# EPILEPTIC SEIZURE DETECTION BASED ON WRIST PHOTOPLETHYMOGRAPHY (PPG): DETECTION OF NOISE SEGMENTS

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## 1. INTRODUCTION

The aim of the global project is to develop a wearable seizure detection system based on the integration of Electroencephalogram and Cardiorespiratory information. In a first step, the Heart Rate (HR) is investigated measured by wrist-worn Photoplethysmography (PPG). A disadvantage of PPG is the presence of motion artifacts [1], which will lead to poor specificity in seizure detection. In order to reduce these false alarms, the artefacted segments should be detected and later reconstructed.

## 2. MATERIALS AND METHODS

The data, used in this experiment, consists of 24-hour recordings of 17 patients, recorded in UZ Gasthuisberg with Empatica E4 (wrist PPG and triaxial Accelerometry (ACM)) and Faros (ECG). The data is split in 7s segments. Each segment is labeled as clean or artefacted by quantifying and comparing the HR extracted from ECG (reference) with the HR from PPG. For each segment, variance, first-/second-/third-largest peak of the spectrum, and spectral Shannon entropy are extracted in addition to 8 other features proposed in literature. Moreover, 20 ACM-derived features are calculated. A linear least-squares support-vector machine is proposed to classify the segments as a clean or artefacted segment within a leave-one-patient-out approach. A backwards wrapper is applied for feature selection on PPG- and ACM-derived features.

## 3. RESULTS AND DISCUSSION

In Table 1 the sensitivity (Sens), specificity (Spec) and Accuracy (Acc) are shown (Average ± standard value) for PPG-, ACM- and all features. Adding the ACM features to the classification does not increase the performance. The reason is that the PPG signal has already enough information on itself. By using only the ACM features, a low sensitivity is obtained. This is due to the fact that not all artefacts are caused by wrist motion, for example subtle finger motion.

An automated artefact detection method for PPG data is developed. For this dataset, the ACM features do not improve the performance, suggesting that ACM recording could be avoided from the point of view for detecting artefacts in PPG signals during daily life.

Table 1: Classification performance

| | PPG | ACM | PPG+ACM |
|---|---|---|---|
| Sens [%] | 85.50 ± 8 | 58.04 ± 18 | 85.50 ± 7 |
| Spec [%] | 91.84 ± 5 | 93.01 ± 4 | 92.36 ± 4 |
| Acc [%] | 90.33 ± 2 | 76.23 ± 11 | 90.23 ± 3 |

### References

[1] Petterson, M.T. et al. The effect of motion on pulse oximetry and its clinical significance. *Anesthesia & Analgesia*, 105(6), S78-S84.