Overview
Detection epileptic seizures

Overview

- Problem
- Goal
- Method
  - Detection with accelerometers
  - Detection with video data
- Result

Problem

- Detection of epileptic seizures with EEG (Golden Standard)
  - Not comfortable
  - No long time monitoring
  - No monitoring in home environment

The Royal Children Hospital Melbourne

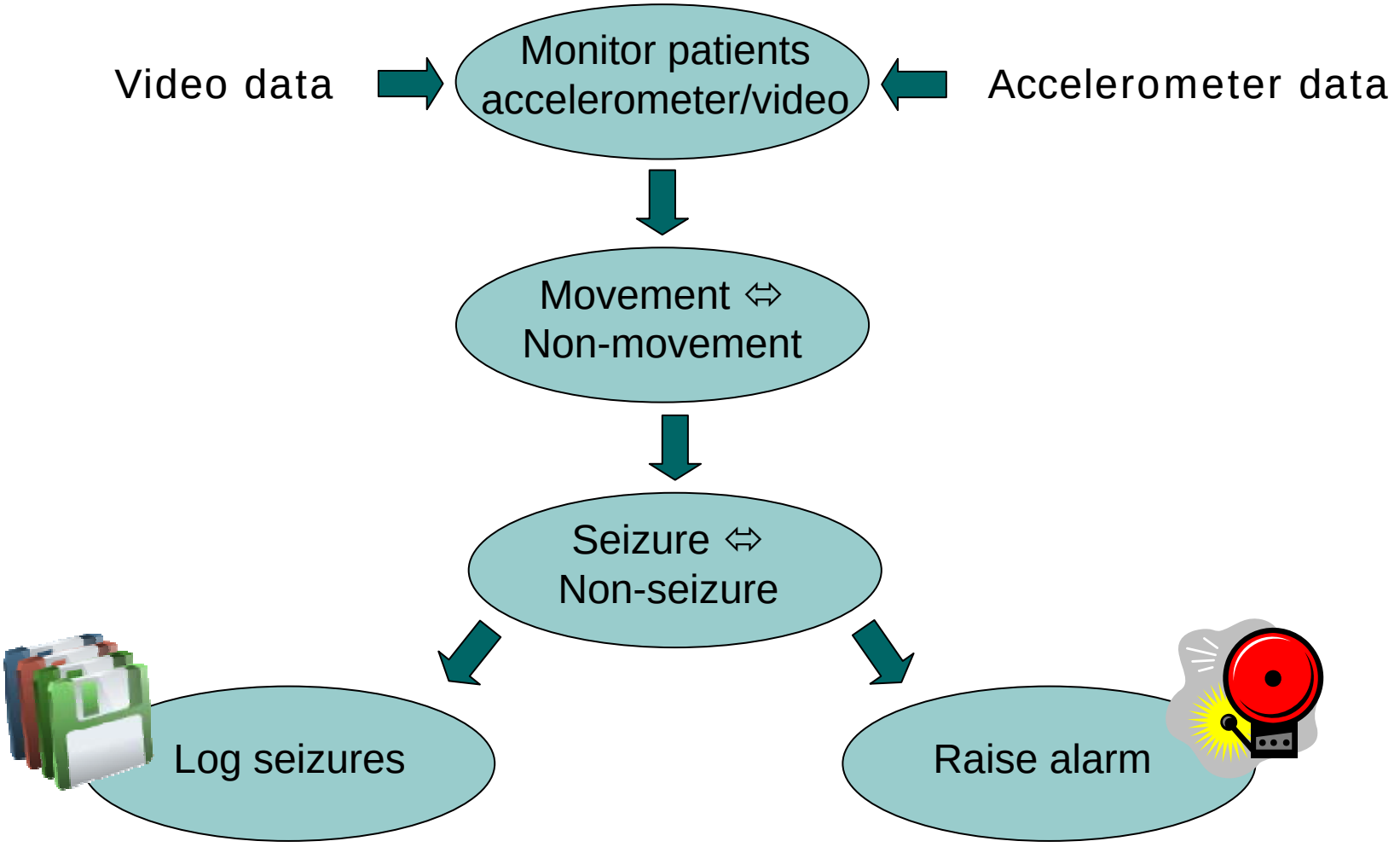
Goal

- Comfortable detection of epileptic seizures by means of video and accelerometer monitoring
- Long term monitoring at home
- Log seizures (follow up disease)
- Raise alarm

Video monitoring

Accelerometer monitoring

Method: overview

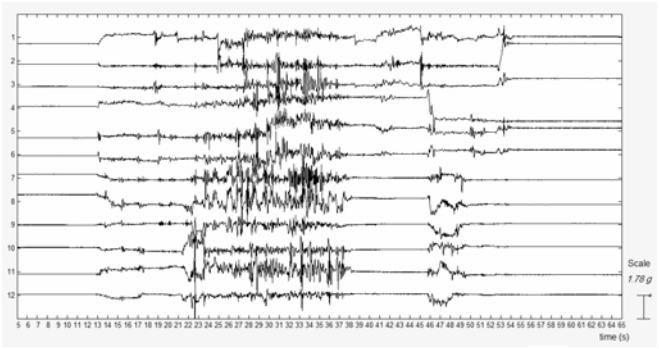


Method

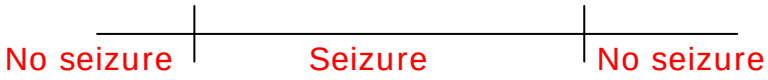
- Collect labeled datasets of patients
  - Neurologist labels video/EEG-signals
- Synchronous logging EEG-signal with video and accelerometer data

