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Using models for classification: real-life applications

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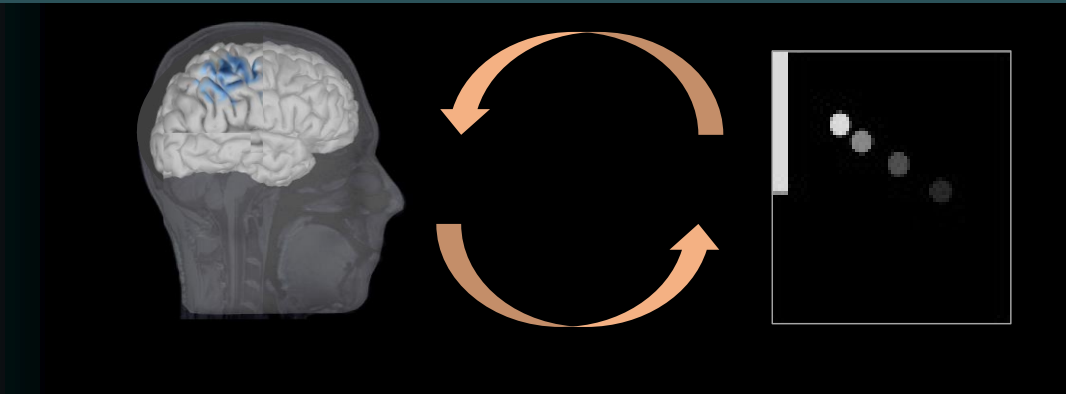
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Using models for classification: real-life applications



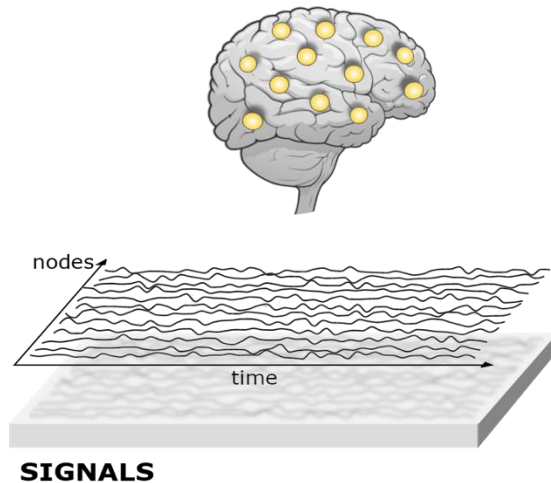
Marie-Constance Corsi,

Inria research scientist

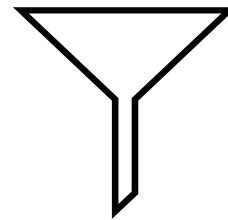
NERV team, Paris Brain Institute



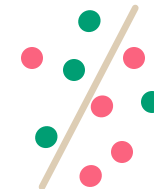
M/EEG recording



Features extraction



Classification



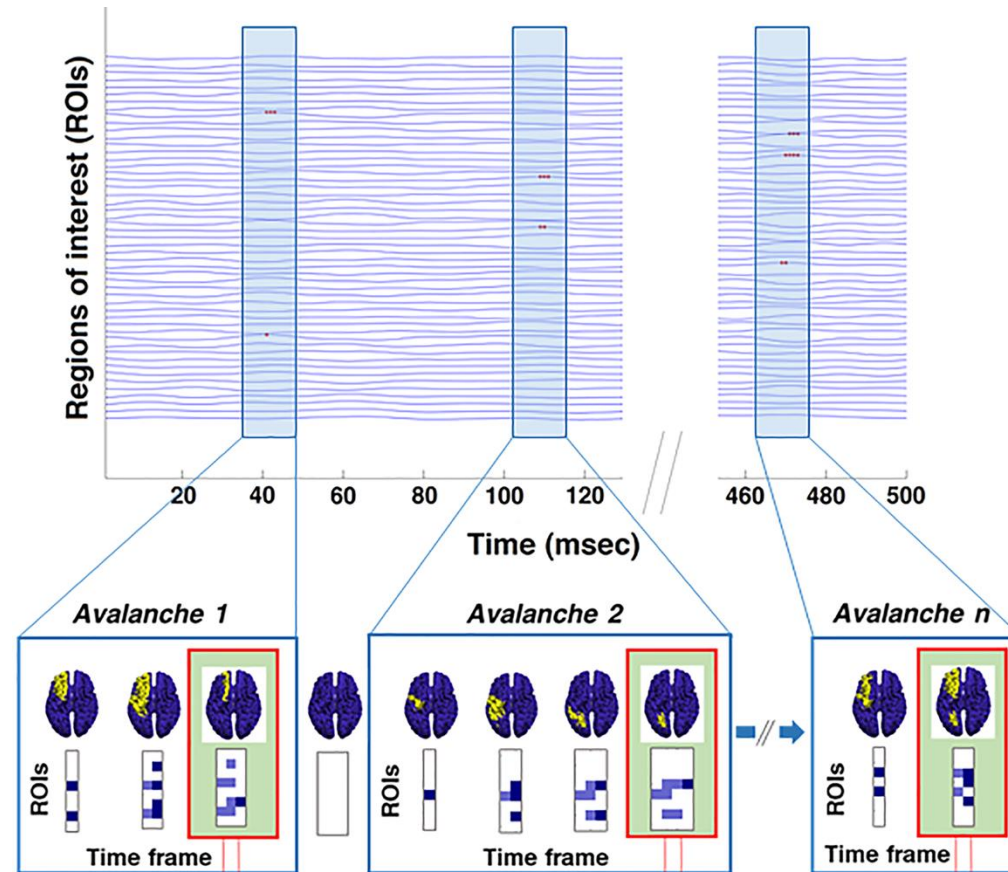
For which purpose(s)?

