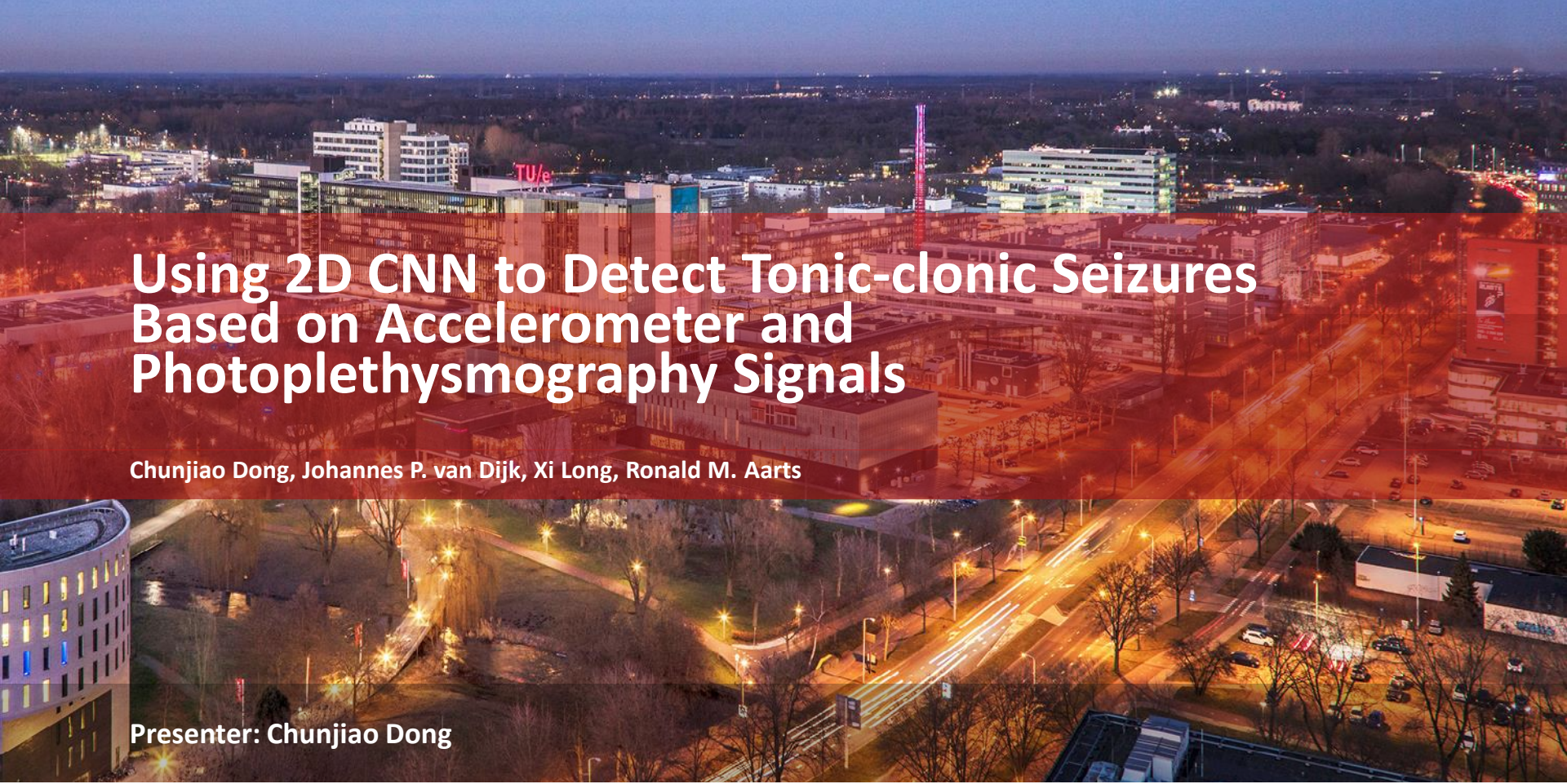


Using 2D CNN to Detect Tonic-clonic Seizures Based on Accelerometer and Photoplethysmography Signals

Chunjiao Dong, Johannes P. van Dijk, Xi Long, Ronald M. Aarts

Presenter: Chunjiao Dong

Electronics Engineering Department, Signal Processing System Group,
Eindhoven University of Technology

Kempenhaeghe

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Why do we need a device to monitor epileptics?

