

Attempting to reconstruct auditory neural generators using EEG

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Introduction

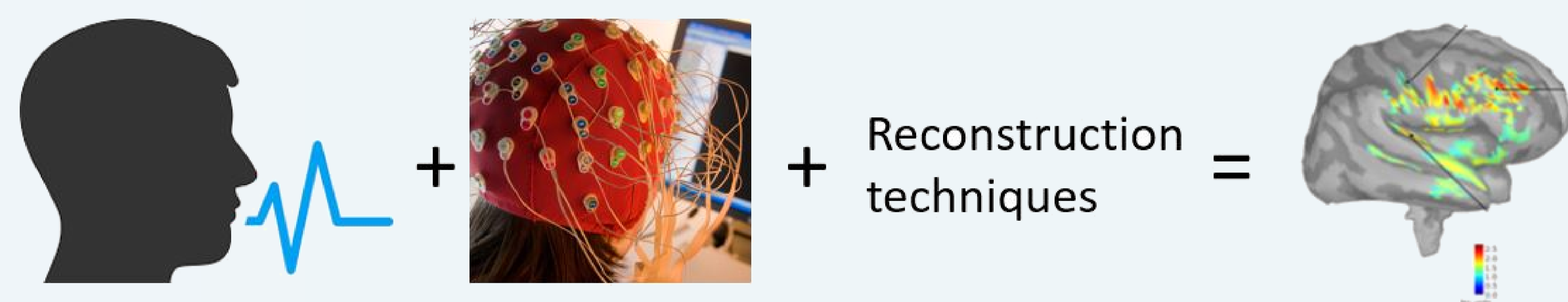
Auditory Neural generators

- ▶ Auditory neural generators are regions of the brain (cortical and/or sub-cortical) in charge of processing auditory signals.
- ▶ Neural generators differ depending on the characteristics of the auditory signals.

Reconstruction Neural generators

- ▶ Finding the neural generators in charge of processing specific external signals using brain images/signals + localization techniques.
- ▶ Historically ==> Reconstruction of neural generators has been done using MRIs.
- ▶ For speech/auditory signals ==> **Temporal** processing is necessary.
- ▶ MRI not useful for temporal processing ==> EEG allows analysis of **temporal** information [1].

Reconstruction Auditory Neural generators



- ▶ Use of repetitive signals to generate Auditory steady-state responses (ASSRs).
- ▶ There are two reconstruction techniques previously used for auditory signals ==> *BESA* [2] and *Minimum norm imaging* (MNI) [3].

BESA vs MNI

BESA

- ▶ Mainly reconstruction of cortical sources.
- ▶ Use of simple head models.
- ▶ Use of region's dipoles. One dipole per region.