EEG-signals

Accelerometer signals

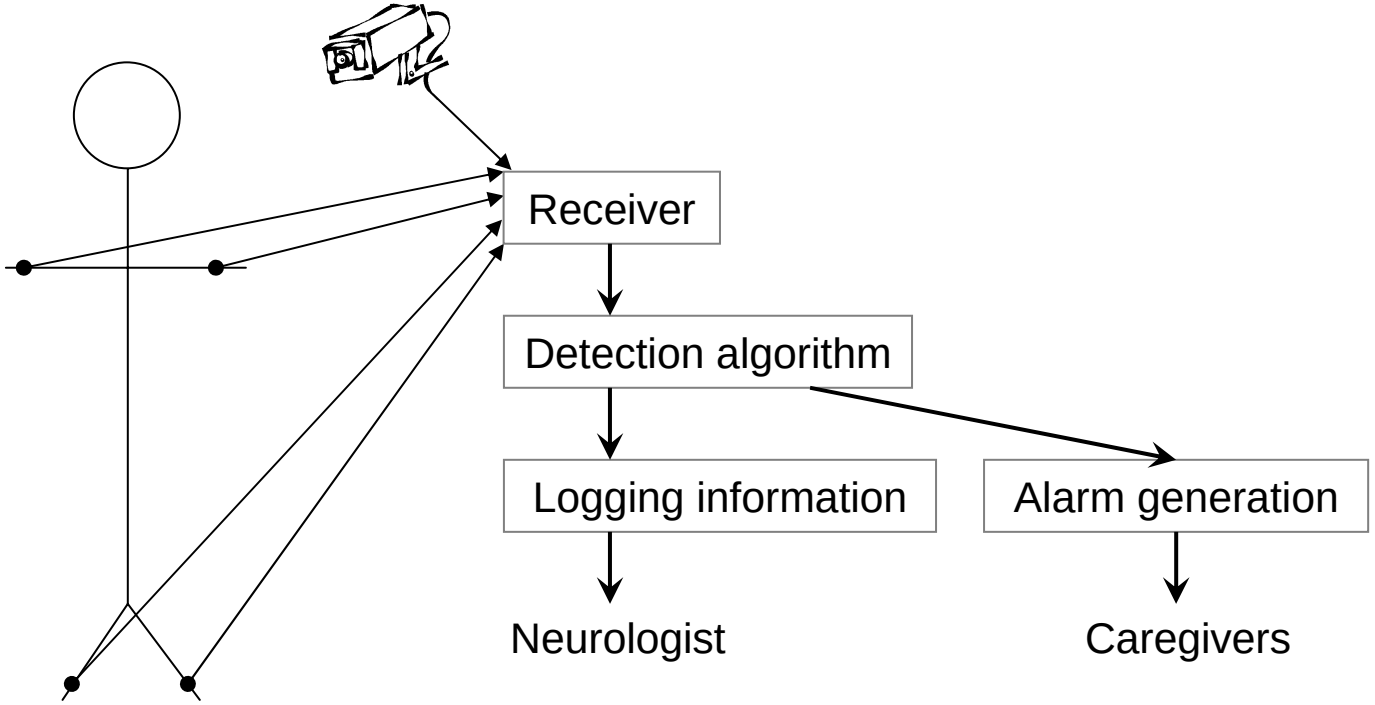


Labels



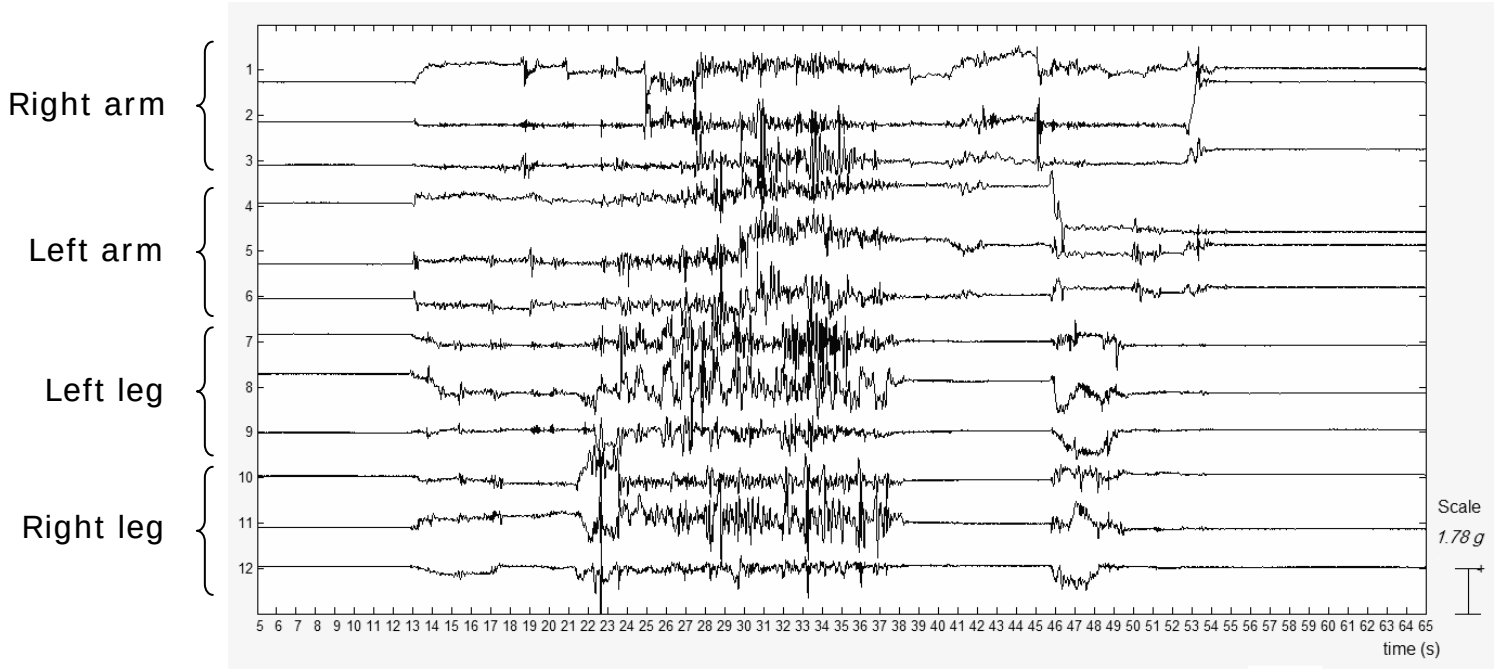
Method: accelerometers

- 3D-Accelerometers attached to wrists and ankles



