Swiss Medtech Day 2020

Zürcher Hochschule für Angewandte Wissenschaften
zh aw Life Sciences und Facility Management

INSELSPITAL
UNIVERSITÄTSSPITAL BERN
HÔPITAL UNIVERSITAIRE DE BERNE

greenTEG

A Virtual Wearable Sensor for Detection of Neurodegenerative Diseases

Giovanni Schiboni, Martin Rerabek, and Krzysztof Kryszczuk, ZHAW (Wädenswil); Philipp Eib, Fabien Rochat, Michele Zahner and Lukas Durrer, greenTEG AG (Zürich); Anneke Hertig-Godeschalk, David Schreier, Markus H. Schmidt, and Johannes Mathis, Inselspital (Bern)

1. Project Summary

Alzheimer (AD), and Parkinson Diseases (PD) are reported to manifest themselves in changes to the circadian rhythm. A novel virtual wearable wrist-worn sensor, deployable in free living conditions, enables long-term predictive monitoring of the core body temperature, which is the only health marker directly linked to the circadian rhythm. The goal is to distinguish between normal and pathological core body temperature trajectories.

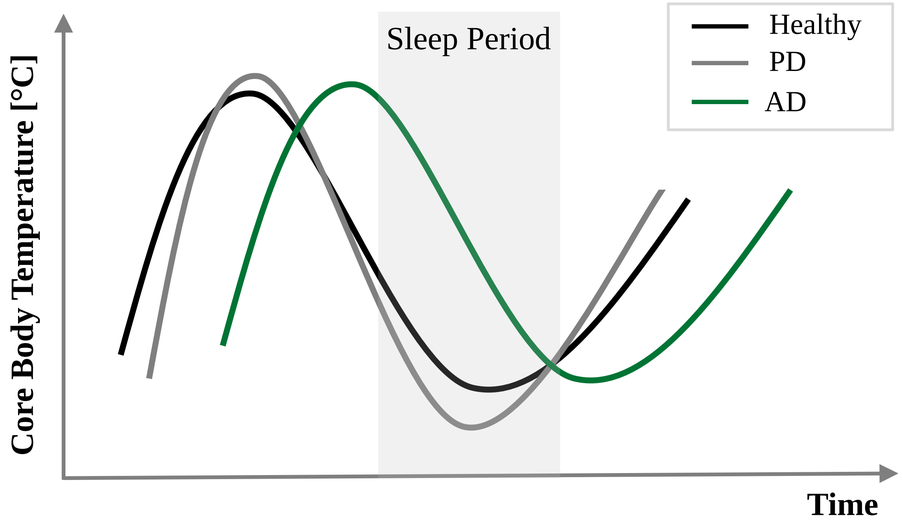

Fig. 1 – Changes in the circadian cycle, measured via core body temperature, are indicative of neurodegenerative diseases. E.g. An amplitude shift may be a symptom of AD; A phase shift may be a symptom of PD.

2. Project Objectives

In this project, we aim to:

- Develop a wearable wrist-worn system capable of continuous, non-invasive monitoring of the core body temperature trajectory;
- Collect a database from 60 healthy controls, and 40 clinical patients affected by neurodegenerative diseases;
- Develop embedded machine learning algorithms for:
  - Core body temperature prediction from physiological measurements;
  - Extraction and comparison of thermal circadian rhythm patterns;
  - Classification of healthy and pathological circadian rhythm trajectories;
- Test the hypothesis that a wearable wrist-worn virtual sensor can provide long-term circadian rhythm assessment to detect symptoms of neurodegenerative diseases. Anomalies in the thermal circadian rhythm patterns, i.e., amplitude and phase shift, are interpreted as symptoms of AD and PD diseases.

3. Business Potential

Wrist-worn wearable devices have the potential to elucidate physiological conditions, providing clinically relevant information by seamless biosignals monitoring in free living.

