EEG - artefact rejection

General instructions

- Use the Jupyter notebooks attached
- You will need to install Conda-Py distro (or Anaconda Navigator along with other components in case of Windows PC) along with MNE-Python toolbox for doing this tutorial
- These installations can be made on NIX, WINDOWS and MacOS
- The skeleton code to perform all basic operations are already provided
- Use the tinker boxes provided to insert code and play around with the ICA

Assignment - Part-A - Simulation

Instructions

1. Use a Python based toolbox such as scikit-learn for machine learning for this exercise

Exercises

1. Generate three signal components - square, sawtooth and sine wave of 200 seconds at a sampling rate of 1kHz
2. Mix the signals in the following combinations
    a. Square: 20%; Sine: 20%; Sawtooth: 60%
    b. Square: 33%; Sine: 33%; Sawtooth: 34%
    c. Square: 60%; Sine: 20%; Sawtooth: 20%
    d. Add randomly distributed Gaussian noise before computing the mixed signals (standardize the signals before adding noise and mixing)
3. Deploy ICA and PCA to separate the signals into components
4. Answer the following questions
    a. Which of the methods was better? Why might it be?

Assignment - Part-B

Instructions

1. Install Conda Python (Win)
2. Use the skeleton code to run the ICA on the data
3. Look for “EDITME” and “<====” for lines to edit. Feel free to play around with the codes.

Exercises

1. Visualize the ICs as topographical plots - can you spot the ECG and EOG artefactual components?
2. Visualize the ICs as topographical AND time-series plots - can you spot the ECG and EOG artefactual components now?
3. Remove the possible artefactual components and replot the data and see if the ECG/EOG artefacts are removed. Did it work?
    a. Perhaps add a few more components if it didn’t?
    b. Reduce the dropped components and see if the artefacts stay removed or if they come back onto the signal?
    c. Was there a difference in the ECG and EOG artefacts in MEG vs EEG? Explain what you observe in this respect (Use the second part of the Jupyter notebook to try it out)
4. How should the dipoles be positioned to create such topographies in EEG? (Hint: Think about the previous assignment)

Optional

5. What happens if you change the n_components or the number of ICA components to be decomposed?
6. What happens if you change the seed parameter?
7. Does it still work well without the reference ECG/EOG channels added along with the EEG data during ICA separation?
8. How does MNE-Python actually perform ICA? What are the different steps? Is PCA a part of it?
9. With this topography in mind, can you now go back to the BESA simulator and simulate dipole position and directions that could create similar topographies in an EEG?