- Validating potential biomarkers
 - Diagnosing diseases
- Distinguishing mental states

...

Capturing fast, non-linear brain dynamics

Neuronal avalanches: bursts of enhanced activity observed across neuroimaging modalities

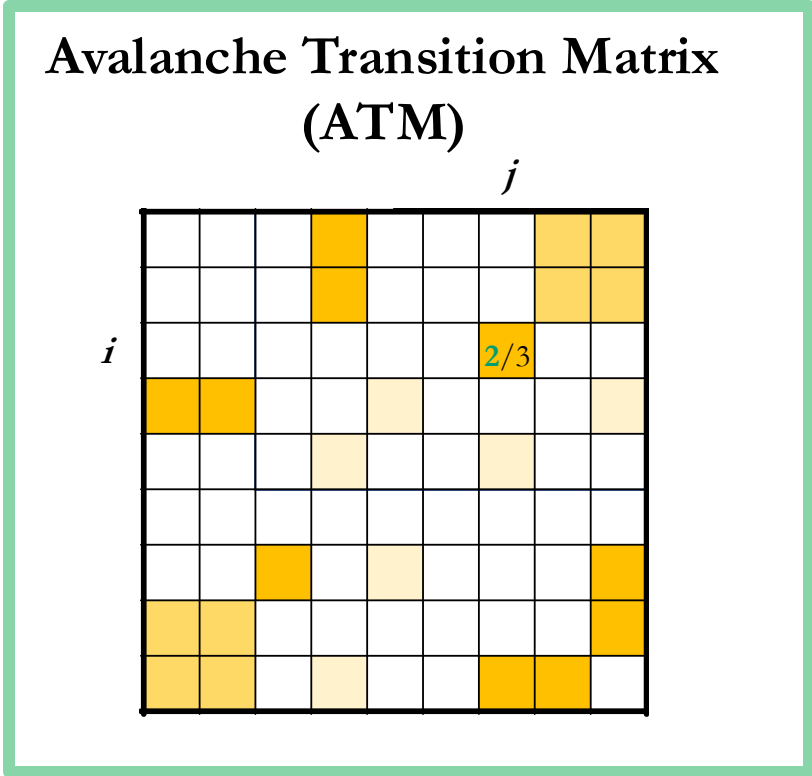
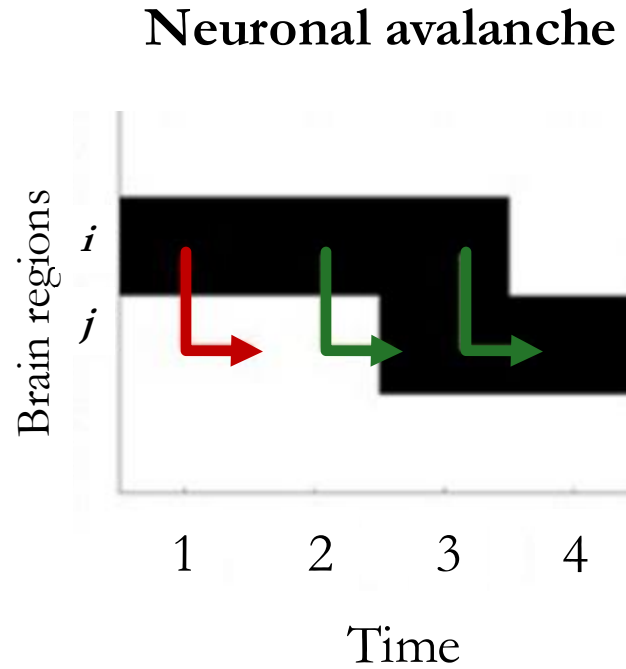
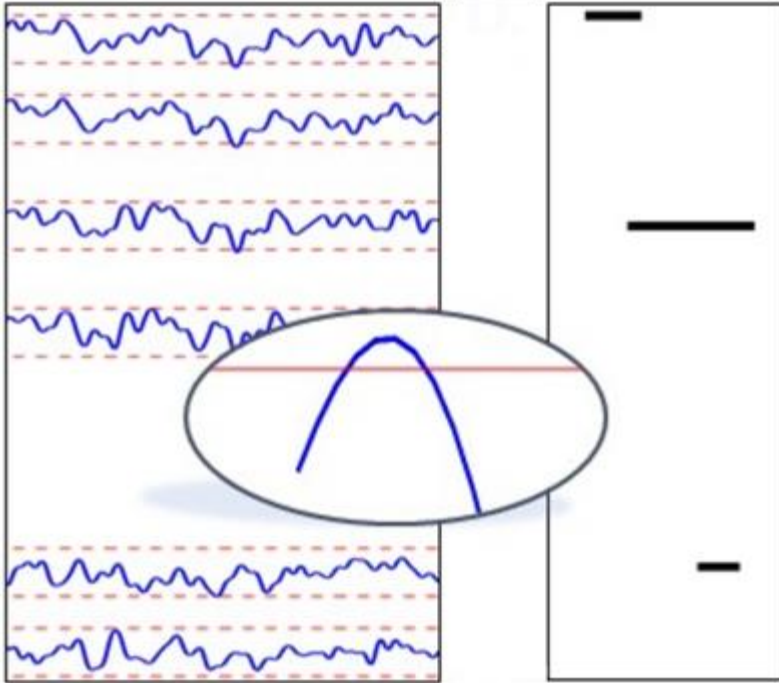


