Neural Engineering 2021/2022 – Sample exercises for the exam

Sample exercises for the Neural Engineering practical exam. The actual exam might be composed of more than one exercise or by slightly modified version of these questions. Moreover, one question outside from the ones presented here or in the lessons could be present, giving bonus points to the final result. Use these questions as study material, together with the sample signals, remembering that the final mark is given mainly by the quality of the interpretation of the results, with a marginal contribution by the soundness and complexity of the coding strategies adopted.

Neural signal processing

1. Load a neural signal and find the number of firing neurons.
2. For each of the neuron in a neural signal, determine its firing rate
3. Detect the spikes coming from a particular neuron using a template-based approach
4. Determine the optimal set of templates for the detection and sorting of firing neurons from a neural signal
5. Determine the minimum number of features able to ensure a good sorting performance
6. Quantify the performance of different feature-based sorting strategies

Muscle synergies

1. Determine the number of muscle synergies in a multi-muscle sEMG recording
2. Extract the muscle synergies from a multi-muscle sEMG recording
3. Test whether the synergistic structure underlying two different multi-muscle sEMG recordings is equivalent
4. Test if the synergies coming from the first x seconds of a multi-muscle sEMG recording are able to explain muscle activity in the remaining part of the signal