

Final Report: Brain Dataset

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July 24, 2016

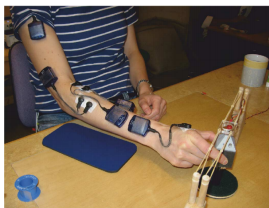
Overview

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

Dataset

Experiment recording human grasp and lift tasks¹

- 12 participants, 5 different types of 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).

Experimental procedure:

- event/commands signaled visually by LED to participant
- participant starts moving hand to grasp object
- grasp object
- move to target position
- hold position
- move object back to initial position
- hand release object
- move hand back to resting position

t-SNE

- expectation
- result

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 off, 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 within one trial
- consideration of target vector definition: one dim multi class vector vs one-hot-encoding
- data set split: train/valid/test → 0.8/0.1/0.1

Recurrent Neural Network

- assuming predictability in human planning → history matters
- network shape:
 - 100 neurons (trial and error showed fewer will fail)
 - 1 layer
 - optimizer: adadelta
 - batch size 50 (limit set by available hardware)
- Bernoulli cross entropy loss at output layer
- Data vector shape
 - input $[300 \times 2428 \times 5] \rightarrow [\text{slice}, \text{trial length}, \text{sensors}]$
 - target $[300 \times 1320 \times 2] \rightarrow [\text{slice}, \text{???, targets}]$

RNN

- Weight initialization from uniform normal dist
- spectral radius
- Important weights
 - skip 150 samples till transient oscillation

LSTM

- usage of breze library implementation ²
- finally not used because satisfying results achivable by RNN already

²<https://github.com/breze-no-salt/breze v0.1> (2016)

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

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Heading

- 1 Statement
- 2 Explanation
- 3 Example

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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