Riemannian Geometry-Based Decoding of the Directional Focus of Auditory Attention Using EEG

IEEE ICASSP 2021

Simon Geirnaert
Joint work with Tom Francart and Alexander Bertrand
Smart neuro-steered hearing devices

Denoising and speaker separation

MIX

Audio

targeted speaker

Auditory Attention Decoding (AAD)

EEG

noise
The traditional approach: stimulus reconstruction

1. **EEG** → **decoder** → correlate over $\tau$ seconds → $\rho_1$
2. **envelope extraction** → correlate over $\tau$ seconds → $\rho_2$
3. **max** → attended speaker
AAD accuracy

![Graph showing AAD accuracy vs. decision window length with high and low time resolution markers.](image)

Decoding the **spatial focus** of auditory attention
Decoding the spatial focus of auditory attention using common spatial pattern (CSP) filtering

[Diagram of brain with arrows indicating EEG, CSP decoder, and LDA classifier]

1S. Geirnaert, T. Francart, and A. Bertrand, "Fast EEG-based decoding of the directional focus of auditory attention using common spatial patterns," *IEEE Transactions on Biomedical Engineering*, 2020
CSP ~ direct classification of covariance matrices
CSP ~ direct classification of covariance matrices
Direct classification of covariance matrices
Direct classification of covariance matrices

\[ T = \log \left( R_{\phi}^{-\frac{1}{2}} R_{xx} R_{\phi}^{-\frac{1}{2}} \right) \]


Direct classification of covariance matrices