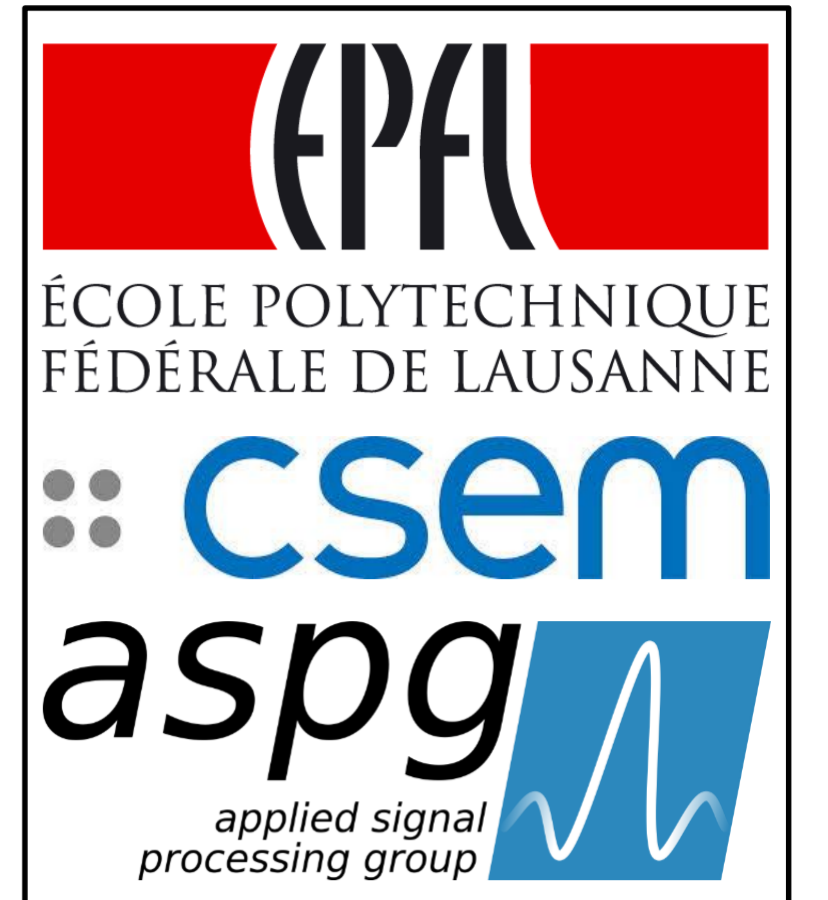


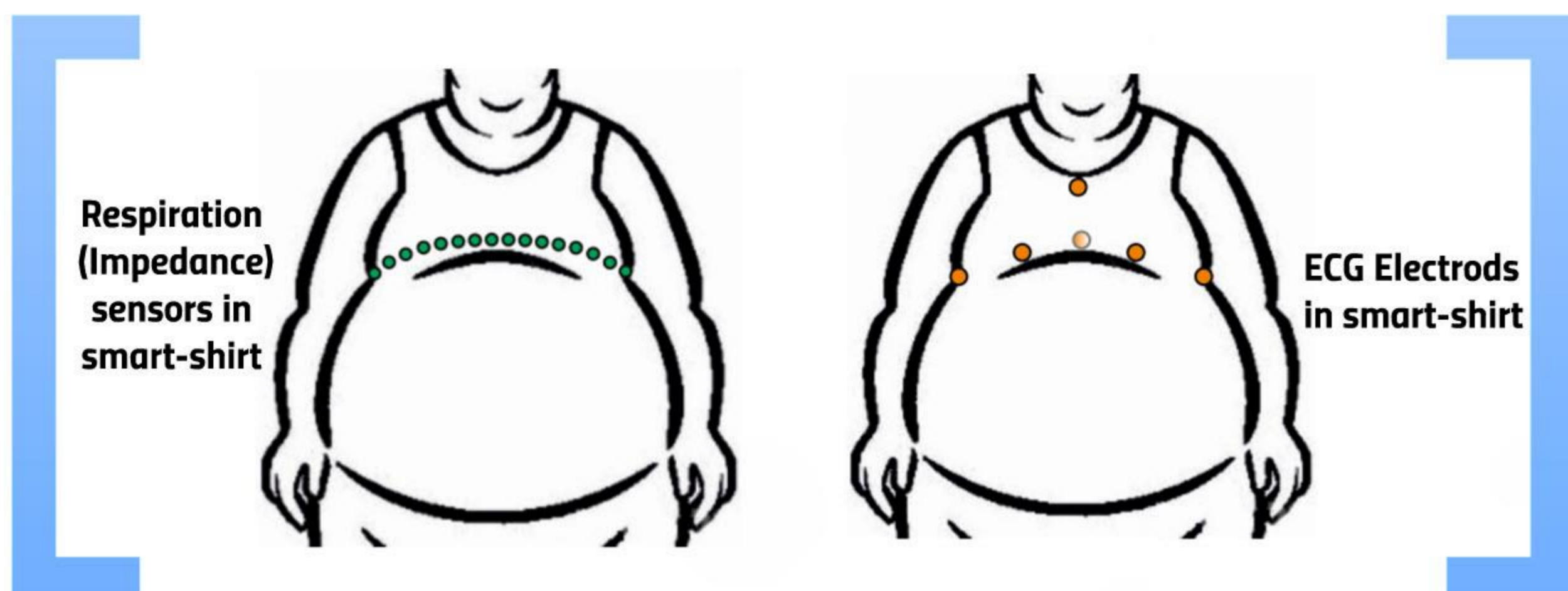
Real-Time Peak and Fiducial Points Extraction in Portable ECGs and PPGs