Adapted from [Polverino et al, Neurology, 2022]

Hypothesis:

The neuronal avalanches could spread differently according to the task/populations & provide original features

Avalanche Transition Matrix (ATM) computation

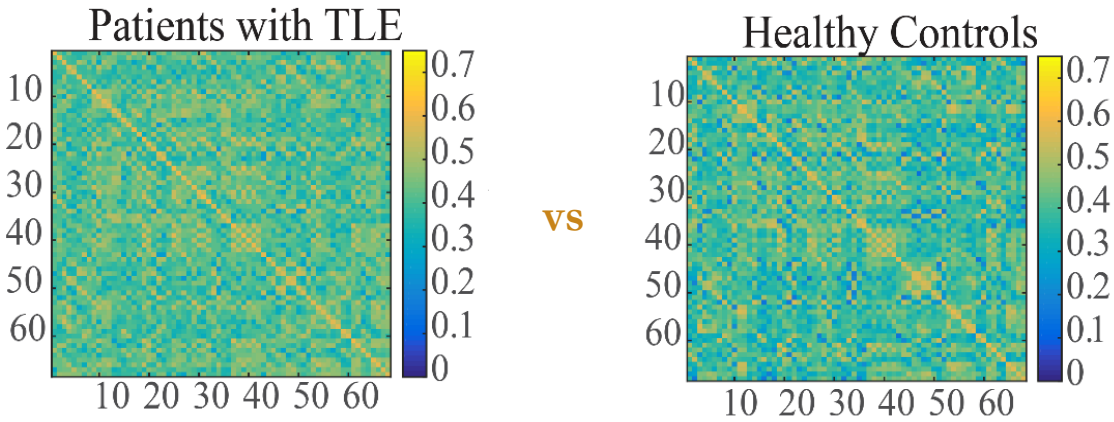


Adapted from [Sorrentino et al, eLife, 2021]

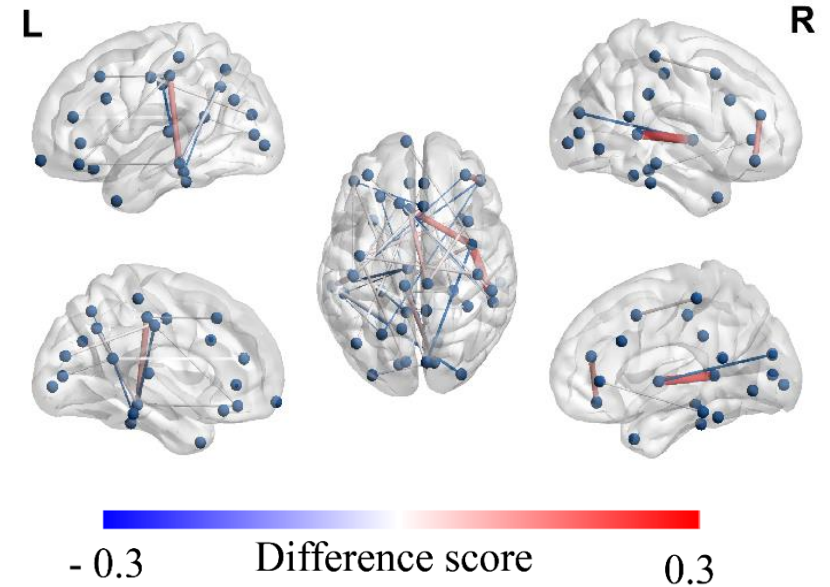


Classification for clinical diagnosis – Temporal Lobe Epilepsy (TLE)