Epileptic seizures often happen unexpectedly. Caregivers are hard to monitor the patients all day.

When the system suspects a possible major epileptic seizure, a **warning** is transmitted to a caregiver via the base station.

Data collection

Signals:
The data set contains **accelerometer** and **photoplethysmography (PPG)** signals.

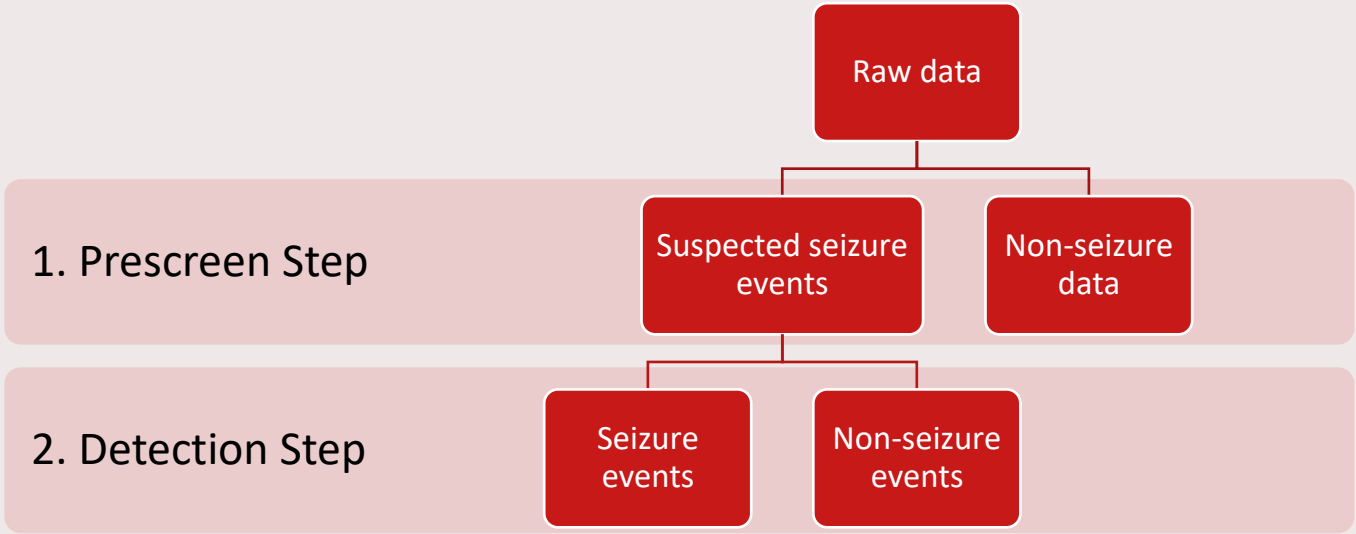
Devices:
Both signals were continuously collected using **NightWatch** armbands.

Subjects:
44 patients monitored in Kempenhaeghe.

Dataset:
1336 tonic-clonic (TC) seizures segments (20 minutes), which are collected during the nights in two to three months.

Methods

The proposed method includes two steps.



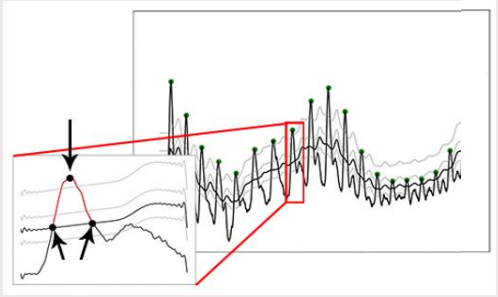
Prescreen Step – resample

Raw data's sampling rate:
Accelerometer (ACM): 10 ~ 12 Hz
Photoplethysmography (PPG): 95 ~ 105 Hz

