

Final Report: Brain Dataset

Roman Podolski, Philipp Bergmann, Dominik Irimi, Manuel Nickel,
Christoph Dehner

Technische Universität München

*roman.podolski@tum.de, philipp.bergmann@tum.de, dominik.irimi@tum.de,
manuel.nickel@tum.de, dehner@in.tum.de*




July 25, 2016

Overview

- 1 Dataset
- 2 Methodology
- 3 Results
- 4 Pitfalls

Experiment recording human grasp and lift tasks¹

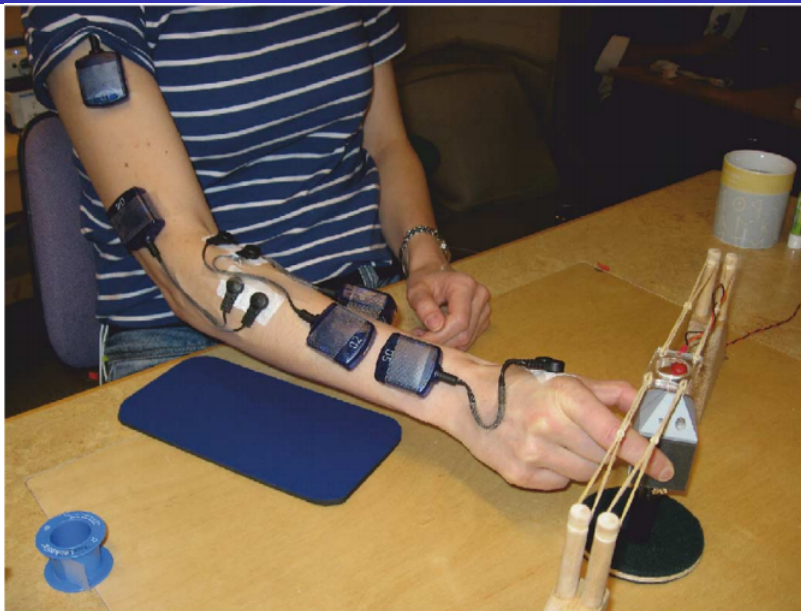
- 12 participants, 9 series recorded each
- EEG: 32 electrodes recorded at 5kHz
- EMG: 5 signals at 4kHz
- kinetic: 36 signals at 500Hz
- objects to grasp with different surface friction/weights (165g - 660g)
- preprocessing: trials provided in windowed format (event timing relative to window)

¹Data source: Luciw, M. D., Jarocka, E. & Edin, B. B. FigShare <http://dx.doi.org/10.6084/m9.figshare.988376> (2014).   

Single trial procedure

- start command signaled visually by LED
- participant moves hand to object
- grasp object
- move object to target position
- hold position
- LED signal, to move object back to initial position
- hand release object
- move hand back to resting position

Experiment



t-SNE

- expectation
- result

General developement

- Theano (python)
- climin library
- breze library

Data preparation

- Input normalization to -1/1 range (tanh activation optimization)
- imagine one lifting trial as a single learning sample
 - recordings have different length, therefore equalize it!
 - zero padding → learning in danger of being misguided
 - tail cut → targets fall of, fails to learn sometimes
- separation into sets of 300 data point records length **improves learning.... Why did Smagt tell us to do that??)**
- Subsampling (10Hz) of EMG data
- Data set split: train/valid/test → 0.8/0.1/0.1

Recurrent Neural Network

- assuming predictability in human planning → history matters
- Network design:
 - 100 neurons
 - 1 hidden layer
 - tanh activation function
 - 50 samples per batch
 - optimizer: Adadelta
- parameter weight initialization by uniform normal distribution
- spectral radius
- Important weights: some samples are more important than others
- Bernoulli cross entropy loss

Learning Targets

- one dim multi class vector vs. mult dim one-hot-encoding
- Selection of available events
 - 1 LEDOn/LEDOff: participant signal
 - 2 tHandStart/tHandStop: hand moving
 - 3 trial_DurReach: time needed to move hand to object
 - 4 tLiftOff: lift object
- Targets - defined over (multiple) intervals in between events
 - 1 move hand to target
 - 2 lift object
 - 3 hold object phase
 - 4 replace object
- Data shape
 - Input: [time slice, features, sensors] $\rightarrow [300 \times 2428 \times 5/32]$
 - Target: [time slice, features, targets] $\rightarrow [300 \times 1320 \times 1]$

Results (1): t-SNE

- Figure of t-SNE of EEG data → Separability of trials
- Possible to separate with standard NN
- Figure of t-SNE of EMG data → As expected

Results (2): RNN

- Overview of the targets
- Hand move to target works good.
- Touch phase target also quite ok.
- hand move back target also (partially) successful
- Comparison: Training with data of one person vs. data of more participants
- etc.

- Prediction do not fit to the target borders exactly
- No working early stopping criterion (so far)
- Targets within the lift phase cannot be predicted properly
- etc.

Blocks of Highlighted Text

Block 1

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

Block 2

Pellentesque sed tellus purus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Vestibulum quis magna at risus dictum tempor eu vitae velit.

Block 3

Suspendisse tincidunt sagittis gravida. Curabitur condimentum, enim sed venenatis rutrum, ipsum neque consectetur orci, sed blandit justo nisi ac lacus.

Heading

- 1 Statement
- 2 Explanation
- 3 Example

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table : Table caption

Theorem

Theorem (Mass–energy equivalence)

$$E = mc^2$$

Example (Theorem Slide Code)

```
\begin{frame}  
\frametitle{Theorem}  
\begin{theorem}[Mass--energy equivalence]  
$E = mc^2$  
\end{theorem}  
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References



John Smith (2012)

Title of the publication

Journal Name 12(3), 45 – 678.

The End