



# Fetal ECG detection

Biomedical Signal Processing 2023-2024

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# REFERENCES

- **Paper:**
  - S. M. M. Martens, C. Rabotti, M. Mischi and R. J. Sluijter - *A robust fetal ECG detection method for abdominal recordings* - Physiological Measurement, 28, 373, 2007
- **Dataset:**
  - Noninvasive Fetal ECG: *The PhysioNet/Computing in Cardiology Challenge 2013*
  - 25 (+ 50) recordings of 4 channel ECGs (1 min each) with annotated FECG

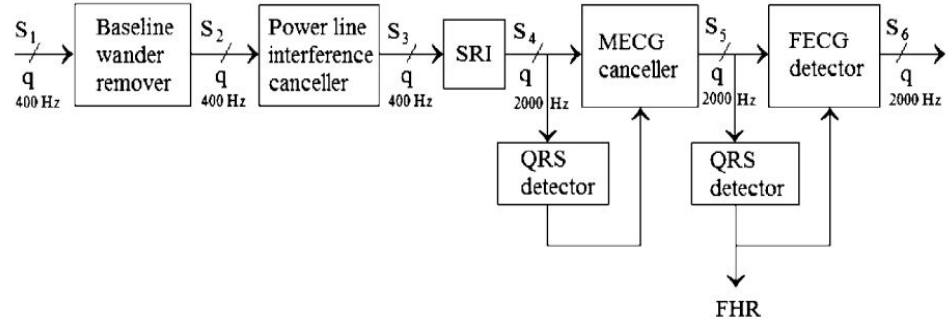


# FETAL ECG DETECTION

- Fetal ECG provides information about the fetal well-being:
  - Fetal oxygenation
- Can be obtained by applying an electrode on the fetal scalp:
  - Only during labour
  - Highly invasive!
- Abdominal recordings:
  - During pregnancy and delivery
  - At home monitoring
  - Non-invasive

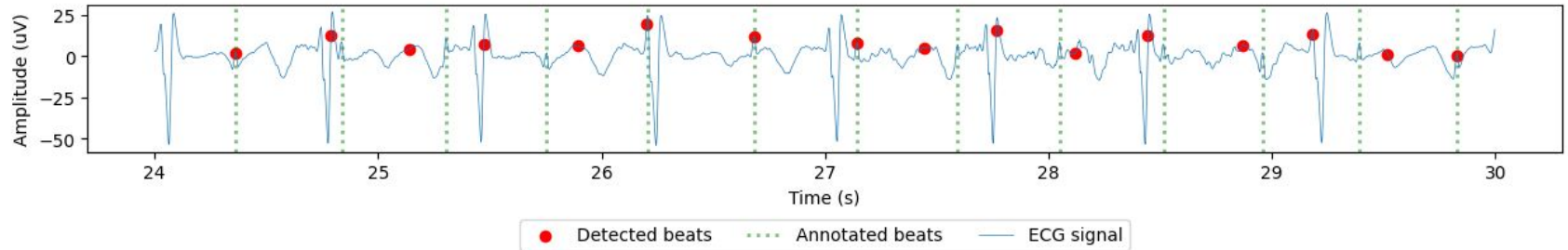
# THE ALGORITHM

- Data preprocessing
  - Baseline removal
  - Power line removal
  - Upsampling to 2000Hz
- Mother QRS detection
  - Enhancing using PCA
  - Building QRS template
  - Find peaks with correlation
- Mother QRS removal
  - Averaging and scaling template
  - Template matching
- Fetal QRS detection



# EVALUATION

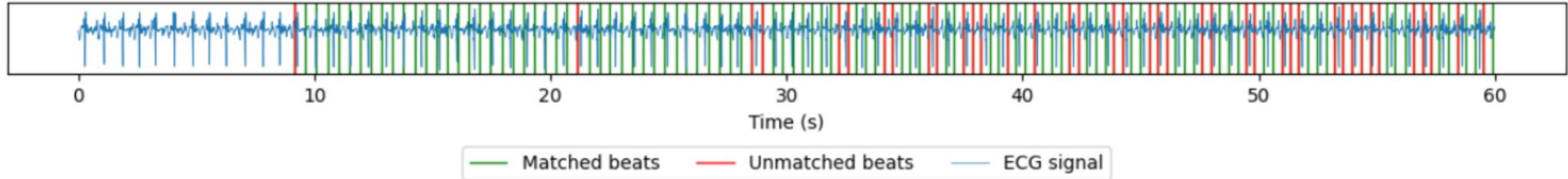
- Beat detection: how many beats are correctly detected?
- FHR trace: how good is the bpm detection?



