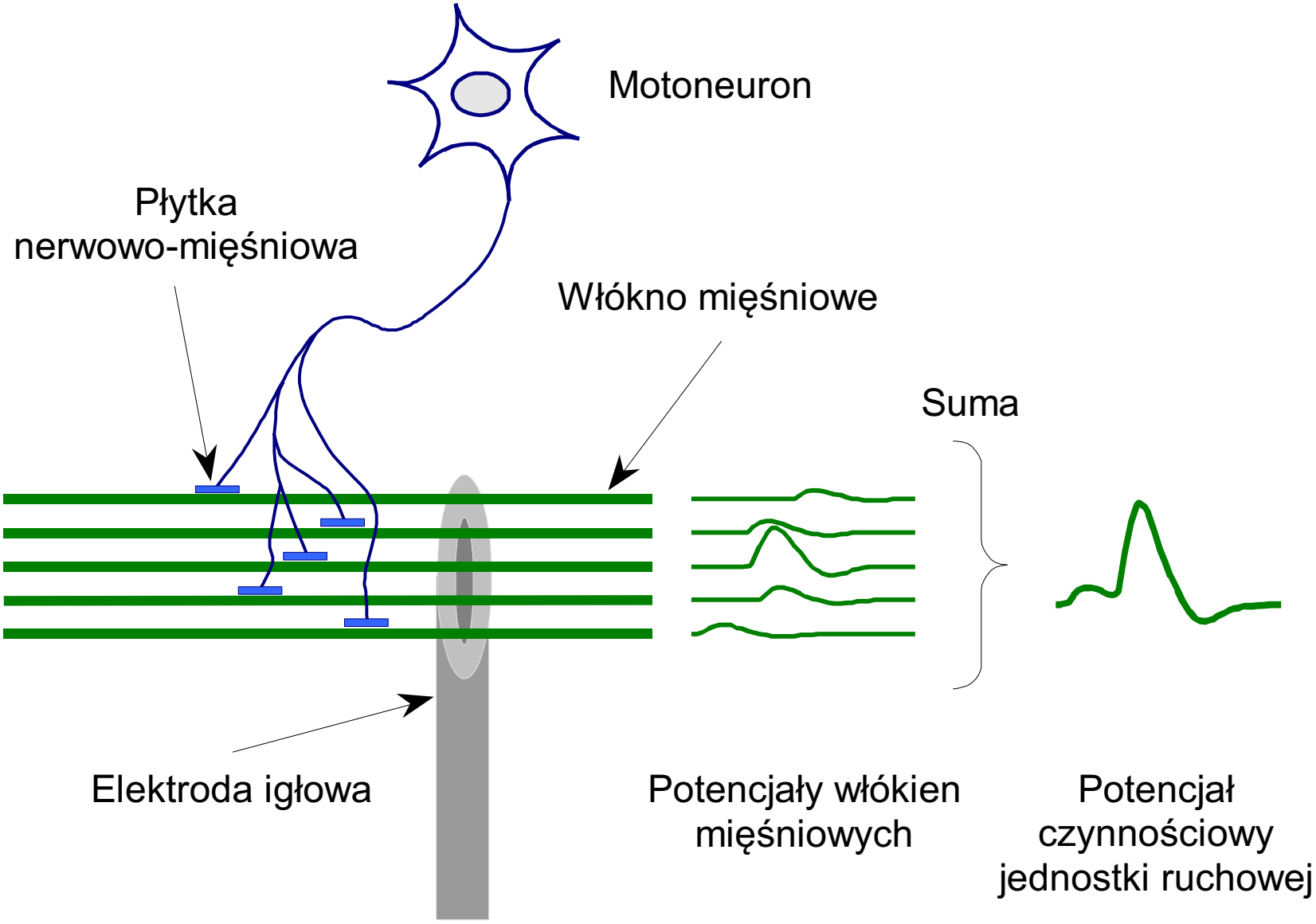
Conclusions

- It has been shown that the comparative analysis of the EMG Radialis and Biceps muscles work has potential for spectrum standardization.
- We perform a process of Digital Signal Processing for two surface measurement of biopotential.
- For the analysis of the time series, the contained data were normalized and selected to minimize the influence of outliers. Minkowski distance are used to compare the spectrums of the segmented time series.
- Future works on automatic categorisation based on the presented signals diagnosis approach should be considered to optimize the process.

