K-COMPLEX LOCALIZATION AND CLASSIFICATION ALGORITHM

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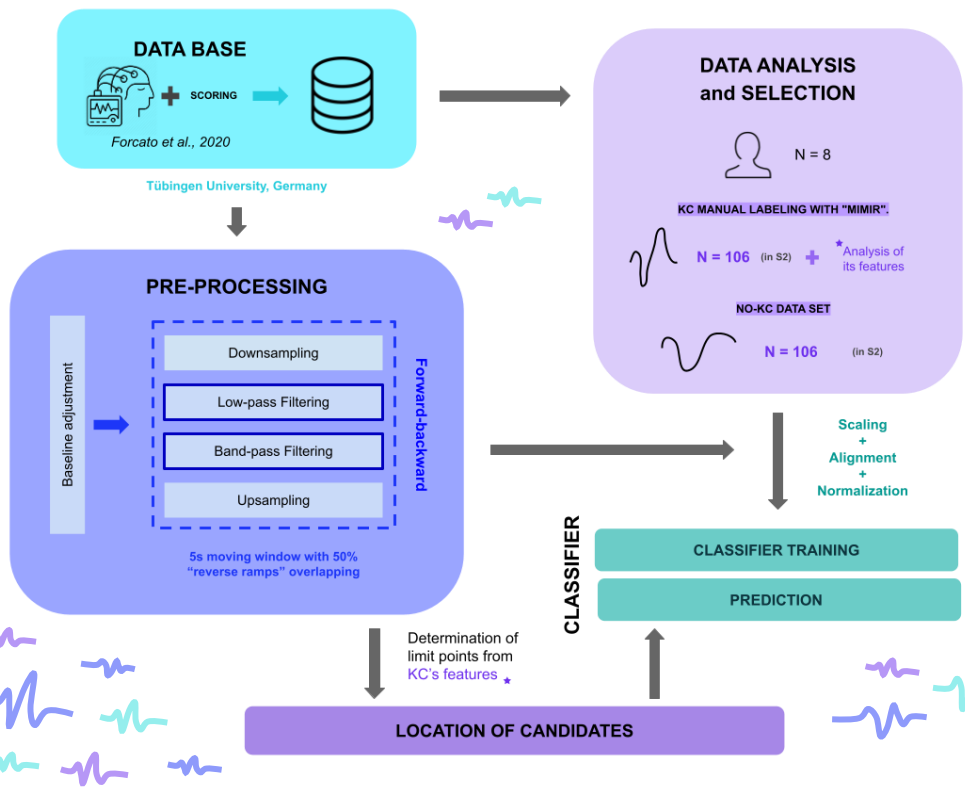
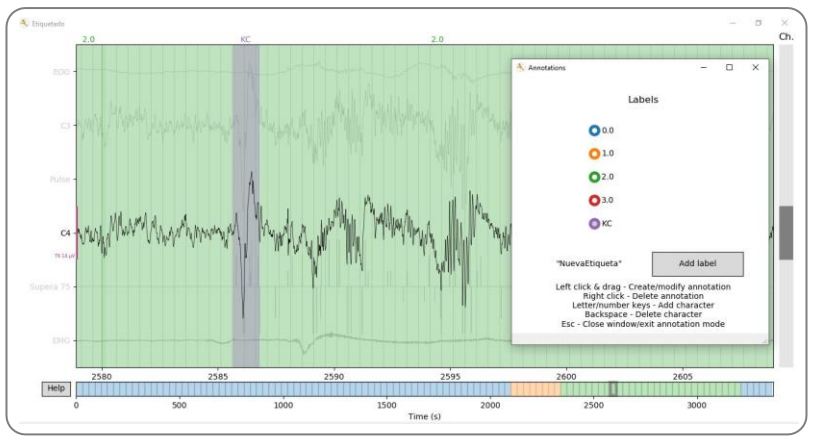
INTRODUCTION

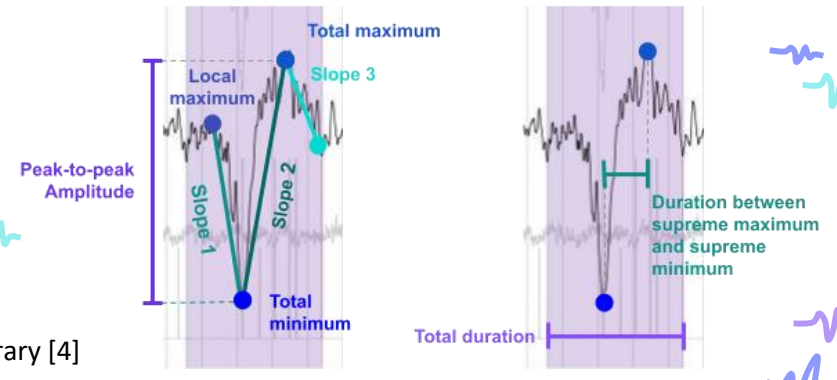
- K-Complexes (KCs) are events present in non-rapid eye movement (non-REM) sleep, which have cellular dynamics similar to slow waves and have 3 distinguishing components: an initial P200, a posterior N500 and a final P900. [1]
- Sleep plays a fundamental role in memory consolidation, favoring the transfer of new information from the hippocampus to the neocortex and its cortico-cortical redistribution. [2]
- There are currently no studies that directly link KCs with memory processes, so they are not being considered as a possible facilitating event of this hippocampal-cortical dialogue. [2] [3]

METHODS

Main goal: Create a Machine Learning based algorithm to automatically detect KCs in order to speed up research and aid in manual labelling.







Programming language: Python 3.7.6 – MNE Python Library [4]

Support Vector Machine Classifier: Python 3.7.6 – Scikit-Learn Python Library

RESULTS

Boundary values (LOCATION)	App > 75µV	0.5s < tot. dur. < 2s	Sup. max > 20uV	Sup. min < -30uV	0.1s < dur. min-max < 0.9s

Results (CLASSIFIER)	True Positive	True Negative	False Positive	False Negative	Candidates	Detected (MIMIR)	Labeled manually
	191	507	208	30	936	399	221

ACCURACY = 74.57%

SENSITIVITY = 86.43%
SPECIFITY = 70.90%
POSITIVE PREDICTIVE VALUE = 47.87%
NEGATIVE PREDICTIVE VALUE = 94.41%

CONCLUSIONS

- High efficiency to detect where there are no KCs
- Detection of KC both spatially and temporally
- Support algorithm for manual labeling

REFERENCES

Future directions: Optimize classification algorithm (PPV score and number of samples).

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[3] C. Forcato, J. G. Klinzing, J. Carbone, M. Radloff, F. D. Weber, J. Born, and S. Diekelmann. Reactivation during sleep with incomplete reminder cues rather than complete ones stabilizes long-term memory in humans. 2020.
[4] A. Gramfort, M. Luessi, E. Larson, D. Engemann, D. Strohmeier, C. Brodbeck, R. Goj, M. Jas, T. Brooks, L. Parkkonen, M. Hämäläinen, MEG and EEG data analysis with MNE-Python, Frontiers in Neuroscience, Volume 7, 2013, ISSN 1662-453X, [DOI]