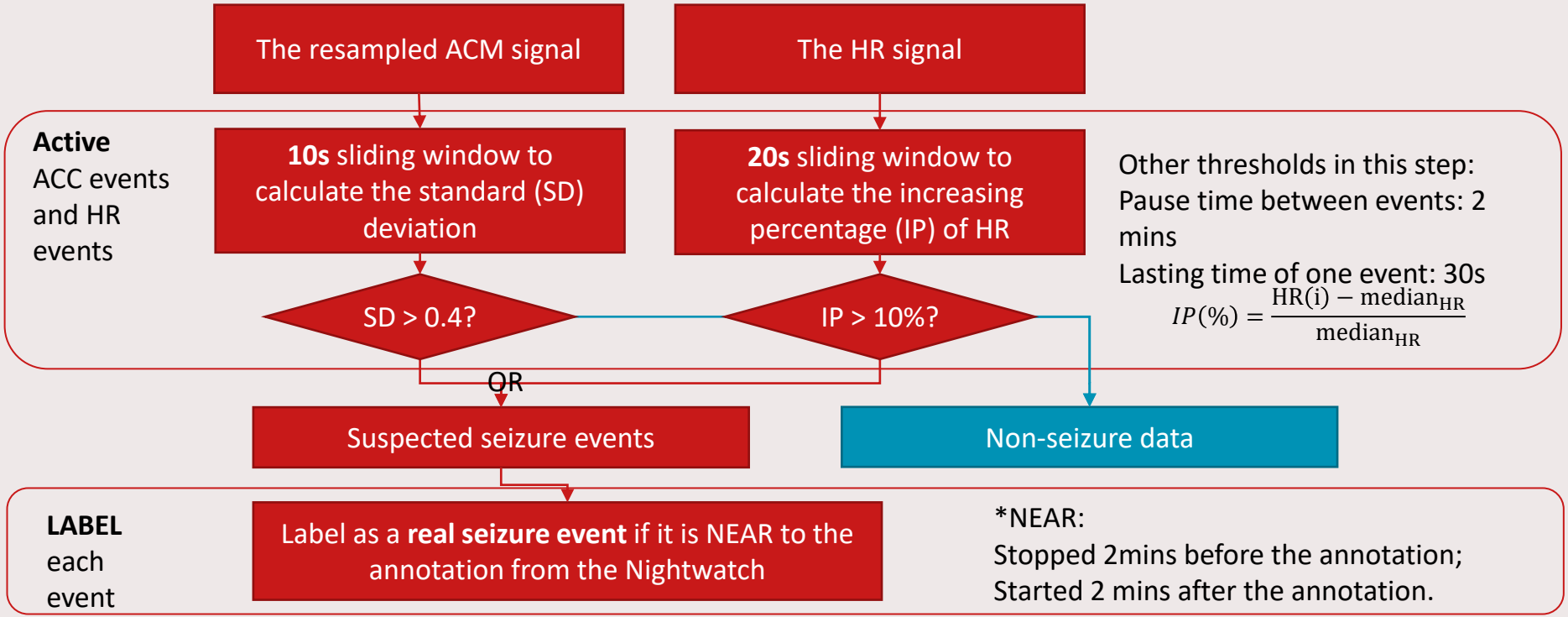
Apply a FIR Antialiasing Lowpass to resample both signals to 20 Hz.

Prescreen Step – extract heart rate signal

- Apply a Butterworth bandwidth filter from 0.5 Hz to 3.5 Hz. (30 bpm to 210 bpm)
- Calculate moving average using a sliding window of 0.75 seconds.
- The red line marks where the signal amplitude is higher than the moving average.
- R-peaks are marked at the maximum of the red area.