# FETAL ECG DETECTION

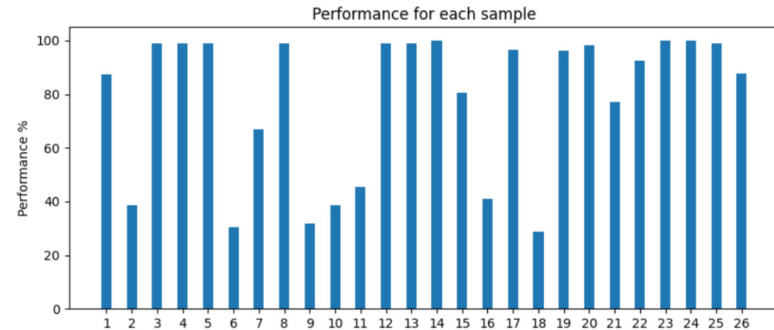
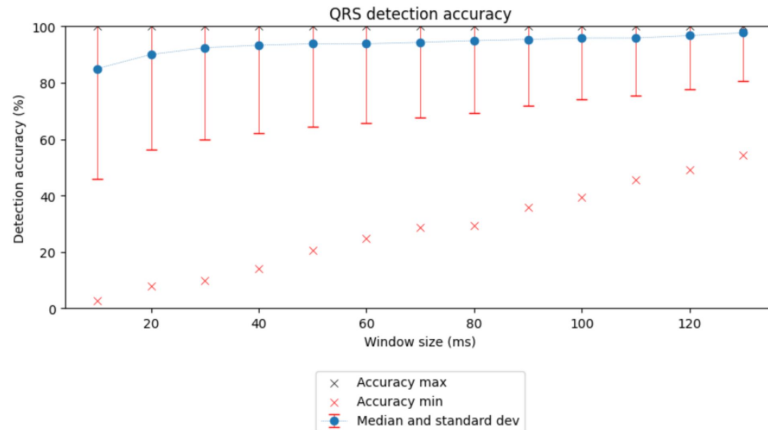
- For every annotated beat we check if there is a detected beat within a window centered on it
  - We check the performance using different window sizes
  - We evaluate: Performance, RMSE, Mean, Std Dev

Sample ID	Window size (ms)	N° of beats	N° of matches	Performance (%)	RMSE	Mean (ms)	Std Dev (ms)
1	130	125	85	68.0	179.45	-143.4	107.88



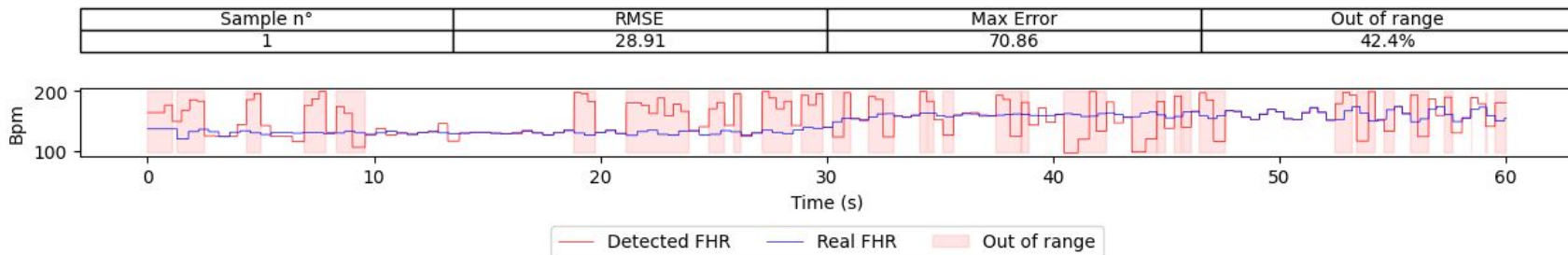
# OVERALL ACCURACY

- We evaluate how the overall accuracy change given the detection window size.
- The accuracy grows as the detection window widens but there is still a big variance (and some relevant outliers)!



# FHR TRACE

- For each sample, we build the FHR trace and we evaluate how much it deviates from the ground truth.
  - We also check the maximum error and how often it was out of range.
- A little offset in the detection can change the FHR trace a lot!





# PEAK DETECTION

- The algorithm performance is highly dependent on the method used to find peaks.
  - We need to find peaks in many places of the procedure (build the QRS average, find correlation, ...)
  - We tried with different values of “distance” (a parameter of `signals.find_peaks` function)