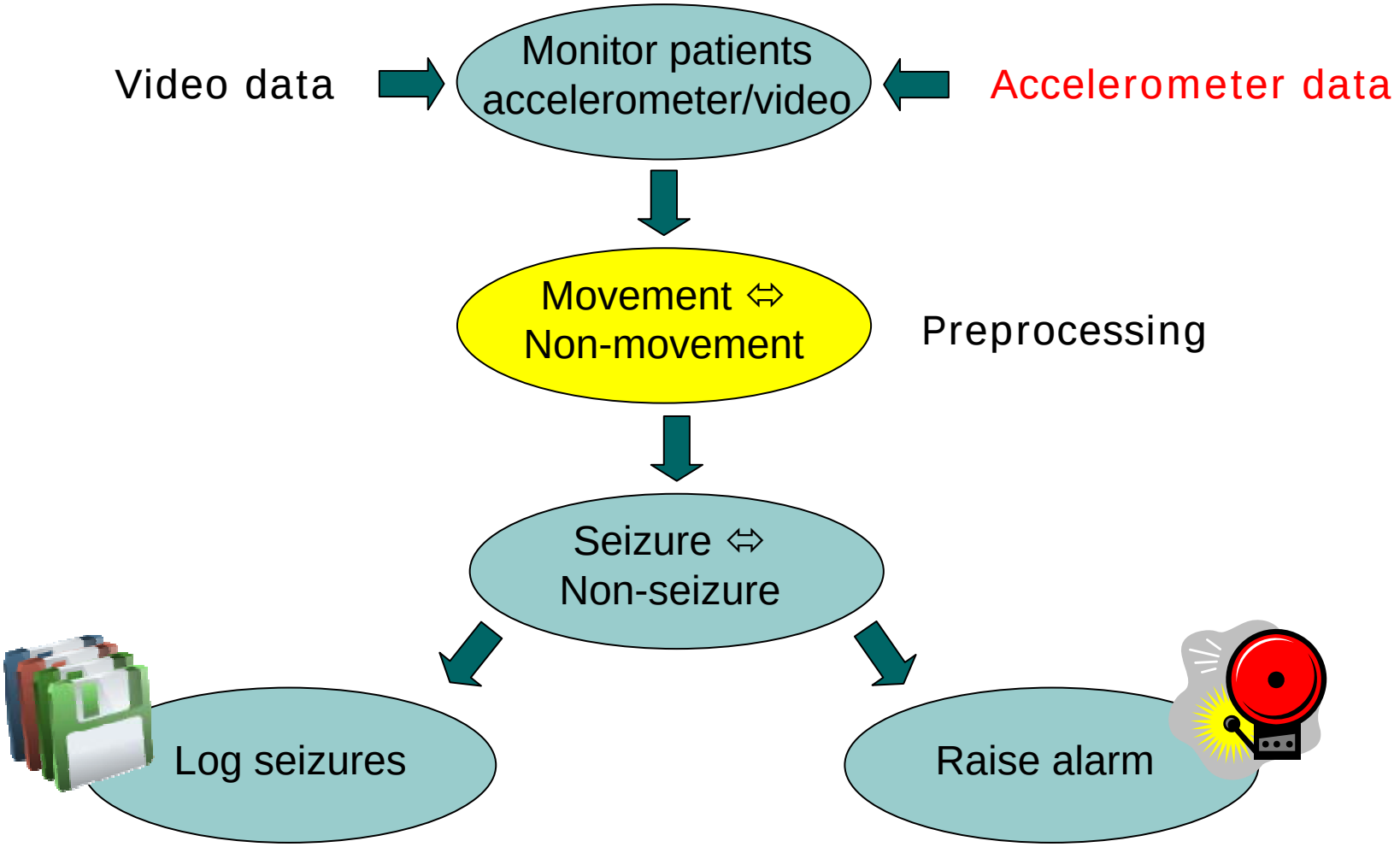
Method: accelerometers

- Acceleration during movement is logged



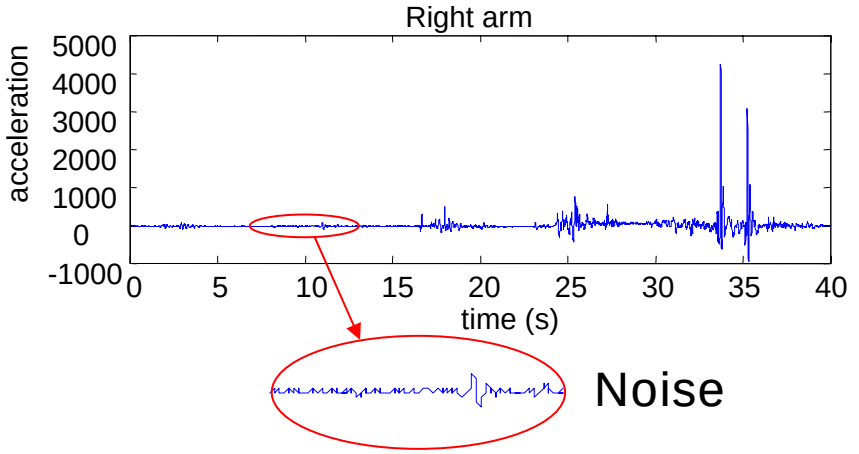
Accelerometer signals of hyper motor seizure

