A comparison of selective recording approaches in the peripheral nervous system using extraneural electrodes

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ToBE's requirements (550 characters with spaces – Objective, 720 characters with spaces – Methods, 720 characters with spaces – Results, 370 characters – Conclusions & Significance

Objective: The peripheral nervous system (PNS) is a key target for developing neural interfaces but recording from the PNS is challenging. Nerve cuffs are frequently used providing a single recording point but advances in manufacturing technology have enabled multi-contact nerve cuffs that can collect temporal and spatial information more effectively. Selective techniques have been developed with different time resolutions but it is unclear how the number of contacts and their configuration affects performance.

Approach: This study investigates 2 extraneural recording techniques and compares them using peripheral nerve recordings from the sciatic nerve from 3 datasets: a high density (HD, 56-contact, 2.3 cm length), reduced-HD (16-contact, 1.3 cm length) and low density (LD, 16-contact, 4.25 mm length). Different types of activity were selectively evoked in the rats (HD / reduced-HD: dorsiflexion, plantarflexion, and pricking of the heel; LD: proprioception, nociception, and touch). Two techniques in the literature (linear discriminant analysis (LDA) and spatiotemporal signatures) were applied to these recordings and the performance of these techniques were evaluated using classification accuracy and F_1-score.

Results: Both techniques showed an expected improvement in classification accuracy with the spatiotemporal signature approach showing an improvement of 21.6 (LD to HD) – 24.6% (reduced-HD to HD) and the LDA approach showing an improvement of 2.9 (reduced-HD to HD) – 41.3% (LD to HD). The results for both techniques were also comparable in both the LD and HD dataset. The results show that the spatiotemporal signature approach could be used in a more compact space and that the addition of electrode contacts greatly affects performance. A similar trend can be observed with the LDA approach with the large increase in performance likely due to the increase in electrode spacing.

Significance: This study provides a direct comparison between 2 techniques discussed in the literature and shows the changes in performance of these techniques with different number of electrode contacts and configuration. It will aid in the development of more selective peripheral nerve interfaces for use in neuromodulation and neuroprosthetic applications.

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