

Charité - Universitätsmedizin Berlin - Charité Competence Center for Traditional and Integrative Medicine (CCCTIM), Research group: Prevention, Integrative Medicine and Health Promotion in Pediatrics



The "Prevention, Integrative Medicine and Health Promotion in Paediatrics" working group led by Prof. Dr. Georg Seifert in the Department of Paediatrics with a focus on Oncology and Haematology (led by Prof. Dr. Angelika Eggert) systematically investigates integrative medical and complementary therapy methods under controlled conditions. Prof. Seifert and his team pursue an integrative medical approach in both their clinical and scientific work.

Bachelor / Master thesis

Development of a multimodal software module to extract respiration from the pulse waveform of a photoplethysmogram (PPG)

City: Berlin, Jena; Starting date (earliest): At the earliest possible; Remuneration: none

Working field

Monitoring respiratory rate is crucial for early detection and diagnosis of conditions like sleep apnea, sudden infant death syndrome, and chronic obstructive pulmonary disease. Traditional methods such as transthoracic impedance plethysmography, nasal thermocouples, and capnography are labor-intensive and expensive, requiring masks, nasal cannulas, or chest band sensors. These devices can be uncomfortable and interfere with natural breathing or sleep positions, making them impractical for certain applications like ambulatory monitoring and stress assessment. Respiratory rate (RR) can be measured manually by counting chest rises, but continuous monitoring requires devices like capnography, transthoracic impedance pneumography, and others. Recent studies indicate that neither manual counting nor these devices provide consistently accurate and reliable RR measurements. Therefore, there is a need for a robust, automatic, reliable, and non-invasive method for both spot-checks and continuous monitoring. Recently, photoplethysmography (PPG) and electrocardiogram (ECG) have gained interest for respiratory rate extraction due to their simplicity and non-invasive nature. PPG and ECG waveforms have been used in various accurate nonparametric methods like time-frequency spectral analysis and parametric methods such as autoregressive (AR) model-based approaches. In addition, time-varying approaches have been developed to better estimate respiratory rates by accounting for nonstationary dynamics in pulse oximeter devices, which can also be used to estimate breathing rates. The PPG waveform contains information about various physiological parameters, but conventional pulse oximeters typically only provide heart rate (HR) and oxygen saturation (SpO₂). Using various biosignal processing techniques, the PPG signal also offers an alternative for obtaining RR.

The goal of this work is to implement algorithms for the robust estimation of respiratory rate directly from PPG signals, aiming to develop a software tool suitable for continuous monitoring of respiration. In particular, we will find, select and implement suitable

algorithms (preferably in MATLAB) from the literature that enable the robust extraction of respiration from PPG signals. In this thesis a method comparison of different approaches applied to simulated datasets and clinical datasets has to be performed. Finally, a new methodological approach will be derived too. This includes a comprehensive literature research, the execution of electrophysiological measurements as well as the systematic evaluation and publication of the results. The work and technical supervision will take place in the working group in Berlin or Jena (home office possible). There is the possibility to combine the position with a research internship.

Requirements

- Student in: Engineering, medical engineering, medical information processing, or equivalent
- Interest in issues of Network physiology, electrophysiology, biosignal analysis
- Motivation to work intensively on the issues described above
- Good knowledge of English (with regard to dealing with international literature)
- Knowledge of and interest in scientific work
- Experience in measuring or processing electrophysiological data (PPG, ECG, ...) is an advantage

What we offer

- Flexible working hours
- Insight into the practicalities of research work
- Opportunity to gain valuable experience in data management and analyses
- Working as part of an interdisciplinary team

Application

Contact person: Dr.-Ing. Steffen Schulz

By post:

Dr.-Ing. Steffen Schulz

Head of research: Analysis and Processing of Biomedical Signals and Information

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More information at <https://stellenticket.de/193271/HTWB/>

Offer visible until 30/04/25