Method: accelerometers

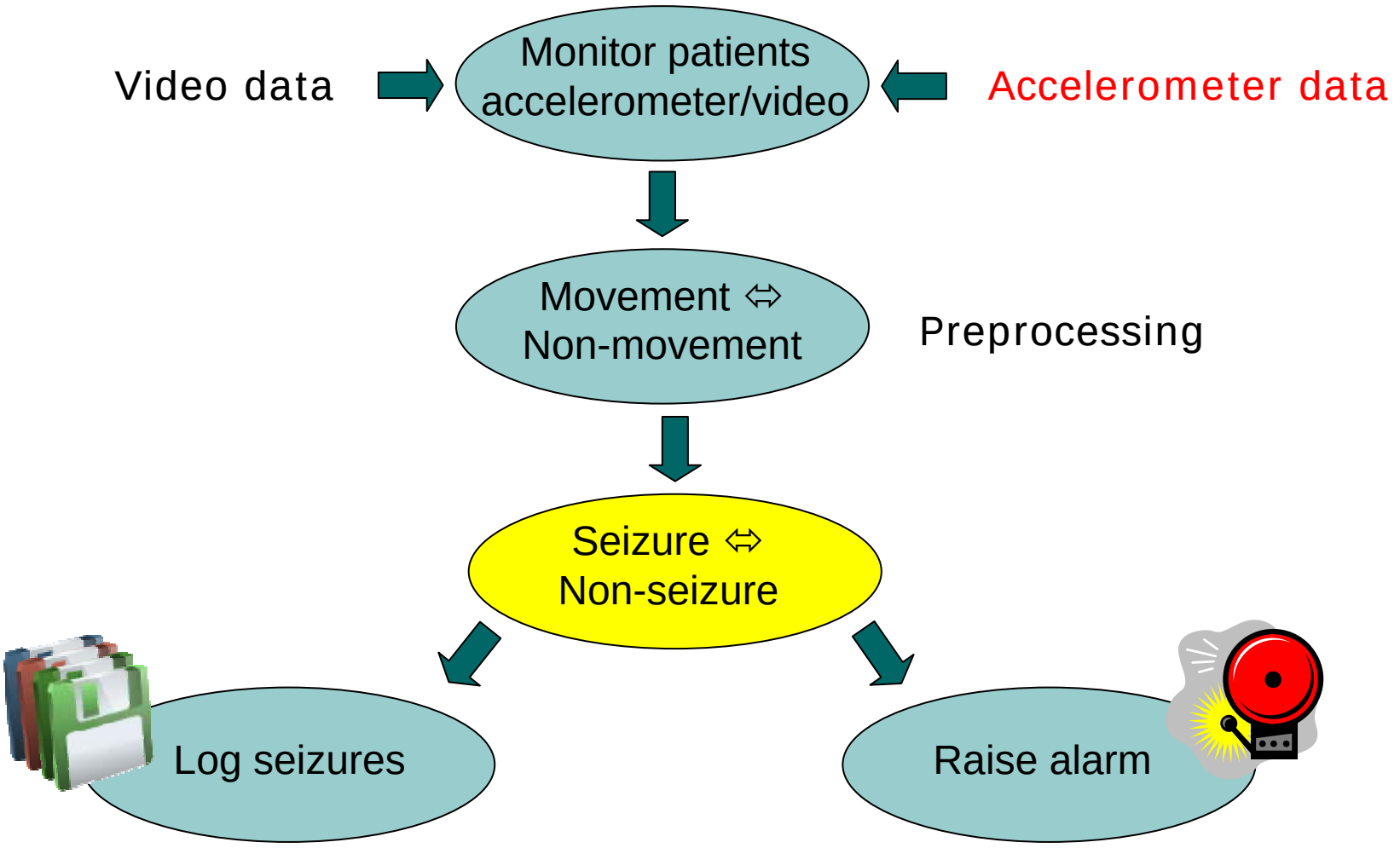


Method: accelerometers

- Preprocessing/Data reduction
  - Resultant per accelerometer
  - Multiple of standard deviation of frame without non-movement is set as threshold
  - Epochs without movement are discarded ➔ data reduction
  - 10-20% remains



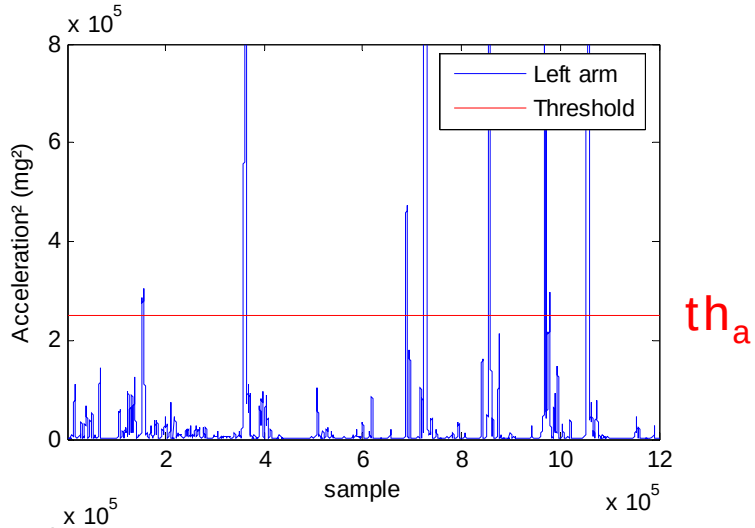
Method: accelerometers



