Cobrawap: a modular cortical wave analysis pipeline for heterogeneous data

Robin Gutzen[1,2*], Giulia De Bonis[3], Elena Pastorelli[3], Cristiano Capone[3], Chiara De Luca[3,4], Anna Letizia Allegra Mascaro[5,6], Francesco Resta[5,7], Francesco Saverio Pavone[5], Maria V. Sanchez-Vives[8,9], Maurizio Mattia[10], Sonja Grün[1,2], Andrew Davison[11], Pier Stanislao Paolucci[3] & Michael Denker[1]

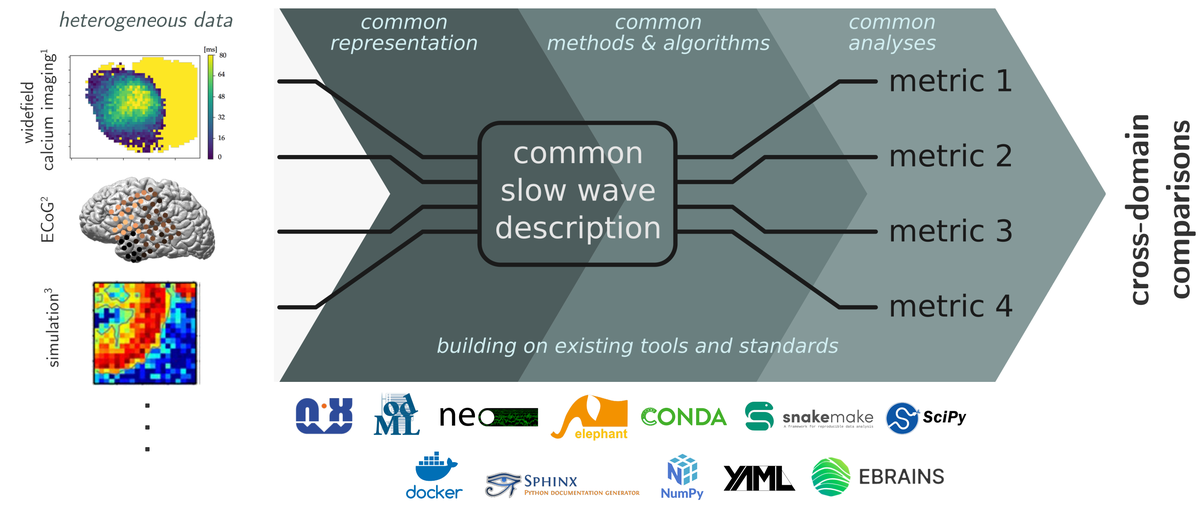
[1] Institute of Neuroscience and Medicine (INM-6) and Institute for Advanced Simulation (IAS-6) and JARA-Institute Brain Structure-Function Relationships (INM-10), Jülich Research Centre, Jülich, Germany
[2] Theoretical Systems Neurobiology, RWTH Aachen University, Aachen, Germany
[3] Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Roma, Rome, Italy
[4] Ph.D. Program in Behavioural Neuroscience, "Sapienza" University of Rome, Rome, Italy
[5] European Laboratory for Non-linear Spectroscopy (LENS), University of Florence, Florence, Italy
[6] Neuroscience Institute, National Research Council, Pisa, Italy
[7] Department of Physics and Astronomy, University of Florence National Institute of Optics, National Research Council, Sesto Fiorentino 50019, Italy
[8] Institut d'Investigacions Biomediques August Pi i Sunyer (IDIBAPS), Barcelona, Spain
[9] Institucio Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain
[10] Istituto Superiore di Sanità, (ISS), Rome, Italy
[11] Unite de Neurosciences, Information et Complexite, Neuroinformatics Group, CNRS FRE 3693, Gif-sur-Yvette, France
* r.gutzen@fz-juelich.de @rgutzen

Summary

- **We developed an analysis pipeline that enables us to align the characterization of cortical waves across data modalities.**
- **This approach improves the comparability of datasets (and models) benefiting more rigorous analyses and validations.**
- **Such modular, adaptable analysis frameworks promote reproducibility, reusability, and collaborative research.**
- **Collaborative brain-wave analysis pipeline: *https://github.com/INM-6/cobrawap***

