Speech artifact removal from EEG recordings of spoken word production with tensor decomposition

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1. Introduction

A. Background

- SAR-ICA by Porcaro et al. 2015
- BSS-CCA by Vos et al. 2010

B. Overview

- Related works
  - SAR-ICA by Porcaro et al. 2015
  - BSS-CCA by Vos et al. 2010

Both proposed a speech artifact removal method with matrix decomposition.

SAR-ICA > BSS-CCA, according to Porcaro et al. 2015

C. Research Objectives

1. Propose a new method for removing speech artifacts with tensor decomposition for sources reconstruction.
2. Evaluate the performance of the proposed method against existing methods (SAR-ICA and BSS-CCA).

2. Methods

A. Pipelines

Proposed method (tensor-based)

- SAR-ICA (Porcaro et al, 2015)
- BSS-CCA (Vos et al, 2010)

B. Key Differences

- We proposed a speech artifact removal method using CPD artifact decomposition.
- The proposed method (CPD) surpasses former methods (SAR-ICA and BSS-CCA), both in identifying speech artifacts (0.985) and producing cleaned data (0.101).

3. Experiment

A. Assessments

Evaluation

- Aim: to compare performances of all methods

Technique:
- Calculate the Pearson correlation (R) between grand-average clusters and the lip EMG during 0-1350 ms in the time domain.

Interpretation:
- The higher the correlation, the stronger the association with lip EMG. Lip EMG is assumed to represent the original speech articulation.
- Speech artifacts: the higher the correlation, the better.

B. Performance Measure

Evaluation results

- Grand-average cluster
  - R (0-1350 ms)
  - SAR-ICA’s Speech Artifact: R = 0.975
  - BSS-CCA’s Cleaned Data: R = 0.101

- Grand-average cluster
  - R (0-700 ms)
  - SAR-ICA’s Cleaned Data: R = 0.875
  - BSS-CCA’s Cleaned Data: R = 0.101

C. Conclusion

- Present study relied on manual visual inspection and EMG channels usage, so future research should...
  - Automate all of the steps needed for speech artifact identification
  - Use other means to determine the speech artifacts

6. References