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Neuroscience 2015

Presentation Abstract

Program#/Poster#:	522.08/V19
Presentation Title:	Decoding grip type from cortical ensemble activity in humans and non-human primates: Improving classification using training data bootstrapping
Location:	Hall A
Presentation time:	Tuesday, Oct 20, 2015, 8:00 AM -12:00 PM
Presenter at Poster:	Tue, Oct. 20, 2015, 11:00 AM - 12:00 PM
Topic:	++D.18.b. Neurophysiology: Implanted electrodes and other direct interactions with neurons

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Abstract: Although human hands are capable of performing a very large variety of dexterous movements, most activities of daily living can be accomplished using a small set of basic grips including power, precision, and key. Formulating high-accuracy neural decoders for these basic grips is therefore an important goal for the development of assistive brain computer interface devices. Performing this type of decoding in a daily-life setting poses a set of unique challenges. Ideally, it should be possible to generate a decoder using a minimum of training data, so the user does not have to go through a lengthy data collection period in order to train or recalibrate the device. We evaluated the performance of linear (linear discriminant analysis) and non-linear (nearest-neighbor) decoding methods applied to spike counts and spike train similarity metrics. For each method we also examined the effect of augmenting the training data using synthetic spike trains derived as follows for each grip category: First, the distribution of spike counts per trial for each unit is fit using a gamma distribution. The number of spikes fired for each synthetic spike train is randomly chosen from this distribution. Once the desired number of spikes is chosen, n times as many spikes are selected from the full set available in all trials with the same grip (following temporal alignment). The spikes are then jittered using normally distributed temporal shifts. Finally, every nth spike is selected (in order to approximate a refractory period). Our test data included cortical recordings from non-human primates performing the three canonical grips as well as human participants in the BrainGate clinical trial attempting to perform the same grips. Our results show that it is possible to achieve high accuracy grip classification using limited training data (with only about 5 exemplars per category) and a small number of single units (around 15). We also demonstrate that it is possible to significantly increase decoder accuracy by using bootstrapping to augment the training data sets when few training exemplars are available. These results are consistent in all datasets examined, demonstrating similar features of grasp-related neural activity in able-bodied NHPs and humans with longstanding paralysis.

Disclosures: **C.E. Vargas-Irwin:** None. **J.B. Zimmermann:** None. **D.M. Brandman:** None. **B. Sorice:** None. **C.H. Blabe:** None. **E.N. Eskandar:** None. **K.V. Shenoy:** None. **J.M. Henderson:** None. **S.S. Cash:** None. **M.J. Black:** None. **L.R. Hochberg:** None. **J.P. Donoghue:** None.

Keyword (s): HUMAN

MOTOR CORTEX

MICROELECTRODE

Support: Office of Research and Development, Rehabilitation R&D Service, Department of Veterans Affairs (B6453R, A6779I)

NICHD-NCMRR (N01HD10018)

NICHD (R01HD077220)

NIDCD (R01DC009899)

NINDS-Javits (R01NS25074)