Our novel sensing technology provides accurate core body temp prediction, which is fundamental for detecting fine changes of the circadian rhythm. Long-term circadian rhythm assessment will enable novel types of medical diagnostics, e.g., early detection of chronic disease, like AD and PD. We foresee that many sensor-based circadian rhythm assessment applications will reach the market, boosting the smartwatch-like device unit sales.

Fig. 2 – GreenTEG wrist-worn device.

4. Hardware Setup

The virtual wearable wrist-worn sensor enables accurate core body temperature prediction, by fusing Energy Transfer, and other biosignals (Fig. 2 and 3).

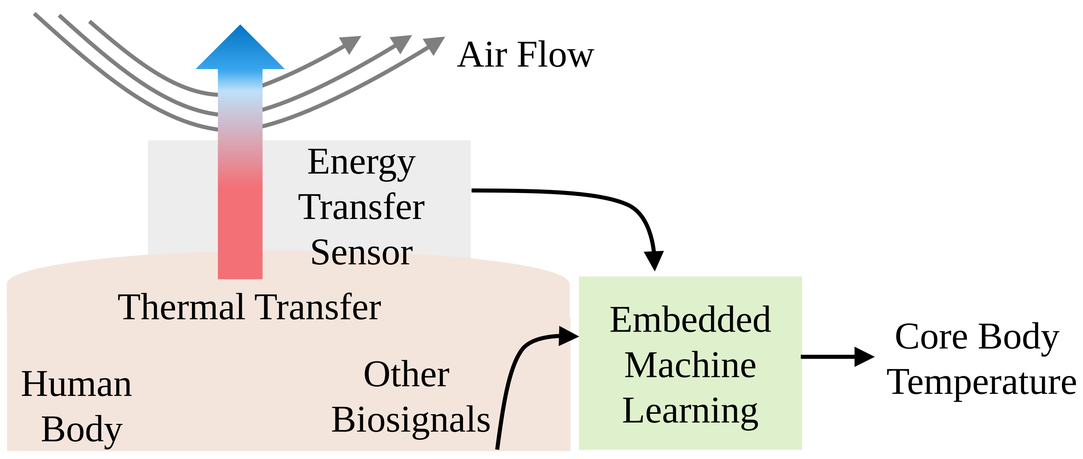

Fig. 3 – Our virtual wearable sensor schema. On-body sensors provide continuous physiological measures, and the embedded machine learning predicts the core temp.

5. Preliminary Results

In the initial project stage, we are focusing on accurate core body temperature prediction (Fig. 4 and 5).