Method: accelerometers

- Seizure detection
  - Mean energy of a sliding window
  - Sliding window ~ length of seizure
  - Patient specific detection

Method: accelerometers



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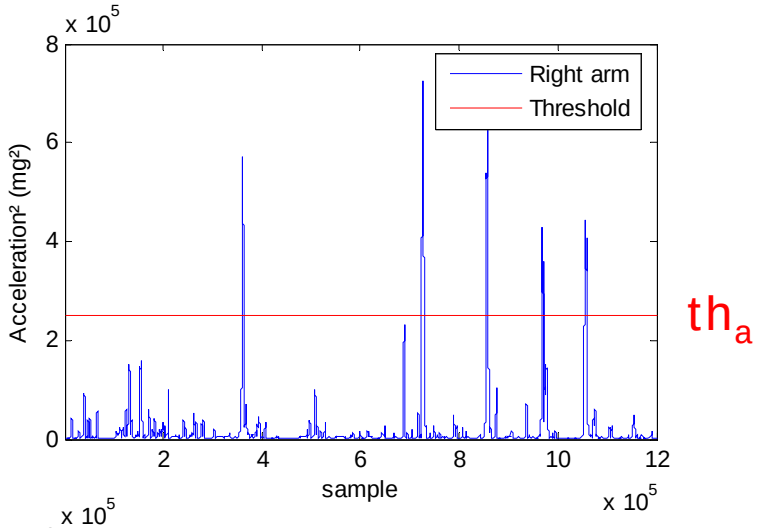

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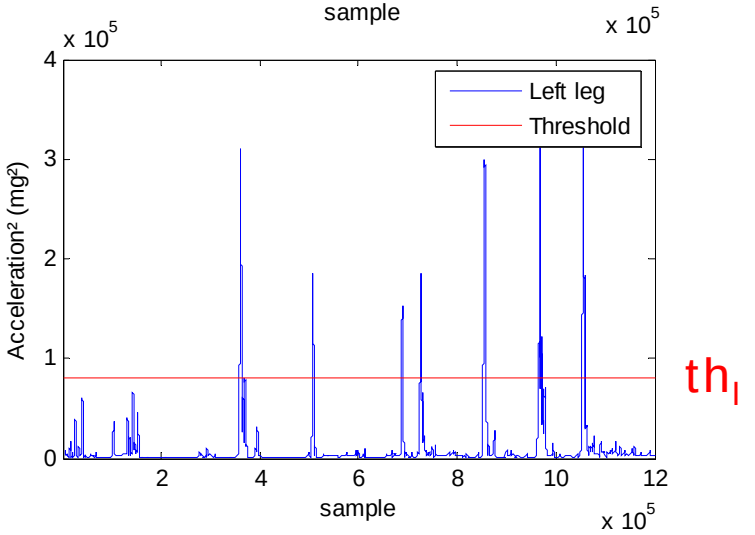