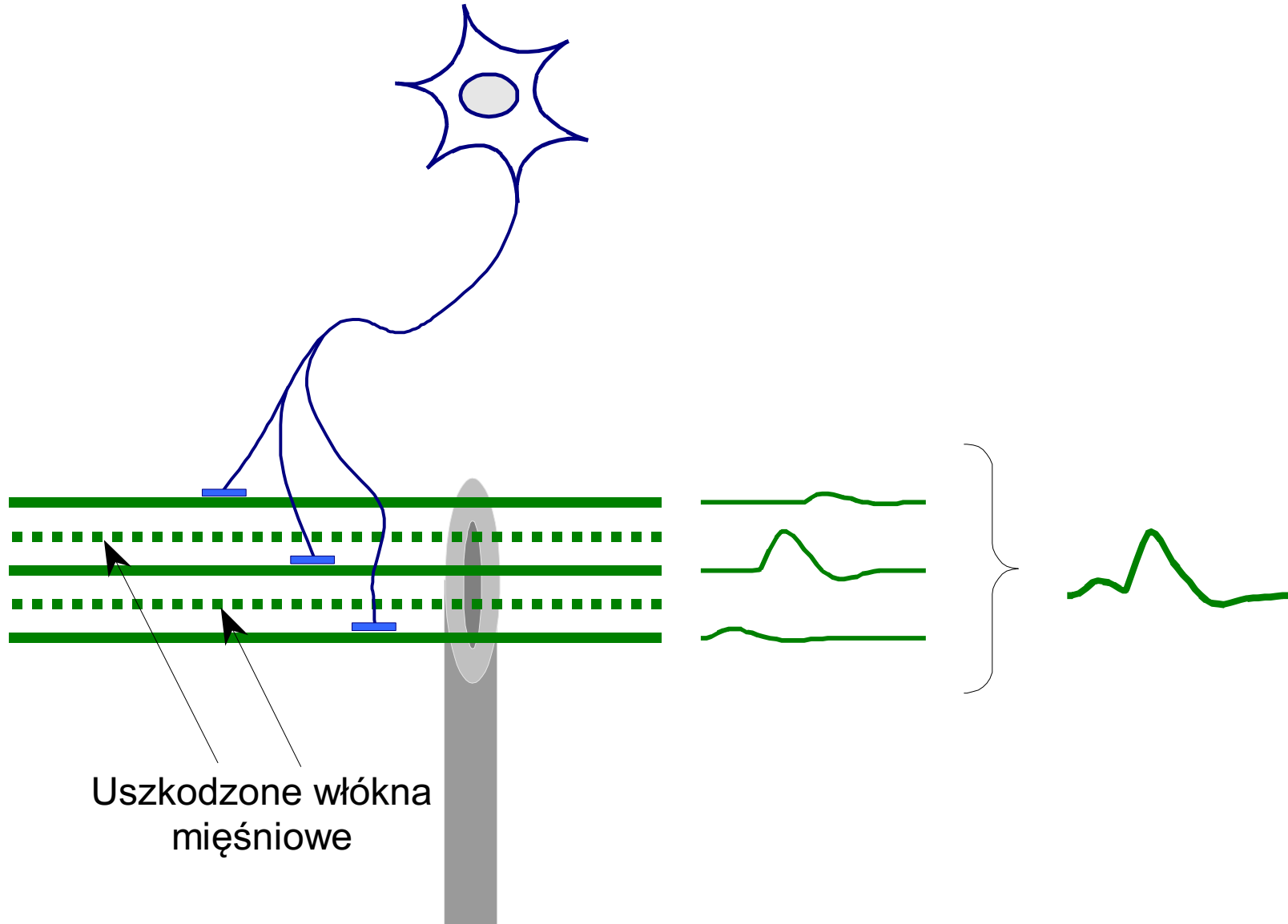
Thank you for the attention



Healthy case



Myopathy case



Neuropathy case

