



Towards A Deep Learning-based Joint Detection Model For Nocturnal Polysomnogram Events

Olesen, Alexander Neergaard; Thybo, Jakob; Chambon, Stanislas; Thorey, Valentin; Jennum, Poul J.; Sørensen, Helge Bjarup Dissing; Mignot, Emmanuel

Published in:
Sleep (Online)

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Olesen, A. N., Thybo, J., Chambon, S., Thorey, V., Jennum, P. J., Sørensen, H. B. D., & Mignot, E. (2019). Towards A Deep Learning-based Joint Detection Model For Nocturnal Polysomnogram Events. *Sleep (Online)*, 42(Suppl. 1), A130 . [0318].

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Five-fold cross-validation on the PhysioNet data set resulted in an ICC(2,1) of 0.59, AUPRC score of 0.45, and on the hidden test set the AUPRC score was 0.45.

Conclusion: Effectively scoring arousals automatically is important, as manual scoring of arousals is time consuming and difficult. The automatic analysis from the clinical data set showed better results than reported from manual scoring. The PhysioNet dataset showed lower validation score due to the lower quality of the signals and the manual scoring. Implementing automatic arousal scoring into a commercial software will make new analysis available to the clinic.

Support (If Any): This work was supported by the Icelandic Centre for Research under the Icelandic Student Innovation Fund and the Horizon 2020 SME Instrument number 733461.

0317

QUANTIFYING IMPORTANCE OF ELECTROENCEPHALOGRAPHY SPECTRAL DOMAIN FEATURES IN AUTOMATIC DIAGNOSIS OF CHRONIC INSOMNIA.

Paul Bouchequet¹, Geoffroy Soleilhac¹, Thomas Andrillon¹, Francesco Romano¹, Marco Brigham², Mounir Chennaoui³, Damien Léger¹

¹Université Paris Descartes EA7330 VIFASOM, Paris, France, ²CMAP École Polytechnique, Palaiseau, France, ³Institut de Recherche Biomédicale des Armées, Brétigny-sur-Orge, France.

Introduction: Polysomnographies (PSG) electroencephalographic (EEG) records contains many relevant information unused in clinical processes. Algorithms commonly used in machine learning can help us identify the most important features used by models in classification problems. The objective is to compare the efficiency of EEG Rapid Eye Movement (REM) and Non-Rapid Eye Movement (NREM) sleep features from PSG in the detection of chronic insomnia between control records.

Methods: 299 PSG have included: 54 controls subjects and 245 chronic insomniacs. Spectral power of the EEG central derivation (C3-M2) have been extracted then divided into 0,5 Hertz (Hz) bands from 0,5 Hz to 40 Hz with Fast Fourier Transforms (FFT) for each REM and NREM 30 seconds sleep epochs. Bands powers have been normalized by dividing by the broadband (0,5-40hz) power. For each PSG, average power for each band have been computed for REM and NREM epochs. A few algorithms, including linear support vector machine (SVM) and random forests, have been trained, firstly with NREM, then with REM features to detect chronic insomnia diagnosis. Global performance have been estimated with a Cohen Kappa (CK) test on a data subset, unused during training (train/test split 0,7, Bootstrap method). Individual importance of each feature have been estimated with the area under the receiver operating characteristic curve (ROC AUC).

Results: SVM is better at chronic insomnia detection with REM features than with NREM features (CK > 0.89). REM bands between 3-6hz have the highest ROC AUC of all the features (>0.9).

Conclusion: EEG spectral domain features from REM sleep are better to diagnose chronic insomnia than spectral domain features from NREM sleep. Differences appeared in specific REM sleep brain oscillations between controls and chronic insomniacs.

Support (If Any): Banque Publique d'Investissement, Dreemcare Project.

0318

TOWARDS A DEEP LEARNING-BASED JOINT DETECTION MODEL FOR NOCTURNAL POLYSOMNOGRAM EVENTS

Alexander N. Olesen^{1,2,3}, Jakob Thybo^{1,2}, Stanislas Chambon^{2,4,5}, Valentin Thorey⁴, Poul J. Jennum³, Helge B. Sorensen¹, Emmanuel Mignot²

¹Department of Electrical Engineering, Technical University of Denmark, Kgs Lyngby, Denmark, ²Center for Sleep Sciences and Medicine, Stanford University, Stanford, CA, USA, ³Danish Center for Sleep Medicine, Rigshospitalet, Glostrup, Denmark, ⁴Research & Algorithms Team, Dreem, Paris, France, ⁵LTCI Télécom ParisTech, Université Paris-Saclay, Paris, France.

Introduction: Manual analysis of nocturnal polysomnograms (PSGs) is still the standard in sleep laboratories. The process is time-consuming and prone to subjective interpretation of scoring rules and scorer fatigue. Recent developments in deep learning algorithms have shown promise for micro-event detection in PSGs. We propose a modification to the recently published DOSED algorithm that can be utilized for detection of arousals, respiratory events and leg movements, and can also automatically annotate start and duration of these events.

Methods: We collected event data from 1000 PSG studies in the public MESA database. Central EEG, left/right EOG and chin EMG; thoraco-abdominal belts, nasal pressure/flow, oxygen saturation and snore microphone; and leg EMG data were used to detect arousals; obstructive sleep apnea (OSA), central sleep apnea (CSA), and hypopnea events; and leg movements (LM), respectively. Briefly, the applied deep learning model consists of an initial spatial filtering layer followed by eight blocks of convolutional layers for feature extraction. Two types of classification layers were used to 1) detect the presence or absence of any type of event, and 2) automatically determine start times and duration of predicted events. The model was trained using 400 PSGs studies, validated on 100 PSGs and subsequently tested on 500 PSGs.

Results: Overall F1, precision and recall scores for arousal event detection were 0.712, 0.721, and 0.703, respectively, while the same metrics for OSA, CSA and hypopnea detection were 0.629, 0.546, 0.743; 0.328, 0.386, 0.284; and 0.47, 0.385, 0.604, respectively. LM detection yielded poorer performance with overall F1, precision and recall of 0.29, 0.226, and 0.402, respectively.

Conclusion: Preliminary results indicate that a concurrent detection model can detect and annotate with start and stop multi-variate events in the nocturnal polysomnogram, although more work in a larger cohort is needed in order to improve LM and CSA detection. However, this is a positive step towards an all-purpose sleep analysis algorithm.

Support (If Any): Klarman Family Foundation; Technical University of Denmark; University of Copenhagen; Reinholdt W. Jorck, Knud Hoejgaard, Otto Moensted, Vera & Carl Michaelsens, Augustinus, and Stibo foundations.

0319

SLEEP/WAKE DETECTION BY BEHAVIORAL RESPONSE TO HAPTIC STIMULI

Katherine E. Miller, PhD¹, Linda Bäbler, M.Sc.², Thomas Maillart, Ph.D.³, Afik Faerman, B.A.^{4,5}, Steve H. Woodward, PhD⁵

¹Perelman School of Medicine, University of Pennsylvania, VISN4 Mental Illness Research, Education, and Clinical Center, Philadelphia, PA, USA, ²Zühlke Engineering AG,