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Dictionary learning for M/EEG multidimensional data

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1. Jitter-adaptive dictionary learning model (JADL)

JADL is a dictionary learning framework that:
- Learns a dictionary over M/EEG recordings that have the same waveform and jitter over all the channels in a single trial.
- Is able to handle signal variabilities such as jitters which is difficult to cope with standard methods such as PCA or ICA.

2. Our modified JADL model

We propose an extension to the jitter-adaptive dictionary learning method, that:
- Is able to handle multidimensional measurements such as M/EEG.
- Is able to account for different jitters across trials.
- Allows one to deal with signal variabilities such as jitters which is difficult to cope with standard methods such as PCA or ICA.

3. Synthetic data generation

- Create a dictionary of K = 3 synthetic atoms.
- Generate an extended dictionary of 9 signals.
  - Introducing random jitters (from the set ∆ of shifts) to the dictionary’s atoms.
  - Introducing random sources (from the set S of sources) to the dictionary’s atoms.
  - Combining the generated signals with a lead field matrix C computed from real EEG measurements [6].

4. Results on lead field synthetic data

A comparison between the original and our multi-dimensional JADL model shows:
- Superior performance and less noisy estimated waveforms compared to the original single-channel JADL framework, both on synthetic and real data.
- More robust to various levels of noise.
- Using the JADL framework allows one to deal with signal variabilities such as jitters which is difficult to cope with standard methods such as PCA or ICA.

5. Results on real data

- The multi-dimensional approach is tested using real MEG and EEG data.
- The method shows superior performance and less noisy estimated waveforms compared to the original single-channel JADL framework, both on synthetic and real data.
- It is more robust to various levels of noise.
- Using the JADL framework allows one to deal with signal variabilities such as jitters which is difficult to cope with standard methods such as PCA or ICA.

6. Conclusions

- The method shows superior performance and less noisy estimated waveforms compared to the original single-channel JADL framework, both on synthetic and real data.
- It is more robust to various levels of noise.
- Using the JADL framework allows one to deal with signal variabilities such as jitters which is difficult to cope with standard methods such as PCA or ICA.

References


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