Pre-stimulus time dimension reduction by using t-SNE to predict conscious awareness about correct or incorrect response

Sejik Park
Departments of Computer Science and Engineering
Interdisciplinary Major in Brain and Cognitive Sciences
Korea University College of Informatics

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We think the Unthinkable

CONTENTS

1. Preprocessing

- Baseline correction
- Artifact rejection by EMD & Pearson correlation

2. Main

- t-SNE (dimension reduction)
- Circle regression

3. Result

- Variance (R2)
- Perceptual accuracy

Preprocessing

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- Baseline Correction
  - **Epoch data with given code (onset-500 to onset)**
  - **Baseline correction were performed using the 500-0 ms pre-stimulus interval**
- Further research
  - **Check all channels for finding bad channel to interpolation**
  - **Artifact rejection (limit maximum amplitude & maximal gradient voltage step): remove epoch**
  - **Offline filter (e.g. 0.5-30 Hz) & ICA noise reduction** (Kawakatsu 2003)
  - **Individual averaged data analysis & Grand averaged data analysis**
  - **Frequency analysis (e.g. wavelet → Beta)** (Pfurtscheller, Woertz et al. 2002)
  - **Change time range or short range repeat analysis**

Also, parallel coding with MATLAB would be better to overcome very slow computation speed

Preprocessing

- Artifact rejection by Empirical Mode Decomposition (EMD) & Pearson correlation
  - **Strong artifact rejection tool to remove blinking and small movement** (Rosas-Cholula, Ramirez-Cortes et al. 2013)
- Further research
  - **Change EMD parameter (resolution, residual energy)**
  - **Change correlation p-value**
  - **Check EMD artifact rejection removing noise not real signal by somatosensory meg simulation data**

Compare artifact rejection tool like ICA, PCA would be helpful

Main

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- t-Distributed Stochastic Neighbor Embedding (t-SNE; dimension reduction)
  - **Dimension reduction is one way to control the complexity of electroencephalogram** (Li and Lu 2009)
  - **t-SNE is good to visualize difference among subject groups**

- Further research
  - **Change t-SNE parameter (dimensionality reduction number, perplexity)**
  - **Using different input (frequency information, connectivity information by grand causality)**
  - **Check EMD artifact rejection removing noise not real signal by somatosensory meg simulation data**
  - **t-SNE with deep recurrent neural network for analysis**

Lack of time-series dimension reduction knowledge

Main & Result

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- Main: Circle regression (non-linear regression)
  - Dimension reduction data plot looks like circular
- Further research
  - Relation between channels to get encoded information
- Result: Variance (R2)
  - Wrong value (because of non-linear regression): all values are over 0.90
- Further research
  - Find way to use linear regression (way to find simple dimension reduction data)

Circle regression is not for R square value

Result

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- Perceptual accuracy
  - hits + correction rejection vs. false alarms + misses
  - Accuracy over 198 epochs: 0.6021 (Channel: 313)
  - t-SNE is good to visualize difference among subject groups
  - Result file: SejikPark_BIOMAG2016.mat
- Further research
  - Find meaning of the 313 channel location
  - Test more data (epochs & subjects) with training & test analysis (e.g. 80% data for training analysis to get parameter and 20% data for test analysis to know the accuracy of method)
  - Find accuracy has meaning (coincidence or real meaningful result)

Limitation: analysis of only 198 epochs of first subjects because of limit of time and computational power

E-mail: sejik4072@korea.ac.kr

Thank you

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