Prosthetic Project Notes:

Cynthia Steinhardt

-What is TEM? How does it work?

- Were they trying to grip these objects b y touch alone?

- Can we map the stim zone better and do we have this data saved?

- try getting feedback as a spectrum bar so they can increment feedback continuously?

- wondered if the classifier get same as zero condition some percent of time because fingers basically touching are a similar shape and texture..

-control of touching and knowing how much grip to prevent pain or damage to prosthetic

-didn’t understand what happened in the second PDT test where less pain was detected

 Clauset analysis

???

Try to use timing different to measure confidence intervals in movement – maybe this is part of what the EEG is for from Luke’s study.

Better classifier – go through a whole range of motions to distinguish instead of just end points

* Ask again If it’s bad

Controls can aim at sorting out these truths

* Confidence level – relation to spend of object and grip force.
* Integration, maybe measured via EEG – interested to hear if there is a known way to do that.

Hear more about bimanual robots – interesting questions potentially there?

Abstracts – 1st week of june \*\* - pain reaction reflex demo - \*\* develop forwards. – do eeg to know felt pain. So you have eeg data \*\*to see brain responses

Sharp v. soft get into the center + feedback loops control – 3 cognitive

* Electrokinesis – how subject felt – George- psychophysics certain stimuli perceived differently –

EEG – data collected –

21st data collected – come at 10:30 12-4 go over more details of the project.

Supplementary – about the integration and fire receptor model and reflex model.

Psychology of timing is known to be different than real – people constantly struggle to estimate timing intervals. Not surprised if brain tricked by the vibration into thinking things happened faster/ assumed happened close to their movement time.

Past Papers:

* Biologically Inspired Multi-Layered Synthetic Skin for Tactile Feedback in Prosthetic Limbs
* Neuromimetic Event-Based Detection for Closed-Loop Tactile Feedback Control of Upper Limb Prostheses
* Prosthesis grip force modulation using neuromorphic tactile sensing
* Tactile Feedback in Upper Limb Prosthetic Devices Using Flexible Textile Force Sensors
  + **Overlapping areas of inhibitory feedback between sensors to better**
  + **triangulate center-surround**
  + **deformable objects, objects of other shapes**
* Targeted Transcutaneous Electrical Nerve Stimulation for Phantom Limb Sensory
  + In this work, we investigated the use of noninvasive, targeted transcutaneous electrical nerve stimulation (TENS) of peripheral nerves to provide sensory feedback to two amputees, one with targeted sensory reinnervation (TSR) and one without TSR.
  + detect stimulation patterns with pulses less than 1 ms. We utilized the psychophysical results to produce a subject specific stimulation pattern using a leaky integrate and fire (LIF) neuron model from force sensors on a prosthetic hand during a grasping task.
  + graded sensory feedback at multiple sites in both TSR and non-TSR amputees while using behavioral results to tune a neuromorphic stimulation pattern
  + Leaky integrate and fire method for modeling neurons
  + how do monophasic, single channel stim safely? \*
  + there is a adaptation to having grip – does the prosthetic induce that ? or are we constantly stimulating – looks like decreased frequency over time
  + interested in normal v. TSR v. non-TSR patients?
  + Do we have their grabbing object info – e.g. this feedback with them interacting with objects, just not in this study \*\* integrate and fire from 7?
    - L. Osborn, H. Nguyen, R. Kaliki, and N. Thakor, “Prosthesis grip force modulation using neuromorphic tactile sensing,” in *Myoelec. Controls Symp.*, 2017, pp. 188–191.

Most interesting – is uncovered perception of pattern

Ramachandran – fool brain into learning and believing –

Conditions of stimulation – neutral, pleasant and more uncomfortable .

Sent data to post-doc in signapore – said it was noisy

Trial – 5 diff stim presentations – marked with marker signal- channel should be high / 255.

EEGtoolbox – matlab- with built in function to import and do quick analysis. Each condition ~ 20 times – each file ~ 5 of those conditions – 3 spots on phantom hand – thumb/finger and pinky, and wrist. Stimulation conditions – 3 for each spot. Pleasant, normal, more uncomfortable.

Microneurography – stimulate and record – Roland Yohanessberg- Switzlerland

Von Masefield.

4 stimulation feedback papers - get sense of what people are trying to do.

From integrate and fire - what was being sent during the grasp. Not what they felt at each time or each object.

Have- force info from sensor, the signal sent out, derivative of it -values that are easy to generate.

Force readings, from any grasp-release- experiment. Produce any modesl you’d like

EMBC – good one b/c a lot of stuff

BioCas – Is more circuitry

SfN –

BioRob – biomedical robotics

Every 3 – upper limb prosthesis

* Neuroelectric controls symposium

1. Working with current EEG data: Luke collected recordings from an amputee mapping different finger positions (3) and different sensations (+,-, neutral) while recording EMG. I would start by trying to decode 🡪 contribution to his paper
2. BIOCaS. From what Luke told me is a sensor and circuit focused event. I thought of a simple neuromorphic idea he found interesting – a center-surround arrangement/interface of the current wrap-around sensors
3. Continuing with EEG work and using it as a readout to confirm things the lab is testing. Quickest- grip-slip. We have force sensors and stimulation paradigms set up. (Can be done with able-bodied people). The last paper reported similar level of feedback for force level and neuromorphic signals. Let’s attempt to decode if more information is being received by the brain.
   1. Caveat – Probably a lower-level signal would be best in my opinion. (e.g. recording from the closest sensory nerves). This is more difficult to set up, may use doctors, but may give an informative intermediary
4. Eventually – I would be interested in working more with feedback and stimulation signals (e.g. developing a localization algorithm for external stim or sub-cutaneous work)

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Somatosensory stuff information:

<http://courses.washington.edu/psych333/handouts/coursepack/ch11-Somatosensory_system_and_topographic_organization.pdf>

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THAKOR LAB : about the peripheral nervous system:

<https://courses.lumenlearning.com/boundless-ap/chapter/nerves/>

* Explains about endoneurial fluid – a blood-brain barrier of the cell – wonder what looks like after amputation – when swelling decreses.
* Afferent nerve sizes:









