Bielefeld University

Title of Thesis

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Master Thesis

in Intelligent Systems

AG Machine Learning

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Abstract

Abstract text

Chapter 1

Introduction

- What is SDB? Apnea vs Hypopnea? Central vs Obstructive? Mixed apnea hard to detect, therefore not in this study.
- SDB is under-diagnosed (x% of people have it dignosed, expected x% estimated undiagnosed) but has many potential harms.
- AHI and Severity classifications. Just looking at AHI is skewed (FP and FN cancel each other out), so also look at Event-Based metrics (Se, Pr, F1).
- Gold standard for detecting it is PSG but it's very obstructive and expensive.
- Results [1] from others.
- Goal is to use an easy to setup finger PPG sensor for this task. As single-night Recordings might not be representative, an unobstrusive way could help.
- Results from others that use only PPG.
- Structure of this work.

Chapter 2

Methods

2.1 Dataset

- Explain MESA (what Patients, how did they record the nights, ...)
- Statistical analysis (Count, Age, ...)
- Scorings from SOMNOLYZER (OSA, HYP, ...)
- Kappa between NSRR and SOMNOLYZER
- Use predicted Hypnogram (maybe?) and their Kappa

2.2 Preprocessing

- PPG [256Hz], SpO2 [1Hz], Hypnogram [1Hz]
- For PPG: Statistical Analysis, Denoising, VAE?, Conv-Block

2.3 Model Architecture

- U-Net (with PPG Conv-Block), Batch-Norm, Attention, ...
- Output: Detection at 1Hz - Event vs No Event
- TODO Next model then classifies into SDB classes

2.4 Training and Evaluation

- Training Parameters (Optimizer, LR, BS, ...) and Setup (Machines, ...)

- Seed and Cross-Validation
- Train on 30min (?) segments. For Testing: Concat 30min Windows with Overlap for full night result.
- Correct results (like Olsen, 10sec minimum event and distance between events)
- Event-based metrics (Se, Pr, F1) and when to count TP, TN, FP, FN
- AHI-based metric (Linear Correlation, Severity Classes, Near-Boundary Double-Classification)

Chapter 3

Results

- Baseline Model vs PPG Preprocessing vs Attention Model Results
- Significance of SpO2 and the Hypnogram (No SpO2/Hypnogram, Only PPG Baseline Model)
- AHI correlations and Severity class results

Chapter 4

Discussion

- Discussion and Implications (Is this way applicable in the real world)
- Limitations
- Further work

Chapter 5

Conclusion

- Summerization of paper
- Significance of work
- Outlook

Bibliography

[1] Jiali Xie, Pedro Fonseca, Johannes P van Dijk, Xi Long, and Sebastiaan Overeem. The use of respiratory effort improves an ecg-based deep learning algorithm to assess sleep-disordered breathing. *Diagnostics*, 13(13):2146, 2023.