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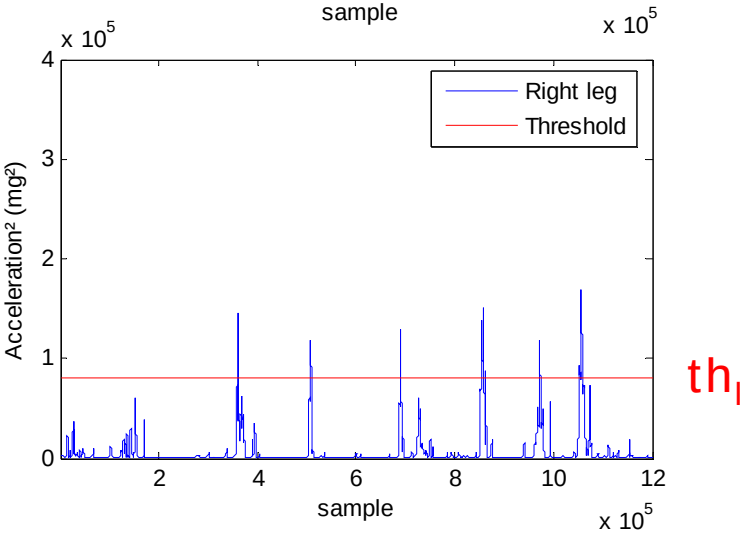

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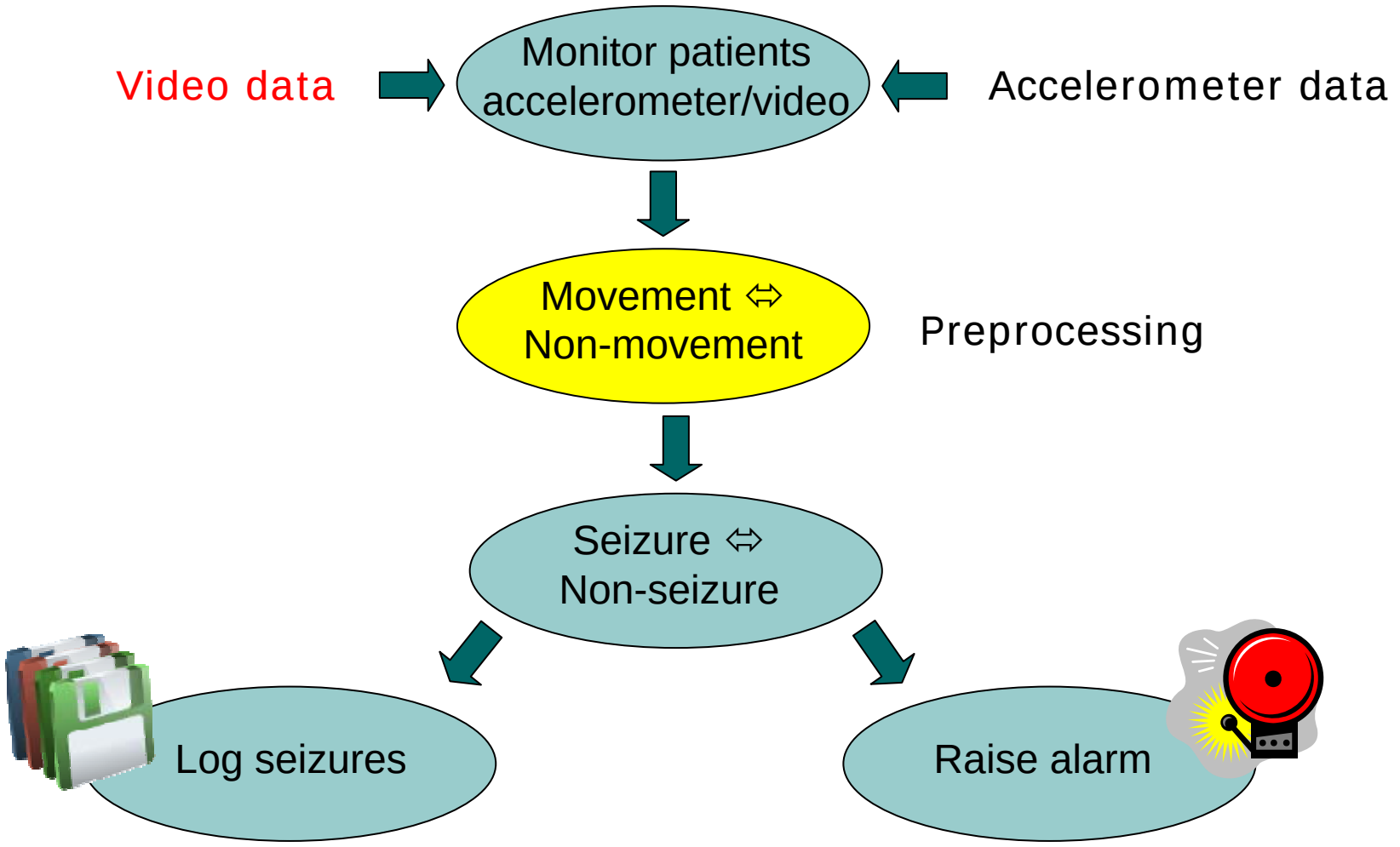
Method: accelerometers