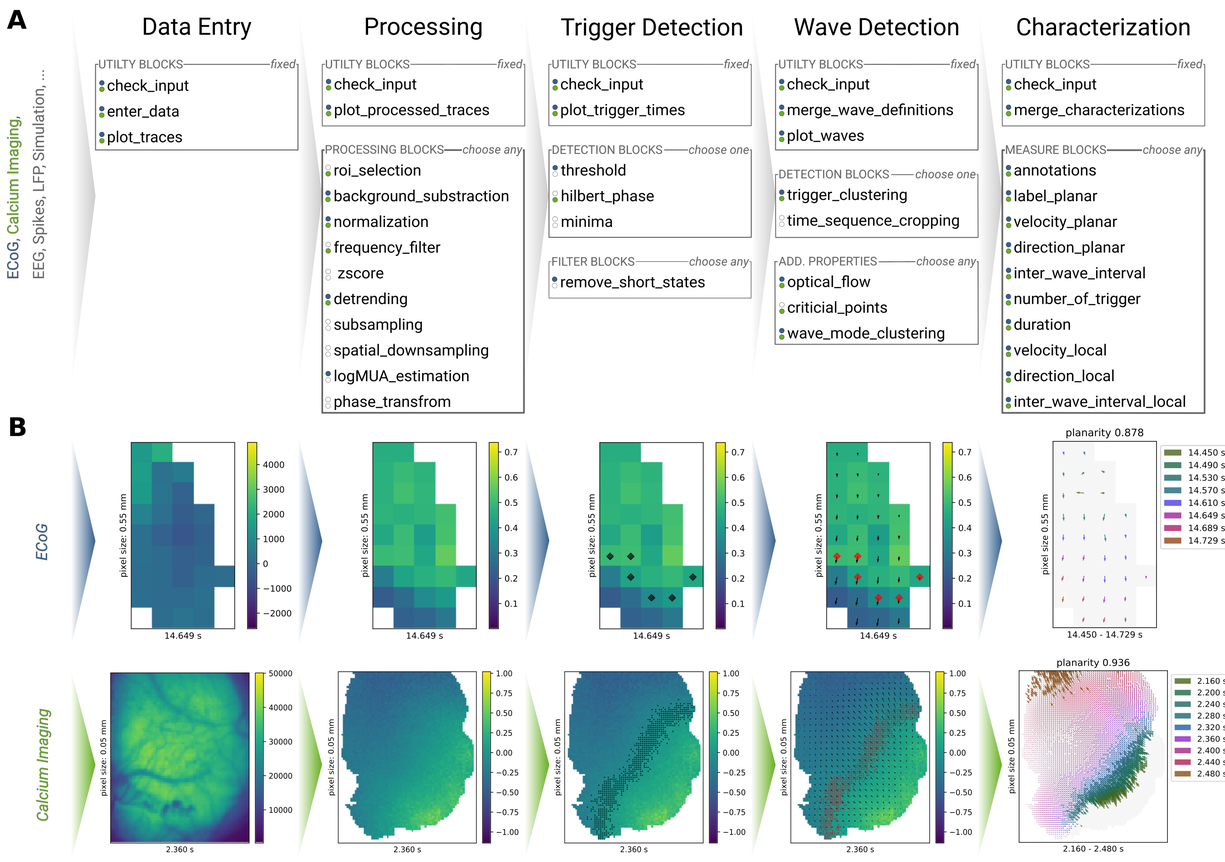
How to compare heterogeneous data

- Slow waves (1-4 Hz), which are typically present during sleep and anesthesia, are observable across species, scales, methods.
- Comparability of heterogeneous data is needed for integration of data sources, model calibration & validation, quantifying experimental variability.
- To support comparability, analysis workflows require reproducibility and reusability.



Implementation of a modular analysis pipeline

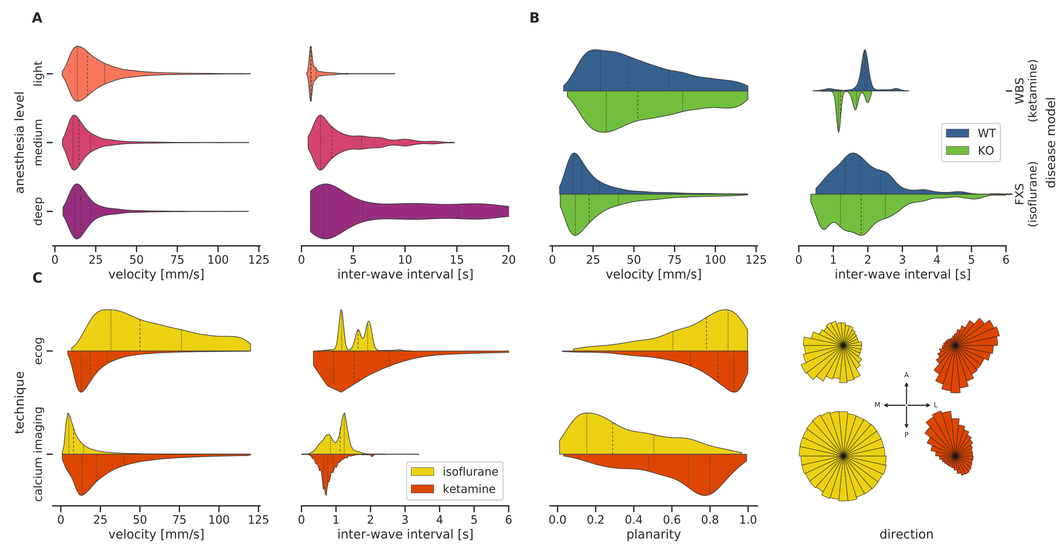
- We built a pipeline consisting of modular, adaptable, and reusable elements: sequential stages containing selectable method blocks (*A*).
- Each block is represented by a Python script and an input→output rule in a workflow manager, that handles the execution order and the parameter settings.
- By configuring the block and parameter selections, the pipeline can be adapted to the data and analysis needs towards a common description level (*B*).