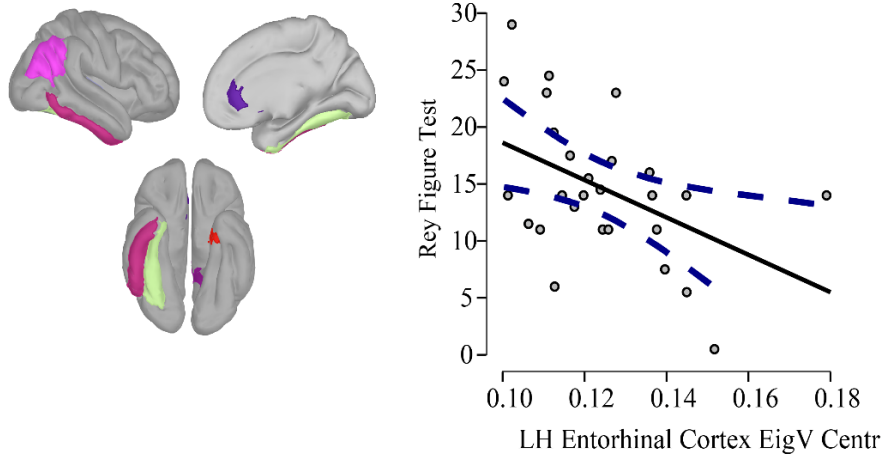
Mean transition matrices



Significant edges

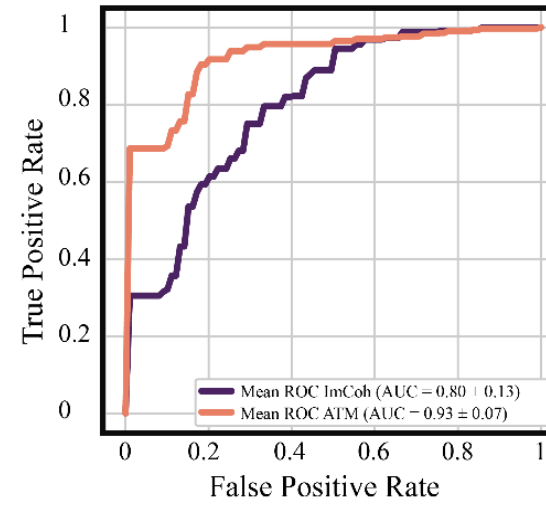
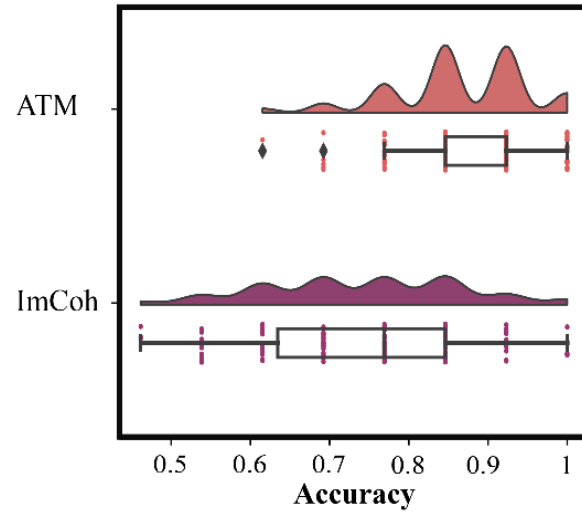


Significant Nodes and Correlation

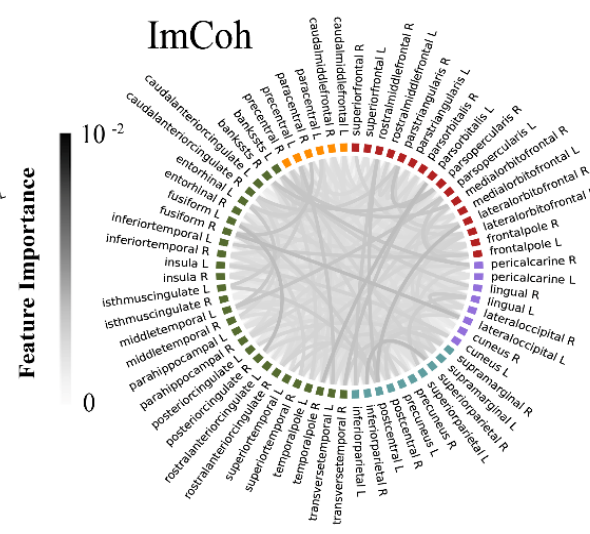
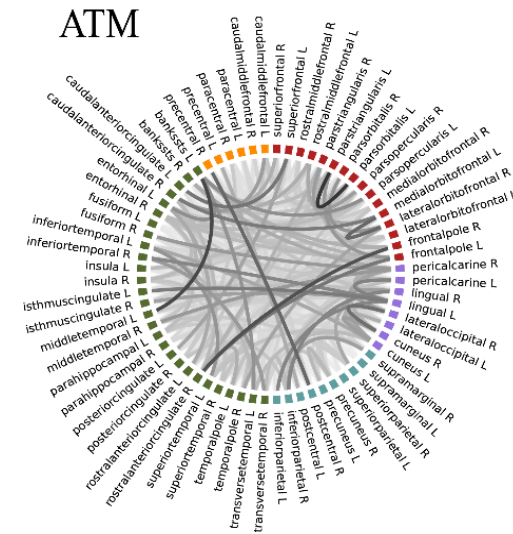


Classification for clinical diagnosis – Temporal Lobe Epilepsy (TLE)

