COALIA: a ground-truth for the evaluation of the EEG source connectivity

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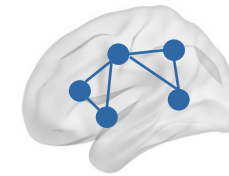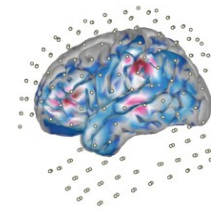
Introduction

Introduction:

- EEG source connectivity has gained increased interest in past recent years.

EEG source connectivity

Ground-truth?

Problematic:

- The absence of a '**ground truth**' when applying EEG-source connectivity on real EEG data represents a challenge for comparative studies
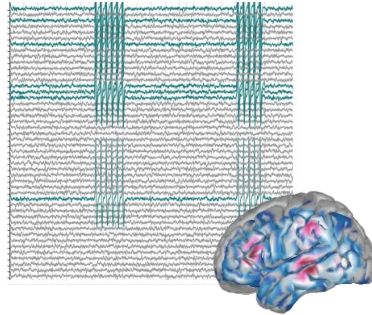
Objective:

- Use **COALIA**, a physiologically-inspired model to generate epileptiform, cortical activity and evaluate the effect of:

  1. five different electrode densities

  2. two inverse solution algorithms

  3. two functional connectivity measures
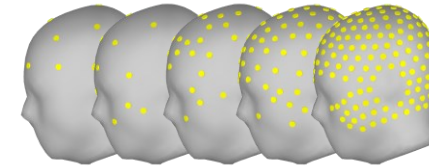
Methods and Materials

1. Reference network
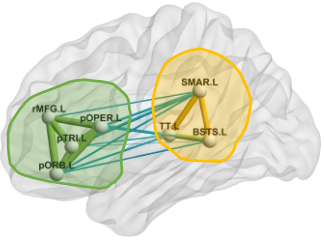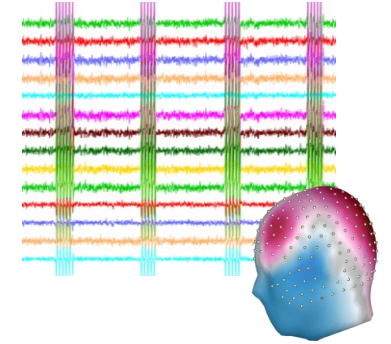
2. Simulated cortical activity
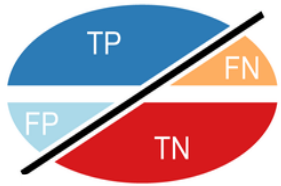
COALIA computational model