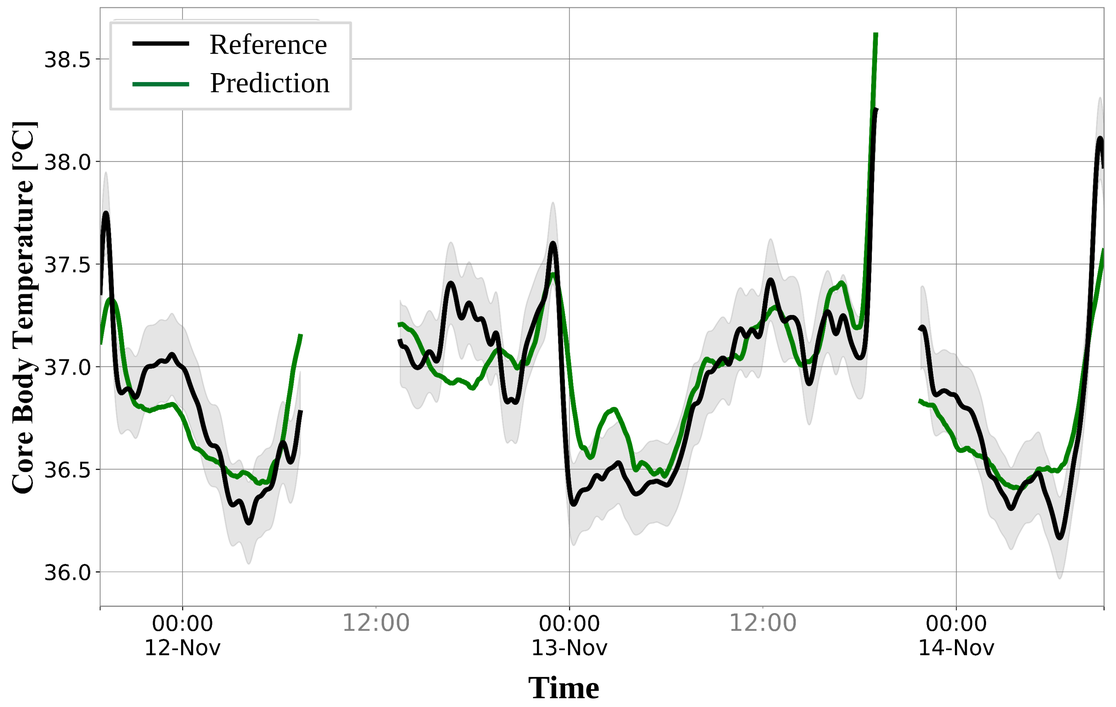

Fig. 4 – Core body temperature prediction vs. reference (ingestible temperature sensor) collected from one healthy participant over three days of monitoring. The predictive model was trained using data from ten healthy participants, leaving data of one participant out for testing. Thermal high peaks are related to sporting activity. Missing signal segments are related to personal hygiene events, when the sensors were taken off the body. The plot exhibits an evident periodic pattern, typical of the thermal circadian rhythm.

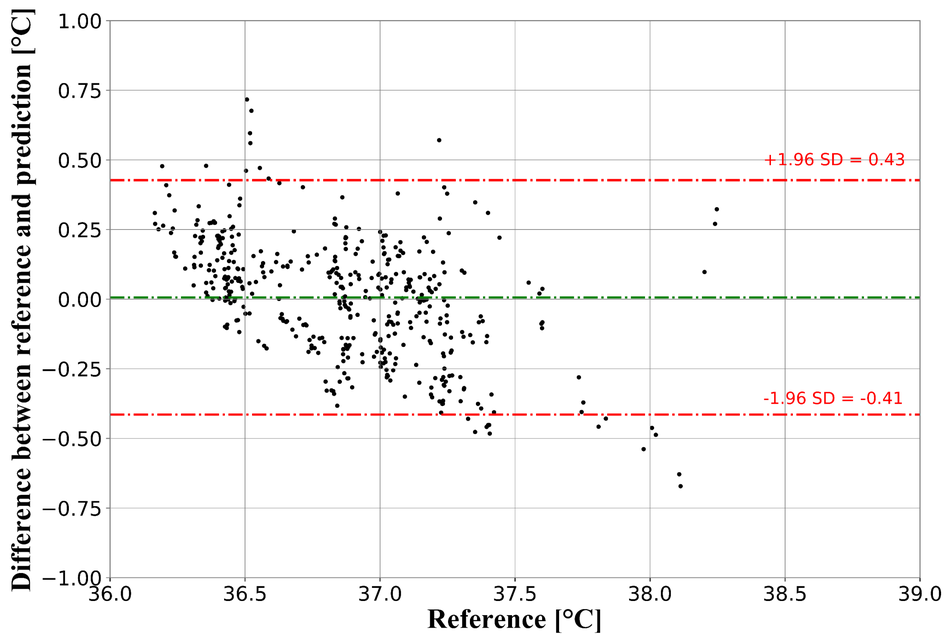

Fig. 5 – Bland-Altman plot computed from the results presented in Fig.4. The prediction quality is comparable with temperature measurement accuracy provided by conventional medical devices.

Contacts: krys@zhaw.ch; scbo@zhaw.ch; lukas.durrer@greenteg.com

Innosuisse innovation project 30664.1 IP-LS