- Results
  - Threshold trained on one dataset with 7 seizures
  - ROC-curve to select ideal values
  - Algorithm tested on second dataset, all seizures were detected (12) without false positives

Method: video data

- Algorithm with Optical Flow to detect movement in video recordings
- Setup has to work under different circumstances in a home environment (e.g. different luminance)
- Tested in simulation for optimal parameters for algorithm

Method: accelerometers



Method: video data

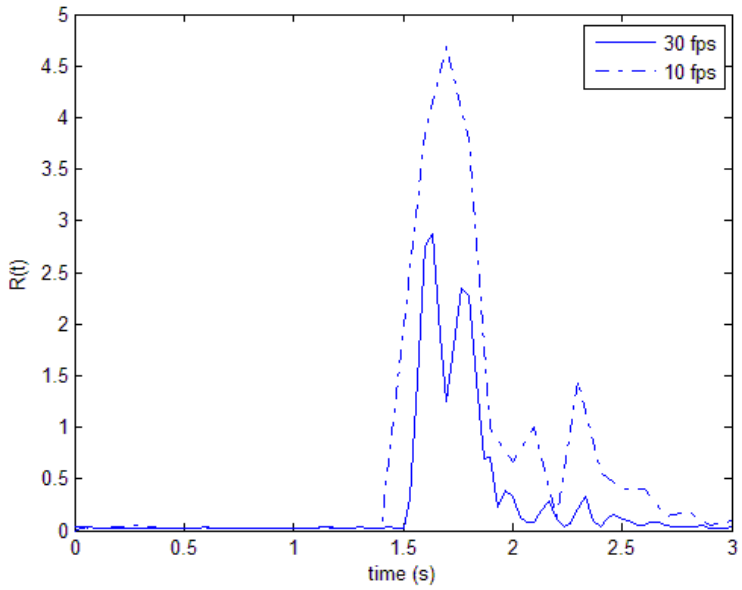
- Algorithm to detect movement
  - Preprocessing
    - Downsample time
    - Downsample space
  - Optical flow (Horn – Schunck)
    - Movement vector in each pixel
  - Calculation of output signal
    - Mean of highest movement pixels

Method: video data

- Simulation
  - Which are ideal parameters for algorithm?
  - Different circumstances
    - Downsample time/space
    - Different camera point of view
    - Compression
    - Different illumination

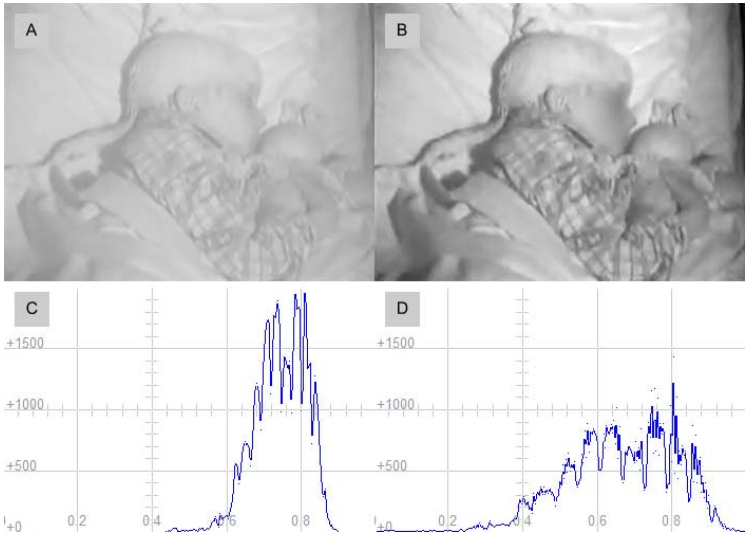
Method: video data

- Simulation results
  - Downsample in time to 10 fps
  - Downsample in space to 320x240
  - Downsample for faster execution of algorithm but specific patterns may be lost

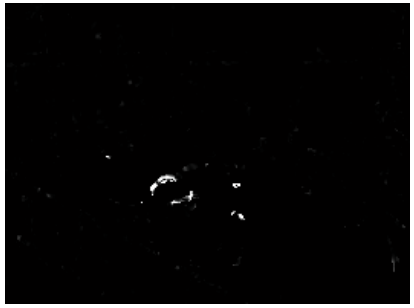


Method: video data

- Preprocessing
  - Downsample (25 fps ➔ 12.5 fps)
  - Resize (352x288 ➔ 320x240)
  - Contrast adjustment for video sequences with low contrast



