

* Title

Grasp classification based on electromyographic (EMG) signals

* Summary of the challenge

Use publicly available muscle activity signals recorded from the surface of the skin of healthy people performing a set of specific grasps that correspond to holding different objects, and classify the signals to the intended grasps.

* Objectives and motivation of the challenge

Grasp classification based on EMG signals has been explored for a while by research to control of robotic prosthetic hands. Even though it performs well in controlled experimental environments, this technique is not used in commercially available prostheses due to the performance of the algorithm being very sensitive to changes over time of the signal and the difficulty to generalize between different people. In this challenge you are going to explore the following tasks:

1. Familiarize yourself with the machine learning pipeline for grasp recognition based on the EMG signals:
 - Raw signal pre-processing
 - Design of classification algorithm
 - Test the classification algorithm
 - Explain the results (visualization, quantification)
2. Explore the between different sessions' (a or b) generalization of your algorithm
 - Can you use the algorithm trained on the 'a' set to classify the grasps from the same subjects' 'b' set?
 - Can you adapt the algorithm to improve the performance of the classifier?
3. Explore the between different subjects' generalization of your algorithm
 - Can you adapt the trained algorithm on one (or more) subject(s) to recognize the grasps performed by a subject whose data you have not used in the training?

The recommendation is to pick only one of the 2. and 3. tasks and focus on this. If you think you have found a good solution for the chosen task you can try your solution to the other task and report on the results.

* Challenge datasets, location and description.

The datasets can be found on the Ninapro website: <https://ninapro.hevs.ch/instructions/DB6.html>. Each folder of this dataset contains files of the format 'Sx_D1_Ty.mat', where x is the subject number and y is the time of the day that the recording corresponds to. On the website you can find pictures showing the acquisition protocol, the grasps performed during the exercise and the description of the information stored in the matlab file.

The dataset includes more information than just the electromyography (EMG) signals. For this challenge focus first on the EMG signal. After you have a working solution for EMG you can try to add information from other sensory modalities (like accelerometers) that are also included in the dataset.

* **Other resources available/required for the development of the challenge** Notice that part of the challenge is the preparation of the raw signal to be of the correct format to be used for classification. This process includes:

- Signal filtering
- Signal normalization
- Windowing
- Extract features (might not be needed, depending on the algorithm you are using)

A python library that can be found useful that implements the above, specifically for the ninapro dataset, can be found here: <https://pypi.org/project/nina-funcs/>

The papers that accompany the datasets are a good source of information on the process of recording the data and building algorithms for the task on hand.

* Criteria to evaluate the solution of the challenge.

The visualization of the results is up to you. Report any experiment you are performing, for example if you explore more than one algorithm or if you implement the between-subjects objective, and try to justify your observations.