Classification performance

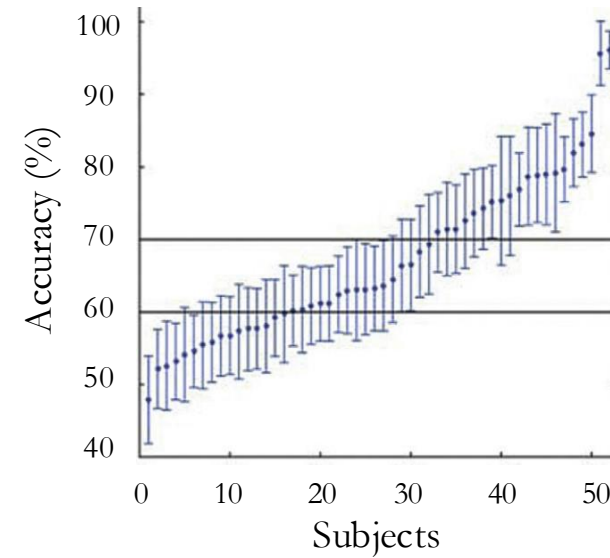
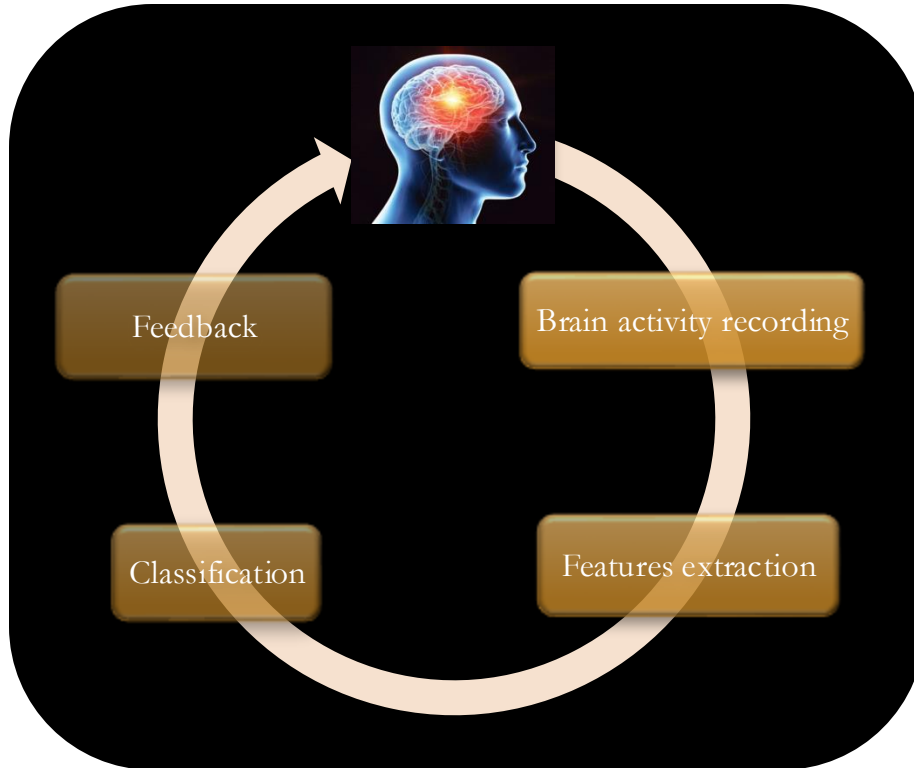


Model interpretability



[Corsi* et al, Sci. Reports, 2024]



