Practicum Part 2

EEG dataset

1 Introduction

WAY-EEG-GAL[1] is a dataset designed to allow critical tests of techniques to decode sensation, intention, and action from scalp EEG recordings in humans who perform a grasp-and-lift task. Twelve participants performed lifting series in which the object's weight (165, 330, or 660 g), surface friction (sandpaper, suede, or silk surface), or both, were changed unpredictably between trials, thus enforcing changes in fingertip force coordination. In each of a total of 3,936 trials, the participant was cued to reach for the object, grasp it with the thumb and index finger, lift it and hold it for a couple of seconds, put it back on the support surface, release it, and, lastly, to return the hand to a designated rest position. We recorded EEG (32 channels), EMG (five arm and hand muscles), the 3D position of both the hand and object, and force/torque at both contact plates. For each trial we provide 16 event times (e.g., "object lift-off") and 18 measures that characterise the behaviour (e.g., "peak grip force").

2 Background and Summary

The idea of extracting signals related to object manipulation from EEG recordings in humans seems reasonable given that even basic motor tasks engage large parts of the human cortex [1]. It is, however, not known how much information can actually be decoded from EEG. Specifically, it is unclear to what extent it is possible to extract signals useful for monitoring and control of manipulation tasks, for instance, to control an upper limb prosthetic device to generate a power grasp or a pinch grasp involving the thumb and index finger. While successful EEG decoding of reaching trajectories has been reported [2], this claim is controversial [3]. This dataset allows critical evaluations of the utility of EEG signals for prosthetic control of object manipulation. It is based on an established and prototypical paradigm to study precision grasp-and-lift (GAL) of an object, introduced in the early 1980's by Johansson & Westling [4–6], and subsequently used in thousands of studies. The correct completion of the GAL task depends on multimodal sensory activity correlated with specific events such as object contact, lift-off, and replacement. This control policy, in which feedforward control routines operate between sensed discrete events, is known as the Discrete Event Sensory Control policy (DESC; [7–9]).

3 Task

The size and richness of this dataset enables investigations of the information content of EEG during dextrous manipulation. We are interested in detecting the following from the EEG data:

- *the intention to reach and grasp.* From the EEG data only (i.e., *not* the EMG or position data), can we detect when the arm is going to move towards the object?

[1] A richer description as well as the data are available from http://www.nature.com/articles/sdata201447.

- *the onset of the load phase, i.e., the participant's intention to apply lifting forces.* From the EEG data only (i.e., *not* the EMG or position data), can we detect when the object is going to be picked up?
- *the object.* From the EMG data only, can we detect which object is being picked up? Weight? Surface? From the EEG data only, can we detect which object is being picked up? Weight? Surface?
- *when an object is replaced on a support for subsequent release.* From the EEG data only (i.e., *not* the EMG or position data), can we detect when the object is going to be put back? Or perhaps, when it is being put back?
- *the hand positions and velocities.* From the EMG data only, can the position and/or velocity of the hand be decoded? Same question for from the EEG data only?

References

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