Applications

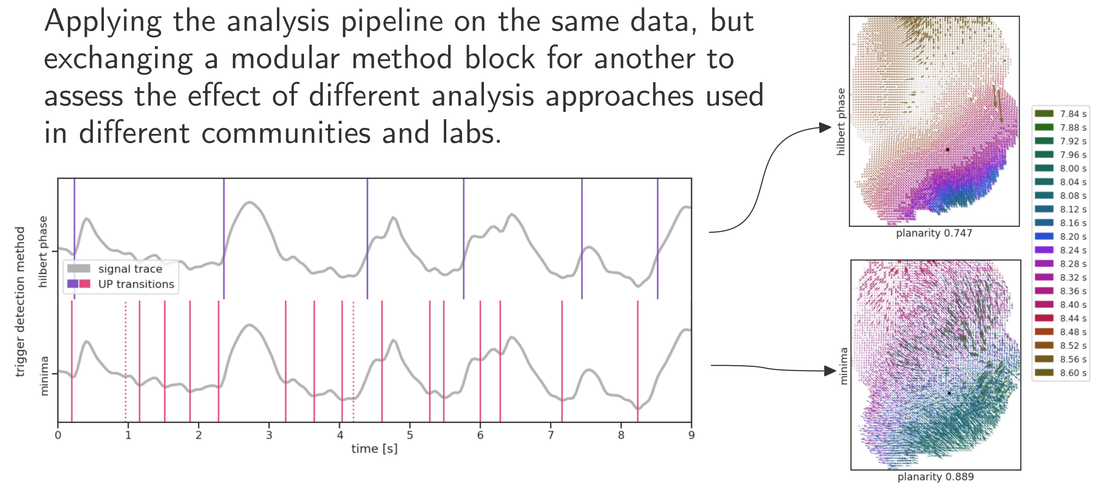
Meta-studies across multiple datasets

Evaluating properties in 60 open-access ECoG and calcium imaging recordings of anesthetized mice[4-8], replicating and consolidating previous findings on wave properties[9-11] (*A,B*), and comparing wave properties across measurement technique and anesthetic type (*C*).



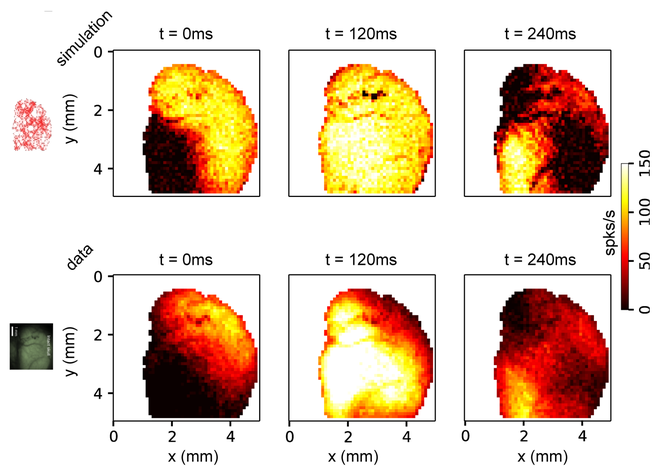
Method benchmarking

Applying the analysis pipeline on the same data, but exchanging a modular method block for another to assess the effect of different analysis approaches used in different communities and labs.



Model calibration and validation

Iteratively comparing wave properties between experimental data and model simulation to optimize model parameters reproducing the wave statistics[12].



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Acknowledgements

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