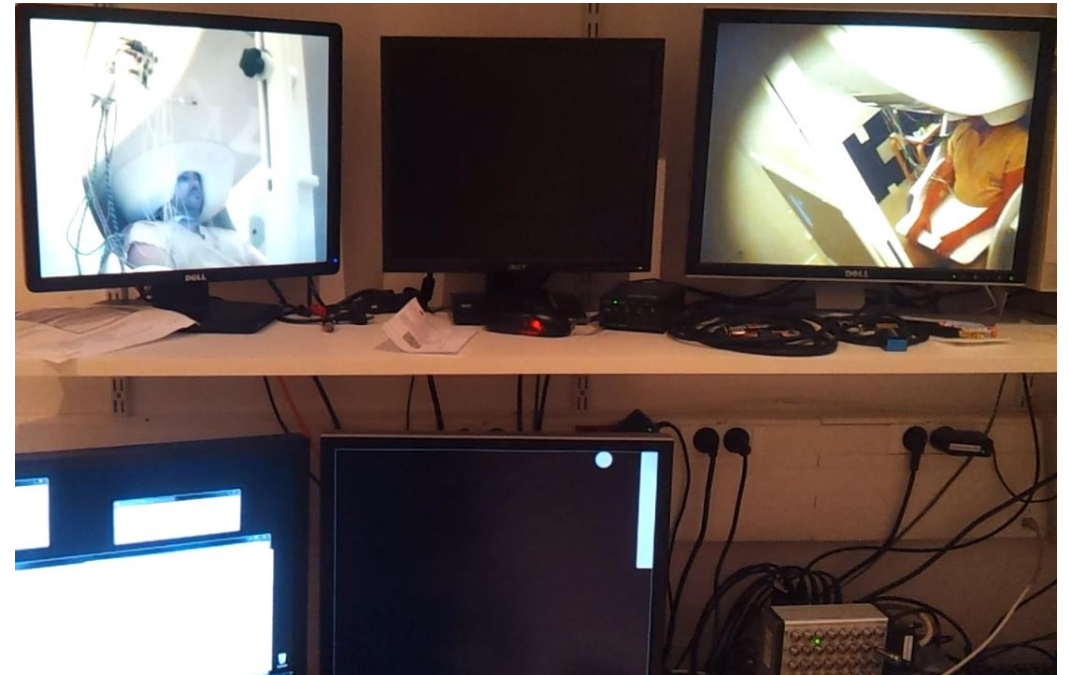
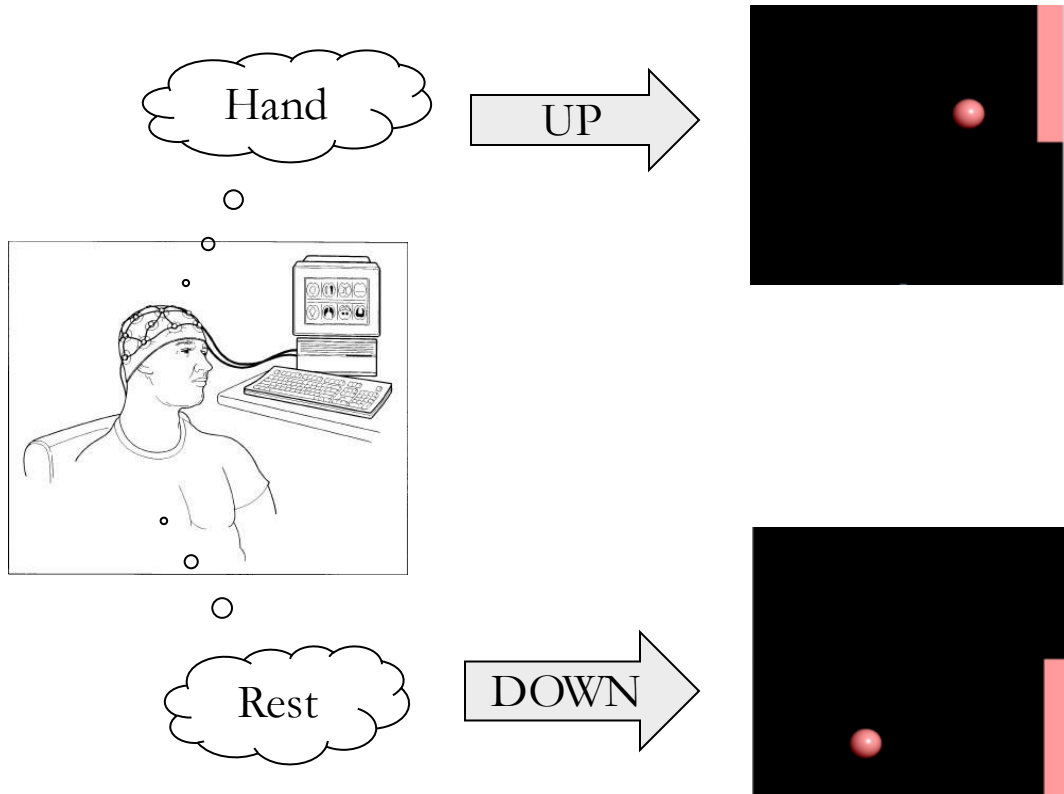


Adapted from (Ahn & Jun, 2015)

Problem:

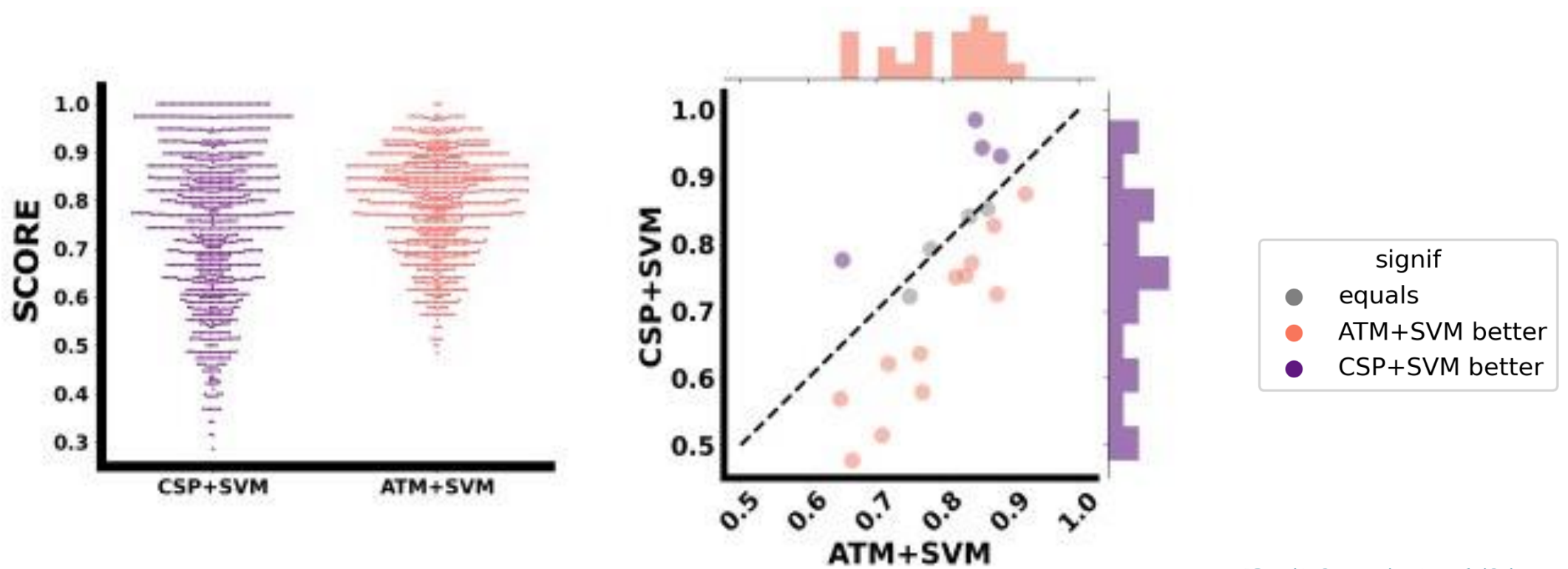
Current BCIs fail to detect the mental intentions in ~30% of users – **BCI inefficiency** (Thompson, 2018)

⇒ Rely on local measurements of the brain activity



For a complete description of the protocol and the dataset, please refer to [Corsi et al, NeuroImage, 2020]

Transition probabilities as alternative features for BCI

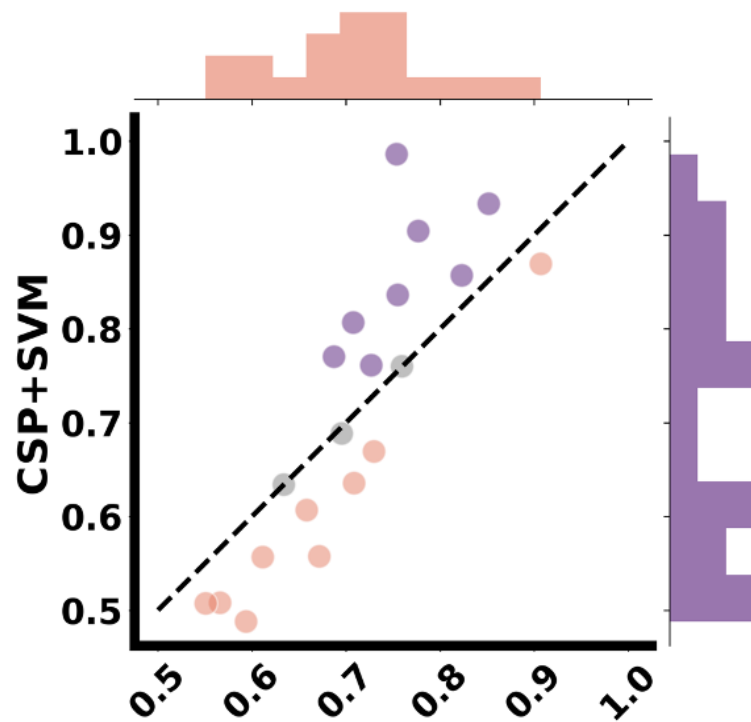


[Corsi*, Sorrentino* et al, iScience, 2024]



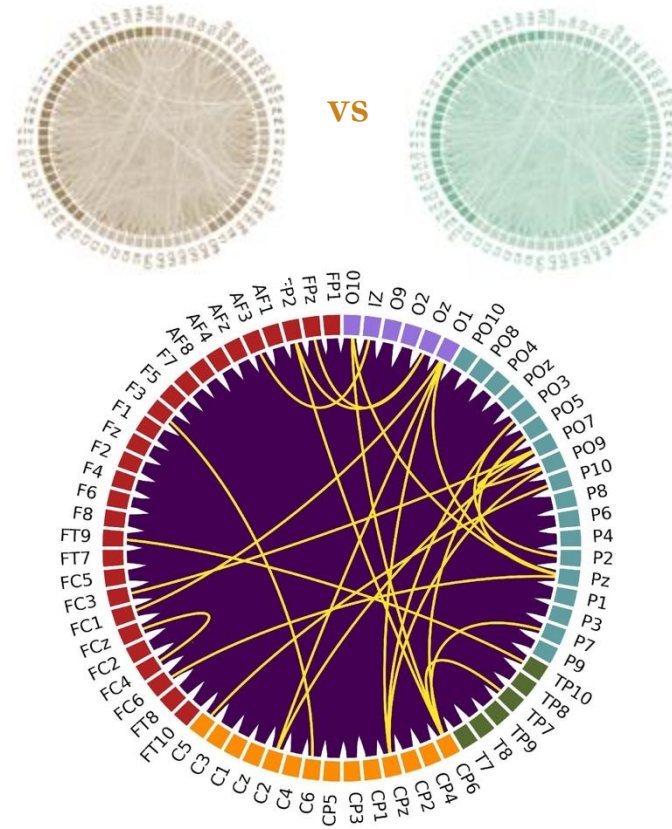
Building innovative BCI protocols based on ATMs