Sasan Yazdani, Jean-Marc Vesin
Swiss Federal Institute of Technology Lausanne (EPFL)



Motivation

- **Monitoring of Obese subjects**
 - ✓ Prone to cardiac/autonomic diseases.
- **Smart-Shirt**
- **Health monitoring through Biomedical signals**
 - Electrocardiogram (ECG)
 - Photoplethysmogram (PPG)
 - Respiration, Blood Pressure and etc.



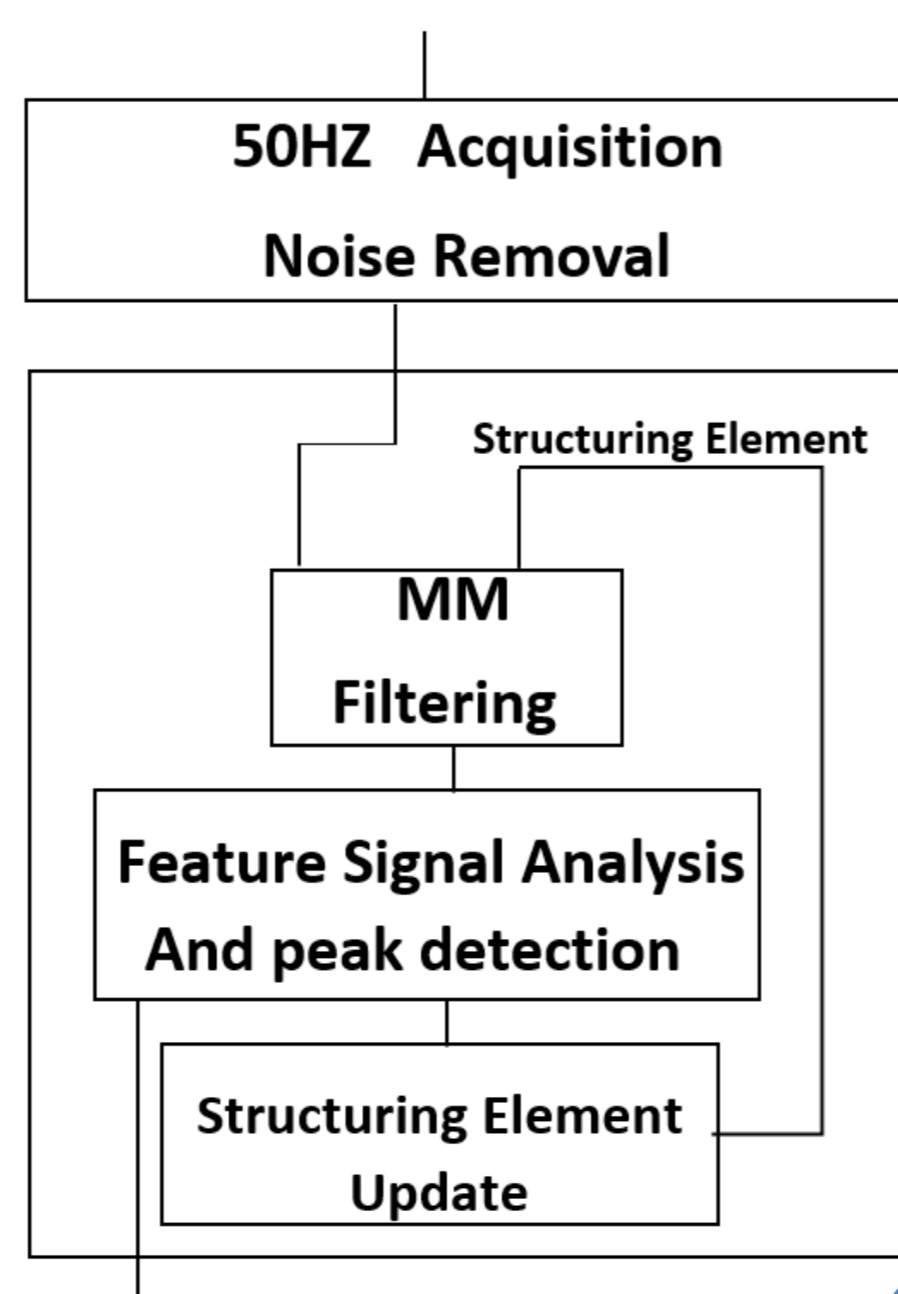
Smart-Shirt Challenges

- **Signal acquisition problems**
 - Noise in ECG/ PPG
 - Electrode contact noise
 - Baseline drift
 - Muscle contraction activity noise
 - Motion artefacts
 - Shift in baseline
- **Hardware Limitation**
