Print this Page

Presentation Abstract

Program#/Poster#:	252.09/KK12
Presentation Title:	Design of a high performance intracortical brain computer interface for a person with amyotrophic lateral sclerosis
Location:	WCC Hall A-C
Presentation time:	Sunday, Nov 16, 2014, 1:00 PM - 5:00 PM
Presenter at Poster:	Sun, Nov. 16, 2014, 1:00 PM - 2:00 PM
Topic:	++D.18.d. Neuroprosthetics: Control of real and artificial arm, hand, other grasping devices
Authors:	***P. NUYUJUKIAN**[1,2,3], C. PANDARINATH[1,3], V. GILJA[1,7], C. BLABE[1,3], J. A. PERGE[8,11,9], B. JAROSIEWICZ[10,11,9], L. R. HOCHBERG[11,8,12,13,9], K. V. SHENOY[4,5,6,3], J. M. HENDERSON[1,3]; [1]Neurosurg., [2]Sch. of Med., [3]Neurosciences Inst., [4]Electrical Engin., [5]Neurobio., [6]Bioengineering, Stanford Univ., Stanford, CA; [7]Electrical and Computer Engin., Univ. of California San Diego, San Diego, CA; [8]Sch. of Engin., [9]Inst. For Brain Sci., [10]Dept. of Neurosci., Brown Univ., Providence, RI; [11]Ctr. for Neurorestoration and Neurotechnology, Rehab. R&D Service, Dept. of VA Med. Ctr., Providence, RI; [12]Neurol., Massachusetts Gen. Hosp., Boston, MA; [13]Neurol., Harvard Med. Sch., Boston, MA
Abstract:	One important potential application of brain computer interfaces (BCIs) is the restoration of communication for people with paralysis. Here, along with a paired report (Pandarinath, et. al., SfN 2014), we describe the development and

application of an intracortical BCI decoder in the BrainGate2 FDA pilot clinical trial (NCT00912041). On a free-paced task using a traditional qwerty keyboard layout, our participant achieved typing rates of 4.4-6 words per minute (22-30 net correct selections per minute), representing, to our knowledge, the highest reported communication rates of any human BCI. Participant T6 is a 51 year old woman with declining motor function due to slowly-progressive ALS who was implanted with a 96-channel electrode array (Blackrock Microsystems) in the hand area of her dominant motor cortex in Dec 2012. Data presented here were collected from ongoing research sessions 13 months post implantation. Both spiking activity as well as high-frequency local field potential power (100-450Hz) were extracted for use as inputs to the neural decoder. Initial kinematic training data was collected using a data glove (Fifth Dim. Tech.) that mapped index finger flexion to the X dimension and thumb flexion to Y. A neural decoder was then generated from this behavioral training data. The decoder used for cursor control was the ReFIT Kalman Filter (Gilja*, Nuyujukian*, et. al., Nature Neuroscience 2012), which was previously shown to be faster and easier to use for this participant (Gilja, et. al., SfN 2013). Continuous cursor performance was evaluated with a center-out task and a random target Fitts task. On an 8 target center out acquisition task with 12cm target distance, 3cm diameter targets, and a 500ms hold time; T6 typically achieved success rates exceeding 95% and average aquire times under 1.5 sec. On a random target Fitts task with a 500ms hold time, where target distance and diameter would vary from trial to trial, T6 was able to consistently achieve a Fitts bitrate exceeding 1 bit/sec. In a typical experimental session, which would last two to four hours and span thousands of trials, participant T6 continued to move her fingers slightly during neural control blocks as she did during finger training blocks. As a control, she was asked to limit her finger movements and place her hands flat on a table while controlling the cursor, yielding comparable levels of control under this paradigm as well. These findings confirm that the ReFIT-KF algorithm successfully translates to a human participant from the healthy, intact, animal models in which it was originally developed and reported. These results may help make BCIs more suitable for the restoration of communication.

Disclosures: **P. Nuyujukian:** None. **C. Pandarinath:** None. **V. Gilja:** None. **C. Blabe:** None. **J.A. Perge:** None. **B. Jarosiewicz:** None. **L.R. Hochberg:** None. **K.V. Shenoy:** None. **J.M. Henderson:** None.

Support: Stanford Medical Scientist Training Program

Craig H. Neilsen Foundation

Stanford Neurosciences Institute

Stanford BioX-NeuroVentures

Garlick Foundation