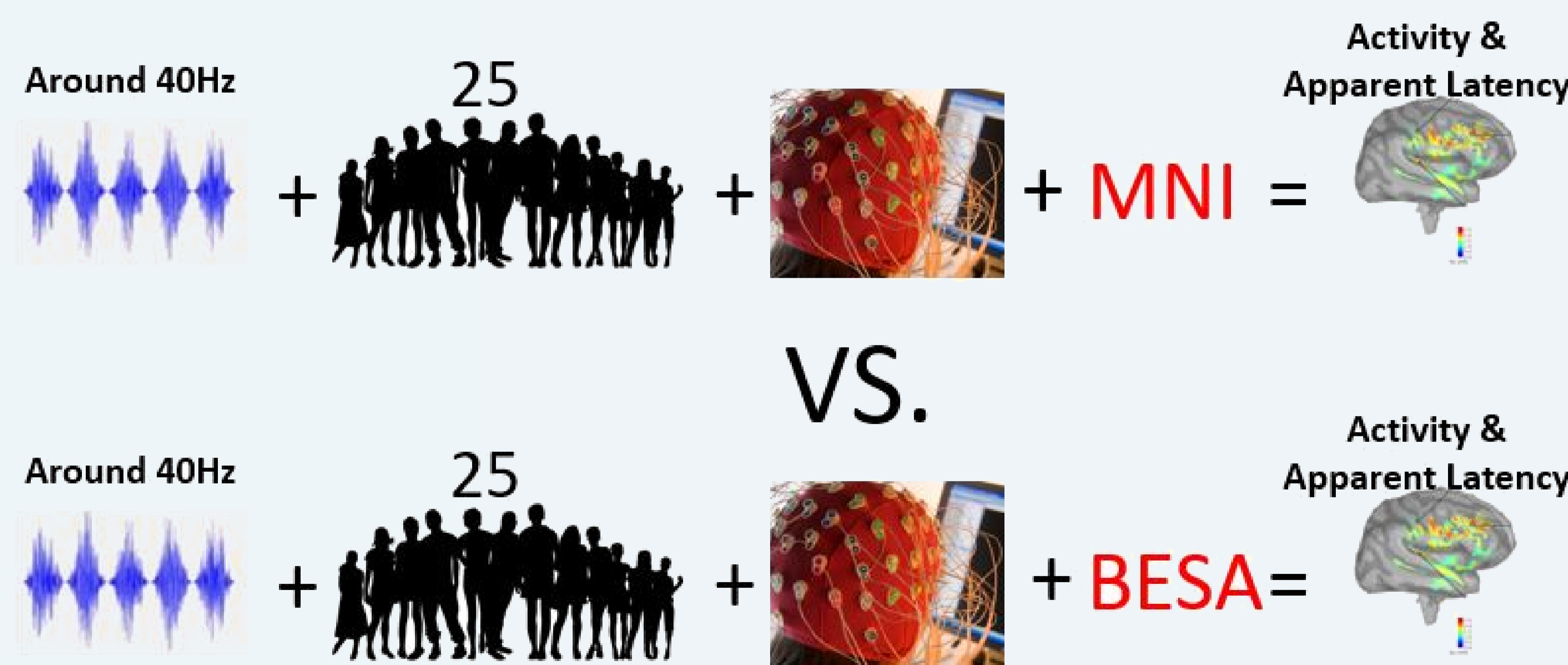
MNI

- ▶ Reconstruction of cortical and sub-cortical sources.
- ▶ Use of complex head models ==> Similar to reality.
- ▶ Use of multiple dipoles per region.

Aim preliminar study

- ▶ *The aim of this preliminary study is to attempt to reconstruct cortical and sub-cortical sources of ASSRs, in normal hearing young adults, using EEG and the MNI technique.*

Methodology



- ▶ Signals modulated at frequencies between 36Hz and 50Hz.
- ▶ Apparent Latency ==> Time interval between stimulus presentation and results brain activity.

Preliminar Results

- ▶ Amplitude values in cortical and sub-cortical sources similar between BESA and MNI.
- ▶ Apparent latency decreases from cortical to sub-cortical in both methodologies.
- ▶ Apparent latency cortical MNI too low.
- ▶ Apparent latency sub-cortical BESA too high.

Conclusions

- ▶ Preliminary, the MNI methodology is able to reconstruct the cortical and sub-cortical sources, in the activity domain.
- ▶ A decrease of apparent latency from cortical to sub-cortical regions is as described in previous studies.
- ▶ It is not clear if the MNI technique loses the phase information or not. This is necessary to calculate the apparent latency.
- ▶ Is it possible that the BESA and MNI techniques can't differentiate, at the same time, the cortical and sub-cortical sources?

Future work

- ▶ Reconstruct auditory neural generators at frequencies around 4Hz and 20Hz. ==> We expect only cortical sources at these frequencies.

Acknowledgments

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Bibliography

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- [3] Ehsan Darestani Farahani, Jan Wouters, and Astrid van Wieringen. Brain mapping of auditory steady-state responses: A broad view of cortical and subcortical sources. *Human Brain Mapping*, 2020.