Print this Page

Presentation Abstract

Program#/Poster#: 80.06/WW12

Presentation Title: Design and application of a high performance intracortical brain computer interface for a person with amyotrophic lateral sclerosis

Location: Halls B-H

Presentation time: Saturday, Nov 09, 2013, 2:00 PM - 3:00 PM

Authors: ***V. GILJA**[1], C. PANDARINATH[1,2], C. H. BLABE[1,2], L. R. HOCHBERG[7,8,10,11,9], K. V. SHENOY[1,3,4,5,6], J. M. HENDERSON[1,2]; [1]Stanford Inst. for Neuro-Innovation and Translational Neurosciences, [2]Dept. of Neurosurg., [3]Electrical Engin., [4]Neurosciences Program, [5]Dept. of Neurobio., [6]Dept. of Bioengineering, Stanford Univ., Stanford, CA; [7]Ctr. for Neurorestoration and Neurotechnology, Rehab. R&D Service, Dept. of VA Med. Ctr., Providence, RI; [8]Sch. of Engin., [9]Inst. for Brain Sci., Brown Univ., Providence, RI; [10]Neurol., Massachusetts Gen. Hosp., Boston, MA; [11]Neurol., Harvard Med. Sch., Boston, MA

Abstract: Brain computer interfaces (BCIs) hold great promise for the restoration of function for individuals with paralysis. Existing work decodes movement intentions from neural firing rates measured with implants in primary motor cortex (M1). Decoding requires a map from firing rate to movement intention, developed either through imagery and/or co-adaptive learning strategies. For individuals with neurodegenerative diseases, effective mapping strategies could be developed while motor function is still present.

To study this paradigm, we are working with a 50-year-old woman with amyotrophic lateral sclerosis (ALS) & weakness of all 4 limbs, but with some retained arm & hand function. At Stanford, as part of the Braingate2 (FDA IDE) multi-site pilot clinical trial, we implanted an array of 100 electrodes (Blackrock Microsystems) in the “hand knob” region of M1. In initial offline studies, firing rates were recorded from these electrodes while the participant controlled a

computer cursor via physical movement to acquire targets in 2 dimensions (X & Y). Targets appeared one at a time on a 5x5 grid & target presentation order was randomized. The participant was instructed to acquire & hold each target for 500 ms. The cursor was controlled by 1 of 5 possible motor output configurations. Neural data from each control mode was linearly regressed to reconstruct X & Y velocity in 50 ms bins. R-values for cross-validated data were computed as a measure of fit quality. In summary, the control modes (& R-values for X & Y, respectively): computer mouse (0.14, 0.31), index finger on a touchpad (0.28, 0.51), wrist flexion/extension (f/e) for X & wrist ulnar/radial (u/r) deviation for Y control (0.16, 0.30), index finger f/e for X & wrist u/r deviation for Y (0.58, 0.10), thumb f/e for X & index finger f/e for Y (0.24, 0.36)
Based on this analysis, index finger touchpad control was used for initial parameter training of a Kalman filter based neural control algorithm. Using this algorithm in an eight target center-out-and-back acquisition task, the participant successfully acquired & held 92% of peripheral targets for 500 ms with a mean (+/- st.d.) acquisition time of 1.2 (+/- 0.76) s. With respect to visual angle, targets were 5.8 degrees in diameter & were 8.7 degrees from the center target and had to be acquired within 7 s. These results are an initial demonstration of the use of residual motor function to inform BCI design and represent a high level of cursor control performance relative to existing clinical trial experience. Further investigation will assess algorithmic methods for advancing system performance & the feasibility of sustaining performance as motor degeneration progresses.

Disclosures: **V. Gilja:** None. **C. Pandarinath:** None. **C.H. Blabe:** None. **L.R. Hochberg:** None. **K.V. Shenoy:** None. **J.M. Henderson:** None.

Keyword(s): AMYOTROPHIC LATERAL SCLEROSIS

ALS

MOTOR CORTEX

Support: NIH-NINDS, Stanford Institute for Neuro-Innovation and Translational Neuroscience, Stanford BioX-NeuroVentures, Garlick Foundation, Stanford Office of Postdoctoral Affairs

Office of Research and Development, Rehabilitation R&D Service, Department of Veterans Affairs (B6453R), NIDCD (R01DC009899), Doris Duke Charitable Foundation, MGH-Deane Institute

The contents do not represent the views of the Department of Veterans Affairs or the US Government. CAUTION: Investigational Device. Limited by Federal Law to Investigational Use