3. Forward model

19/32/64/128/256 channels

4. Scalp EEG

8. Accuracy assessment
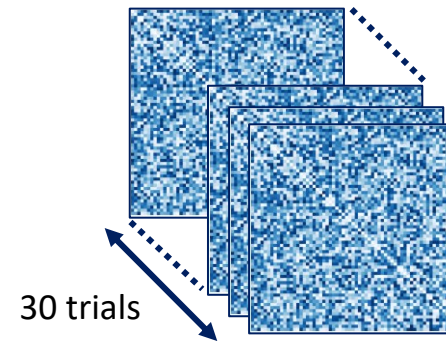
TP FN FP TN

7. Estimated networks
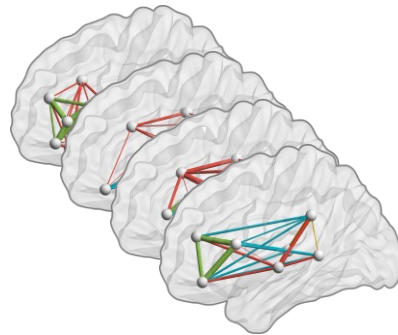
6. Functional connectivity

30 trials

PLV wPLI

5. Source reconstruction

wMNE eLORETA

Results

	19 channels	32 channels	64 channels	128 channels	256 channels
wMNE / wPLI					
wMNE / PLV					
eLORETA / PLV					
eLORETA / wPLI					
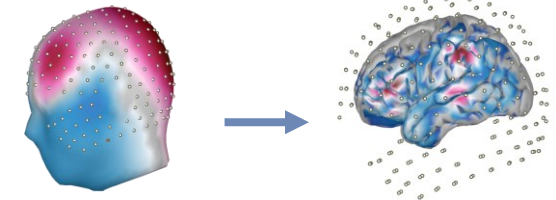
🟩 Epileptogenic network   🟨 Propagation network   🟦 Between-networks connections   🟥 Spurious connections
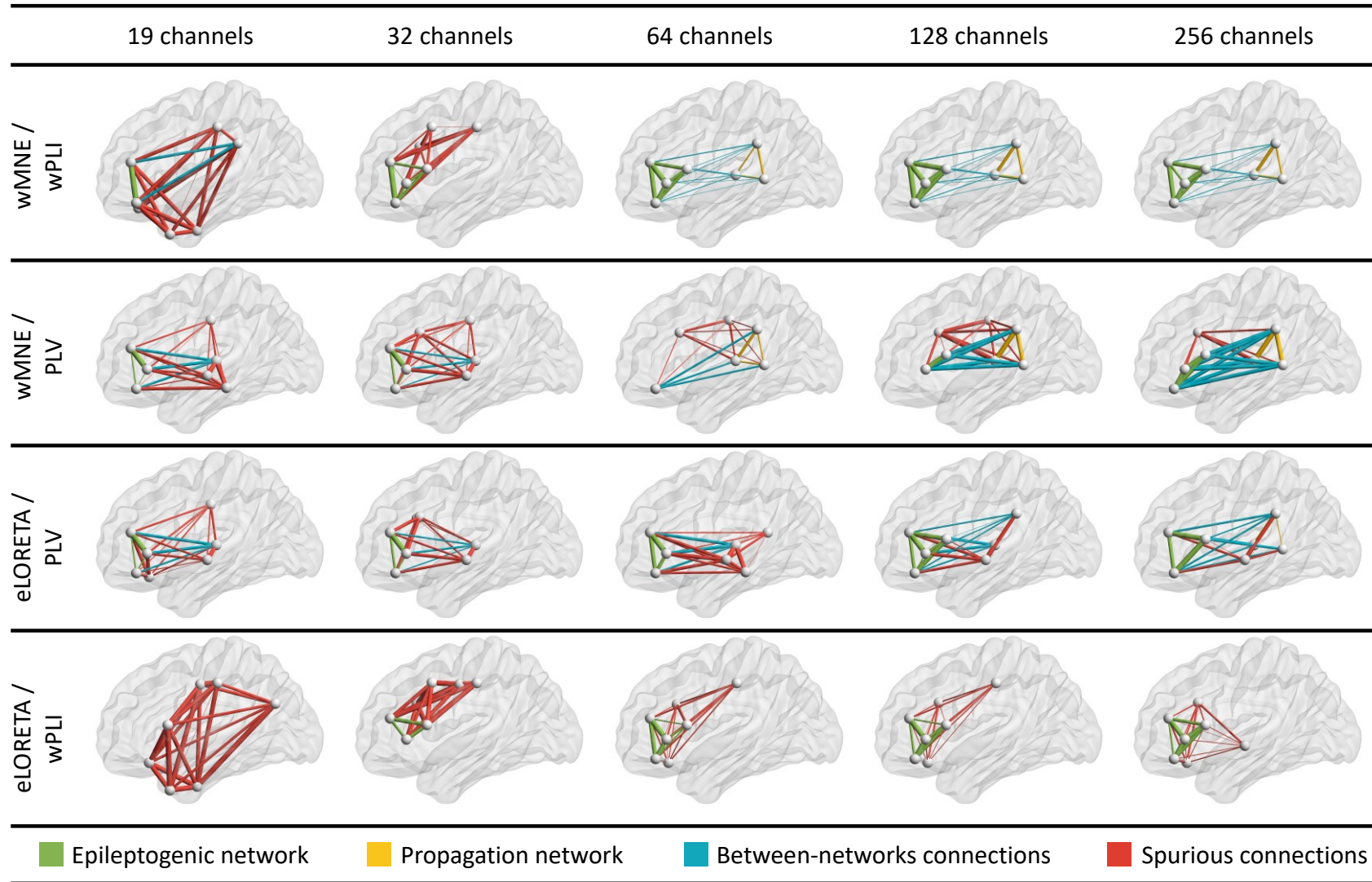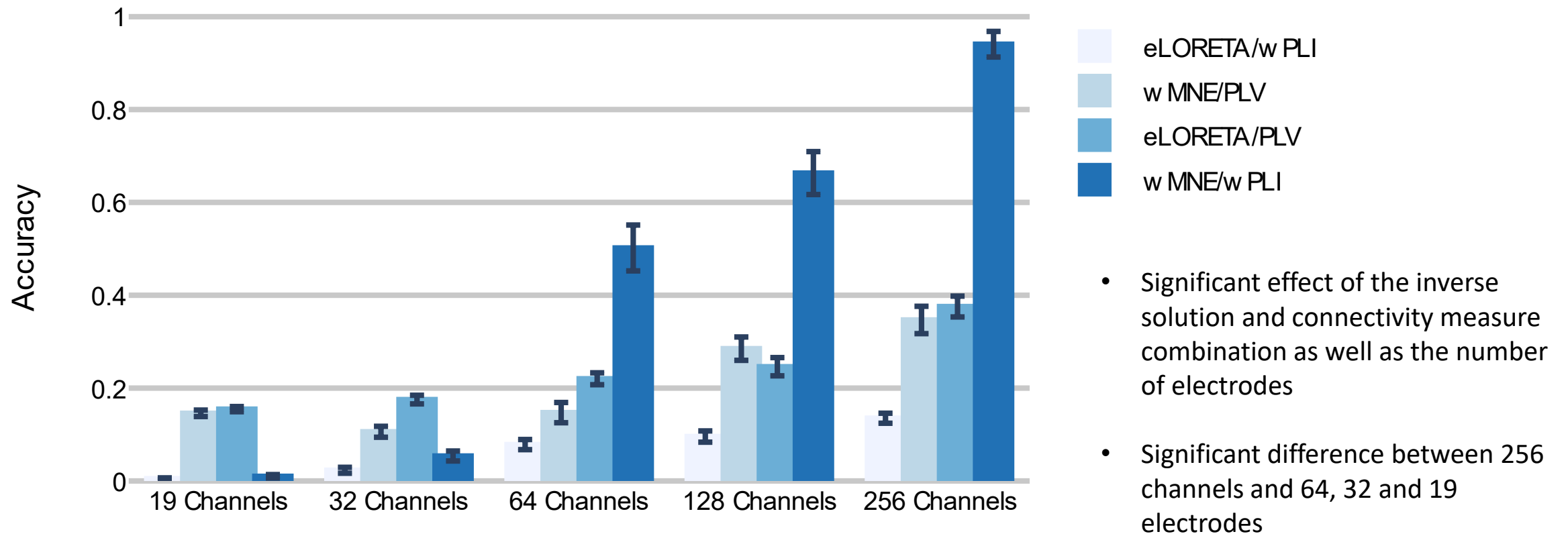
Qualitative results:
- Higher sensor density
  → Better performance

- wMNE/wPLI
  → Best Performance

- eLORETA/wPLI
  → Worst performance

Results

- Significant effect of the inverse solution and connectivity measure combination as well as the number of electrodes

- Significant difference between 256 channels and 64, 32 and 19 electrodes

Conclusions

- Proof of concept that COALIA can provide a ground-truth for comparative studies aiming at optimizing the EEG-source connectivity pipeline.

- A higher network estimation accuracy requires a high number of EEG electrodes

- A careful choice of an inverse solution/connectivity measure combination is necessary.

Thank You!