 - Computation cost
 - Energy cost (battery)
- **The need of Real-time/Online methods.**



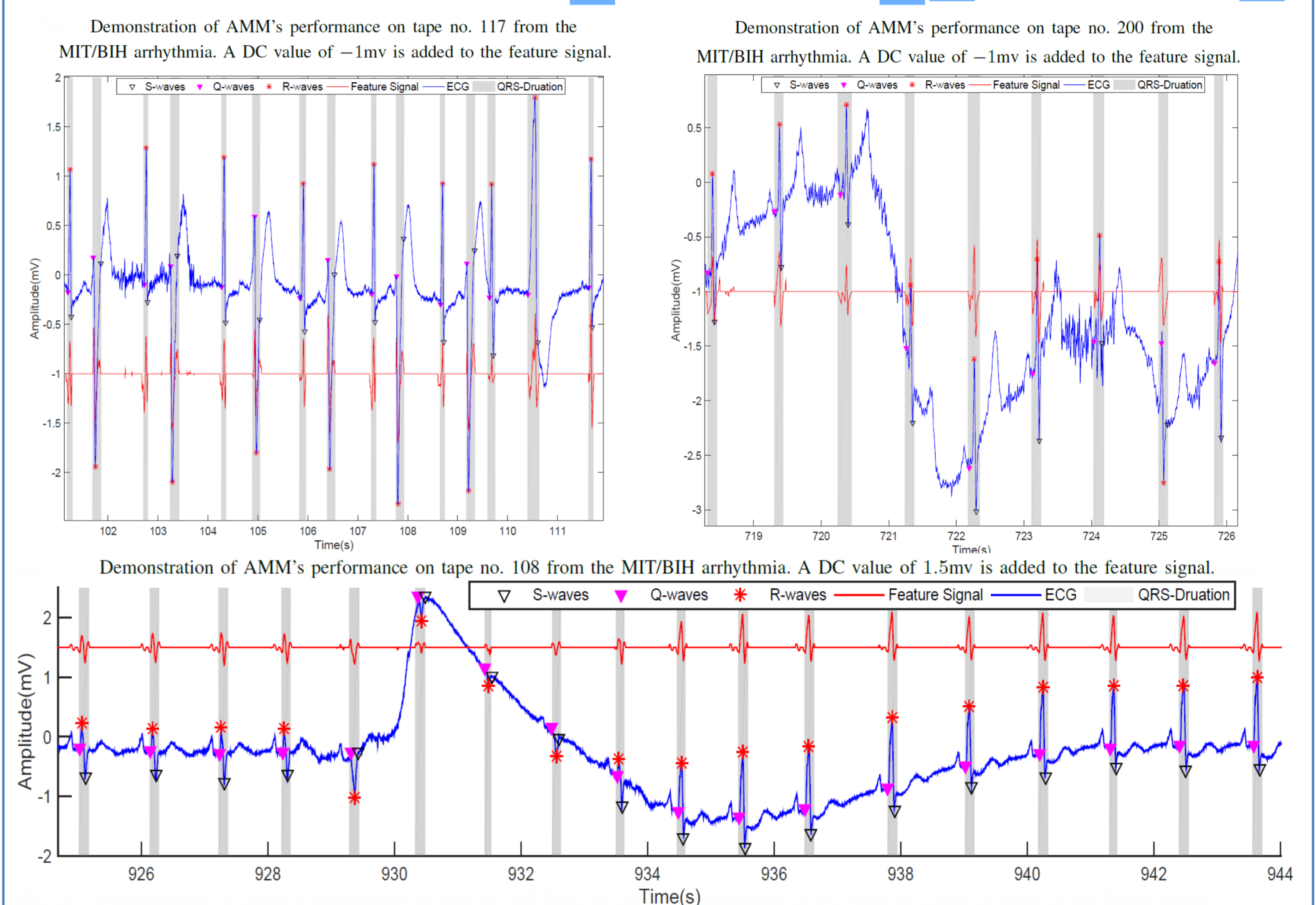
Adaptive Mathematical Morphology

- **Idea**
Employing morphological features in order to extract waveform peaks and fiducial points more precisely.
- **Algorithm**
 - 1) Windowing of the signal.
 - 2) Application of Mathematical Morphology (MM) with predefined structuring element.
 - 3) Detection of waveforms and fiducial points.
 - 4) Reconstruct MM structuring element using the extracted waveform and fiducial points.
 - 5) Repeat step 2-4 for the next window.

