Abstract

Annotation of temporal events such as onset times in electromyogram (EMG) signals is time-consuming, difficult to automate, and may be subject to low inter-rater reliability. Annotation of EMG onset times in EMG signals from participants with Parkinson disease (PD) may be particularly difficult due to artifacts from tremor or dyskinesias. Crowdsourcing through platforms like Amazon Mechanical Turk [1-2] may offer an alternative solution to provide reliable annotations. Here, we tested whether this approach could be used to annotate existing EMG signals recorded during balance tasks in healthy young individuals (HY) and in individuals with PD.

Data Sources

- Existing data of 3,175 EMG recordings of medial gastrocnemius during automatic postural responses to forward and backward ramp-and-hold translation perturbations of the support surface were collected from two research participant groups (Healthy Young Adults [1], n = 7) and mild-moderate PD [4], n = 4).
- All participants with PD were recruited into a pilot rehabilitative intervention [4] and were prescribed and taking antiparkinsonian medications at the time of the study.
- Responses to perturbations were used because typically EMG recordings of lower limb muscles transition from quiescence to activity at approximately 100 ms after perturbation onset.
- EMG signals were recorded at 10 Hz, high-pass filtered (3 Hz), demeaned, and rectified.

Amazon Mechanical Turk Experiment

- EMG signals from healthy and PD participants were uploaded to Crowdlabel [1], an open-source web-based platform used to crowdsource medical labels from biosignals.
- The anonymous EMG signals were posted as the Human Intelligence Tasks (HITs) on Amazon Mechanical Turk.
- Each Turkier was instructed to annotate the beginning and end point of the "changes in the signals" and decide whether the highlighted area is either a bump or umnue (i.e., similar to the baseline) according to the examples.
- All Turkers were remunerated upon completion of assigned HITs.

Results

Comparison of money incentive for completion of the HTs

Two cents

Three cents

Discussion & Future Work

- A total of 69 Turkers contributed to the data collection process, with at least 8 workers each labelling a minimum of 400 EMG signals.
- Over eight days, 6,469 annotations were collected costing $5.06. The averaged time to complete a HIT was 48.5 seconds.
- When payment to Turkers increased from two to three cents, they noticed a drastic change in accruing annotations, with an initial daily rate rising from seven annotations by five Turkers to a maximum of 2,118 annotations from 20 Turkers.
- Our proof-of-concept study has demonstrated that crowdsourced annotation of EMG signal onset times using Amazon Mechanical Turk is feasible and produces a large number of annotation records in a relatively short time. This suggests that this platform may represent a useful component of the analysis workflow in many studies. Further refinement of instructions will be required to identify inhibition of EMG signals.
- Future work will compare the accuracy of annotations produced by Turkers with those produced by automatic algorithms for a larger data set. A voting algorithm [2] will aggregate labels from Turkers and automated algorithms to compute reliable estimation of the activation.

References


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