University of Basel
Department of
Biomedical Engineering

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Master of Science – Biomedical Engineering
Thesis Proposal

Project for Master's thesis: Modulation of sleep spindles in healthy children compared to children with self-limited epilepsy with centrotemporal spikes (SeLECTS)

Objective: Self-limited childhood epilepsy with centrotemporal spikes (SeLECTS) is the most common focal epilepsy syndrome. Children with SeLECTS exhibit sleep-activated focal epileptiform discharges and cognitive difficulties. Thalamocortical circuit dysfunction lead to epileptiform activity and could impair the production of sleep spindles, interfering with episodic memory consolidation. Sleep spindles are brief bursts of neural oscillatory activity during non-rapid-eye-movement sleep stage N2 in a frequency range of 9-15 Hz, generated by well-characterized thalamocortical circuits (Beenhakker & Huguenard, 2009). There is evidence of an association between spindle rates and cognitive performance in children with developmental delay (Farmer et al., 2018) as well as in healthy children (Hahn et al., 2019). Although several automated spindle detectors have been developed to quantify spindle activity (Warby et al., 2014), applications of these methods is limited to data of patients with epilepsy whose spindles can be altered. A recent study of Kramer et al. (2021) applied 3 different spindle detection analysis (manual spindle detection vs. existing automated spindle detector vs. latent state spindle detector) and could illustrate that the newly created latent state spindle detector was a robust and more sensitive new method to accurately measure sleep spindles in children with SeLECTS compared to the manual and automated analysis.

Data: Existing longitudinal data (3 time-points within 2 years) about sleep and cognitive functions of children with SeLECTS and healthy controls (age between 7-12 years). Sleep spindles were analyzed with an automated technique by Epilog. To train a latent spindle detector, spindles of 3 polysomnography records (diagnostic tool to collect physiologic parameters during sleep) will be scored manually by a trained pediatric neurologist.

Aim of the Master thesis: To modulate a new approach to quantify and qualify sleep spindles in number and morphology.

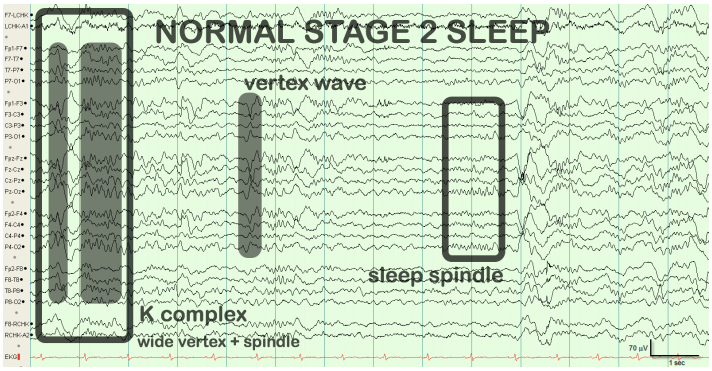

Figure 1: Example from https://eegatlas-online.com/index.php/en/eeg-archive/eeg0006

Nature of the Thesis
Experimental: 0%
Programming: 80%
Documentation: 20%

Specific Requirements
- Programming (Python)
- Deep Learning (Pytorch)
- Statistical Analysis

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- Signal Processing and Time Series Analysis (Fourier- & Wavelet Analysis, Filtering etc)

Group Leader / Supervisor and Collaborators

- Florentin Bieder, Center for medical Image Analysis & Navigation (CIAN)
- Dr. phil. Martina Studer, Department of Pediatric Neurology and Development, University Children's Hospital Basel (UKBB)
- Prof. Dr. Philippe C. Cattin, Center for medical Image Analysis & Navigation (CIAN)
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Contact

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References:

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Farmer, C.A., Chilakamarri, P., Thurm, A.E., Swedo, S.E., Holmes, G.L., & Buckley, A.W. (2018).Spindle activity in young children with autism, developmental delay , or typical development. *Neurology*, 91; e112-e122.

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