Classification performance



Model interpretability

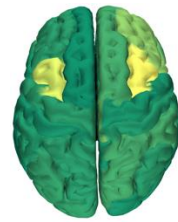
MI vs Rest vs Features importance



C. Mannino

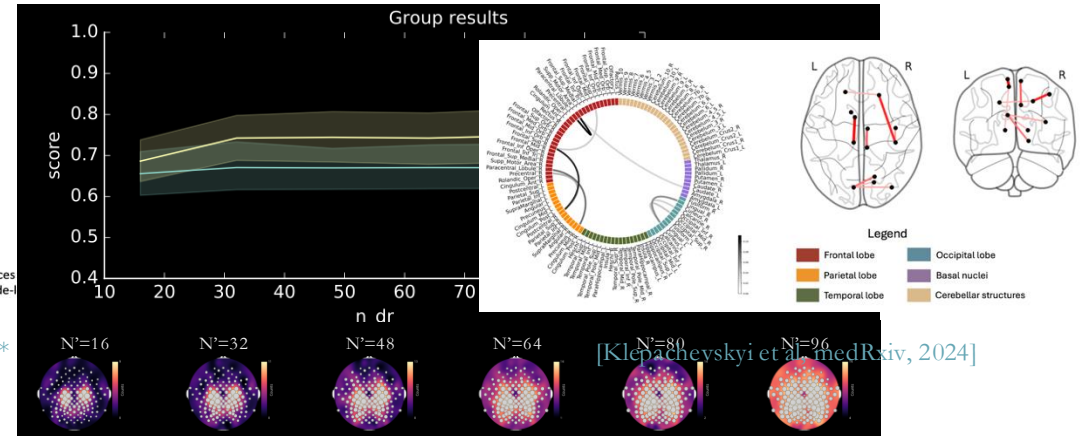
Dealing with (alternative) FC estimators...

- Dealing with high dimensional matrices
 - Classifiers [Lotte et al, 2018]
 - Dimensionality reduction
- Inter-subject variabilities
 - Identifying features associated with robust patterns
 - Ensemble learning approach
- Real impact
 - Interpretability
 - Replicability



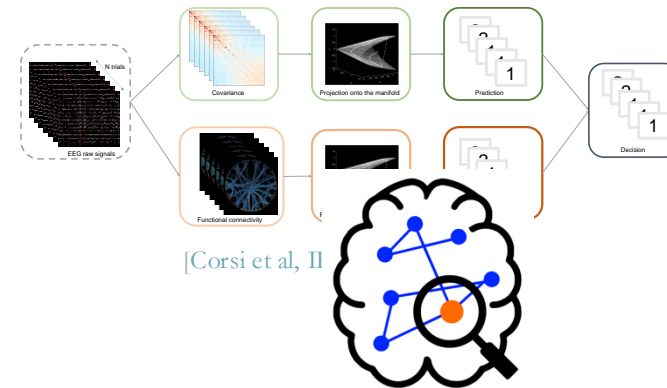
Reliable differences
subjects - Node-1

[Corsi*, Sorrentino*]



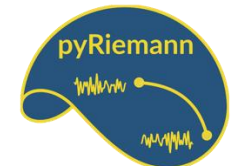
[Klepáčevskiy et al medRxiv, 2024]

[Corsi et al, IEEE TBME, 2022]



[Corsi et al, II]

happyfeat.readthedocs.io/en/latest/



pyriemann.readthedocs.io/en/latest/



moabb.neurotechx.com/docs/

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Institut de Neurosciences des Systèmes

Pierpaolo Sorrentino



Univ. Paris Dauphine

Florian Yger

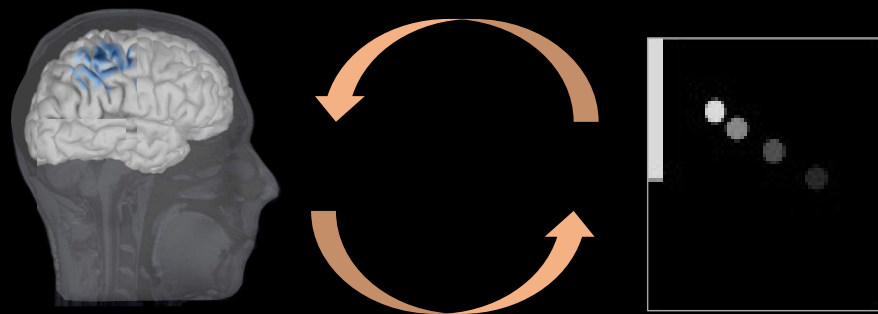


IRCCS E. Medea

Gian Marco Duma



Thank you for your attention!



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[MConstanceCorsi](https://twitter.com/MConstanceCorsi)



[mccorsi](https://github.com/mccorsi)