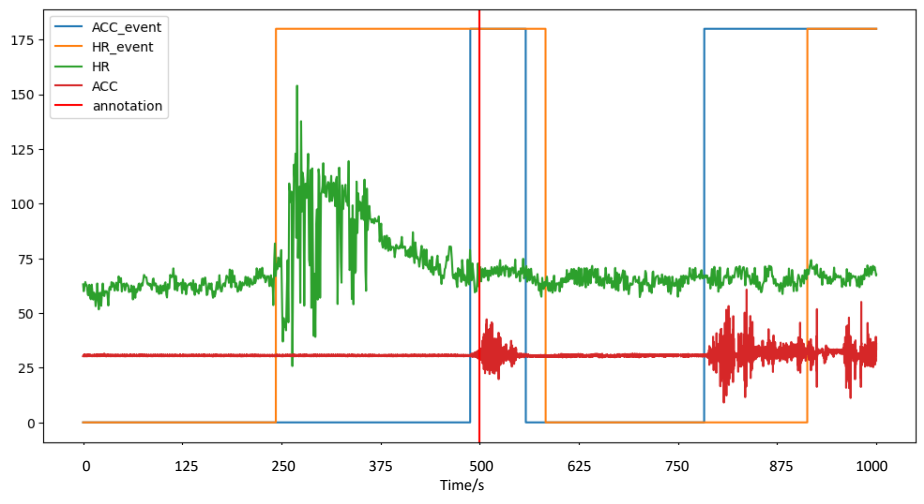


Prescreen Step – extract suspected seizure events and label



Kempenhaeghe TU/e

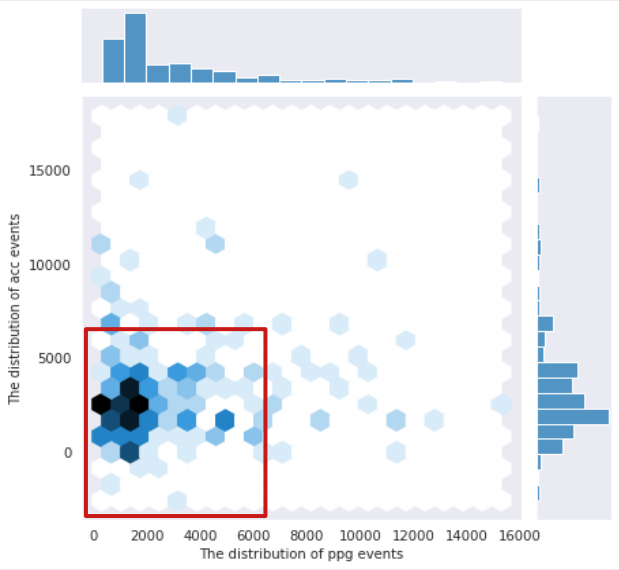
Prescreen Step – results



A total of 2874 suspected events from 44 patients were identified, where 1682 (58.5%) of which are actual TC seizures and only 35 seizures were missed.

Kempenhaeghe TU/e

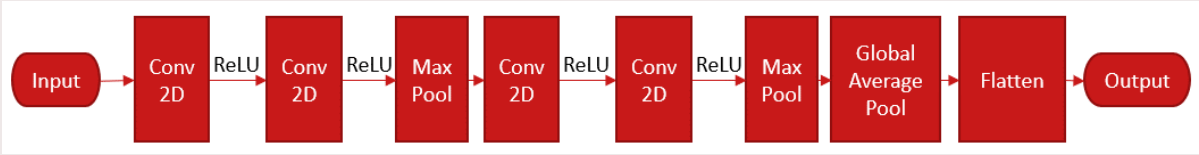
Detection Step – length of each actual seizure events



Zero padding/cut all suspected seizure events to 5 minutes.

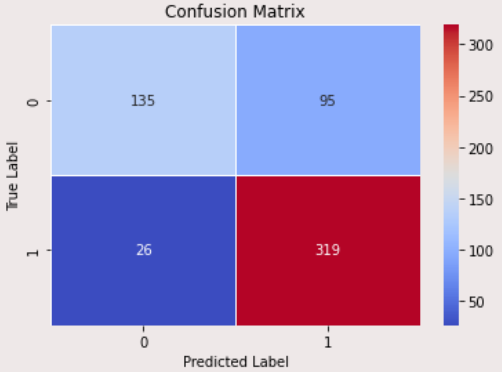
Kempenhaeghe TU/e

Detection Step – 2D CNN model and results



The training set included 1336 TC seizure events and 963 non-TC suspected events. The testing set had 345 TC seizures and 230 non-TC suspected events.

accuracy = 79%,
sensitivity = 92%,
F1 score = 84% on the test data set.



Kempenhaeghe TU/e

Discussions about future works

- Include whole night’s recordings in the first step.
- Include other seizure types such as major seizures.
- Improve the networks model by adding an attention layer.