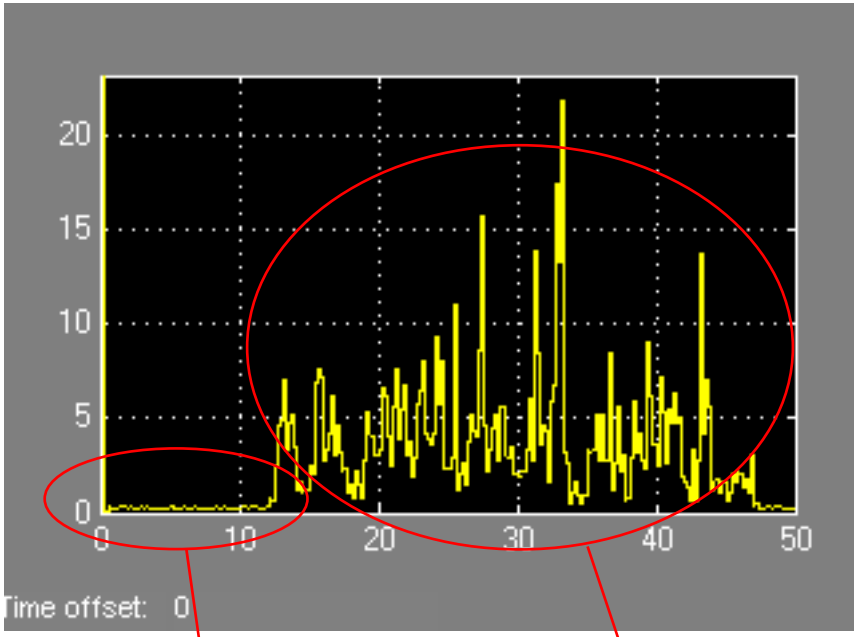
Method: video data



- Algorithm to detect movement
  - Optical flow (Horn – Schunck)
    - Calculates movement vectors according to changing pixel intensities
  - Calculate 0.06% highest values
    - Reduces noise

Method: video data

- Calculate mean of these values
- Set threshold

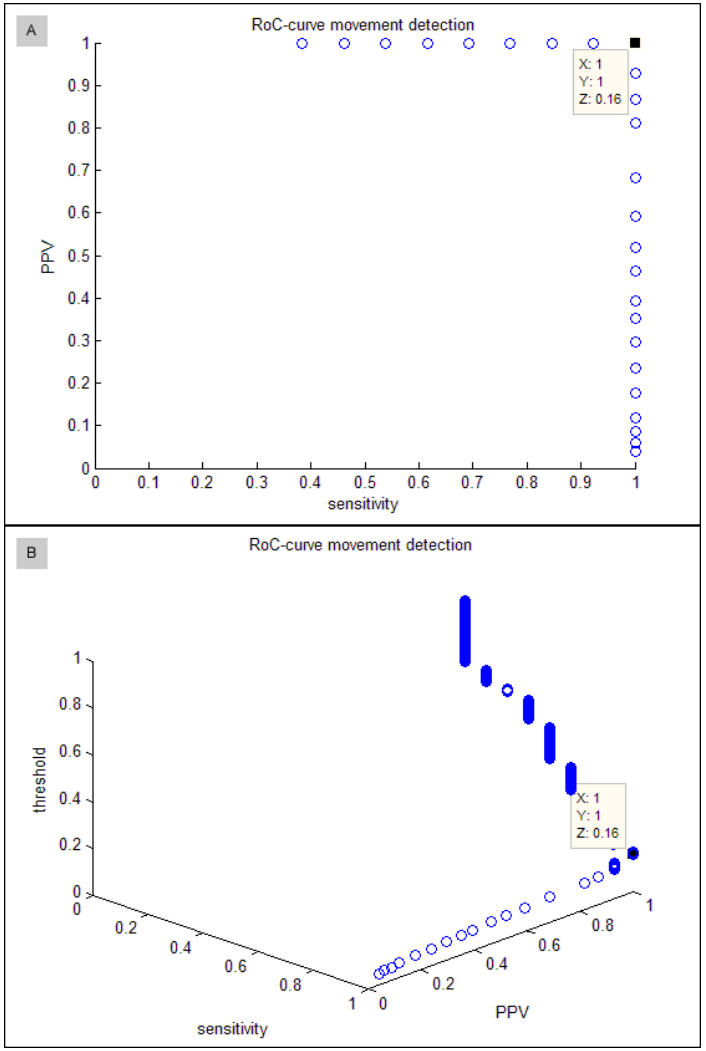


No movement

Movement

Method: video data

- Set threshold
  - Label epochs in dataset with movement
  - Calculate ROC-curves to find ideal threshold



Method: video data

- Future work
  - Define features for detection of epileptic seizures
- Overall future goal
  - Develop stand-alone system to automatically detect seizures

Thank you for your attention

Questions?