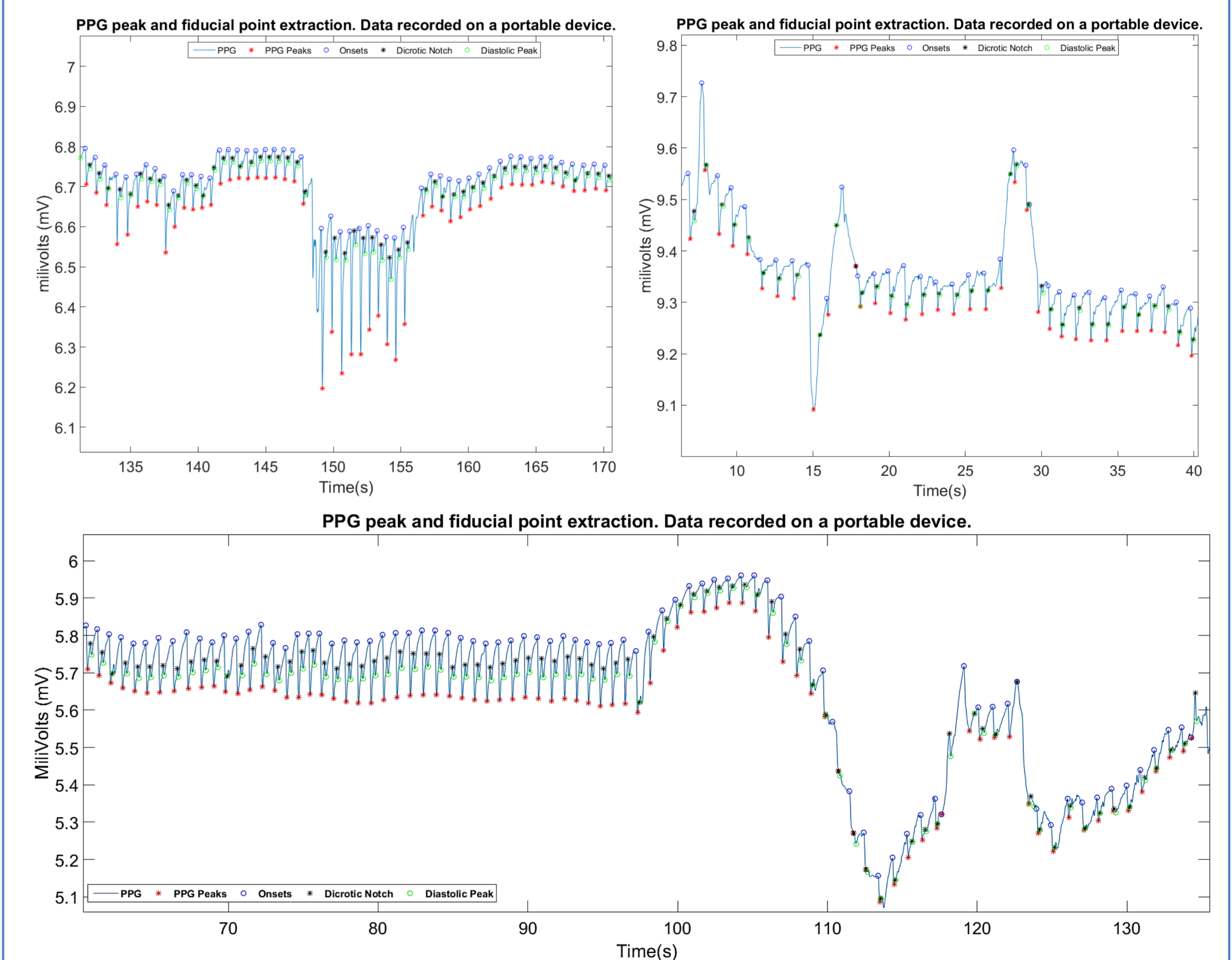


Results

ECG



PPG



Conclusion

- **Observations**
Adaptation has an important role in detecting the precise location of future beats and fiducial points (especially when noise is present).
- **Advantages**
 - Real-Time/Online, Low computation costs, Robust against noise.
 - R-waves as well as the QRS-onsets, -offsets, Q- and S-waves were extracted from.
 - PPG Peaks, waveform onsets, diastolic notches and diastolic peaks were extracted from PPGs.
- **Future Work**
Beat-to-beat QRS morphology changes and their behavior before and after arrhythmias can be studied.