



Central European Institute of Technology
BRNO | CZECH REPUBLIC

Other Physiological Data Recorded Simultaneously with fMRI

Martin Lamoš

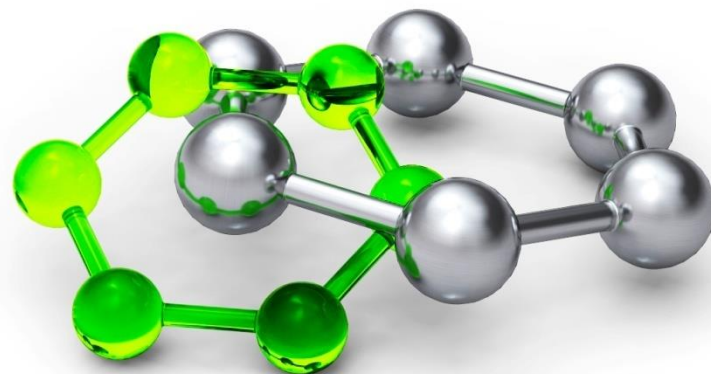
Brno, November 14th 2016



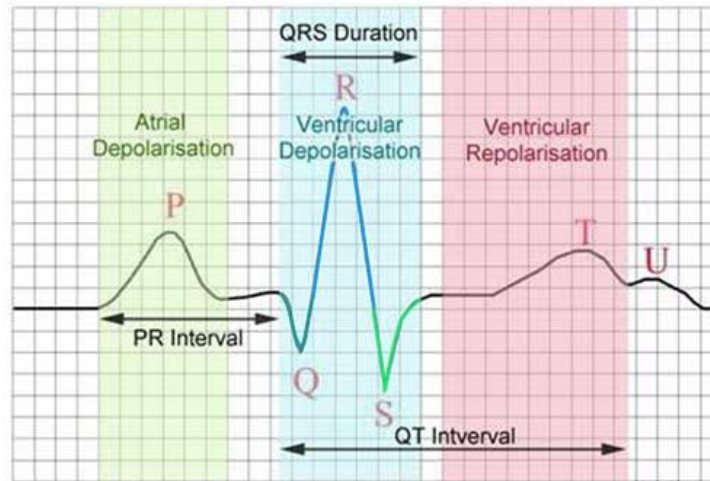
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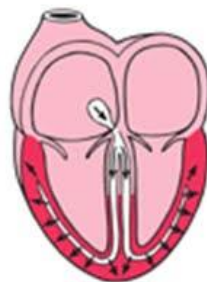
**OP Research and
Development for Innovation**



ECG



Activation of the atria

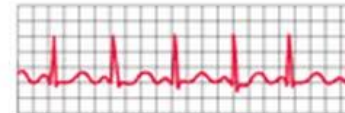


Activation of the ventricles

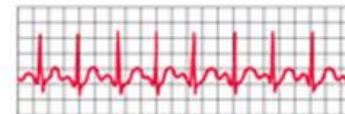


Recovery wave

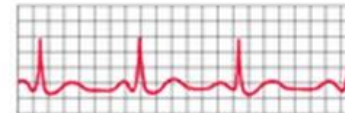
Normal Heartbeat



Fast Heartbeat



Slow Heartbeat



Irregular Heartbeat

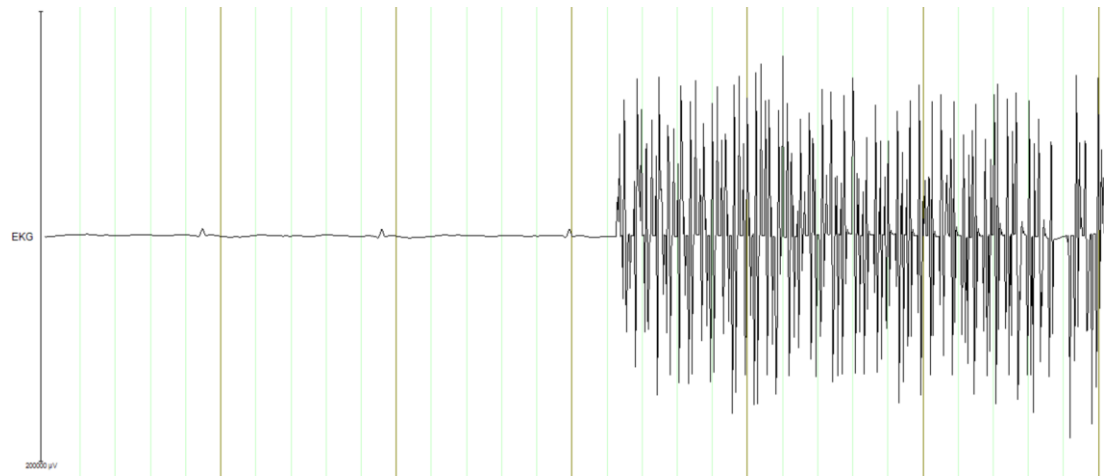


ECG

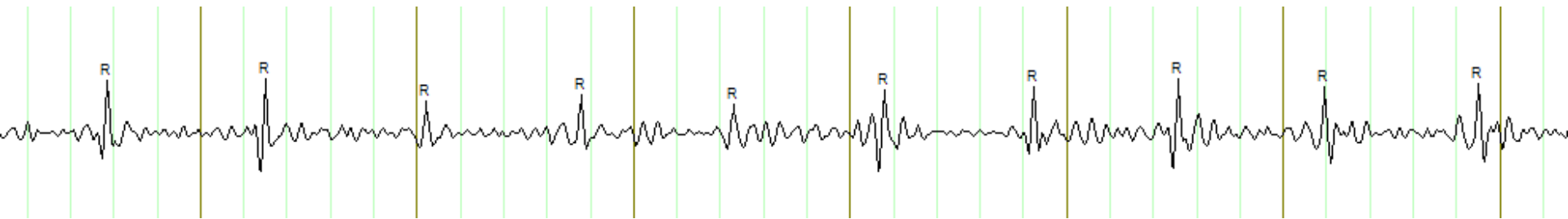
Standard ECG signal



when MR acquisition starts



ECG



Preprocessing

- Gradient artefacts suppression
- Standard temporal signal filtration
- R peak detection

Application

- For preprocessing of fMRI data using RETROICOR
- Analysis of heart rate variability (HRV)

Application of HRV

Dynamic functional connectivity



HRV calculation

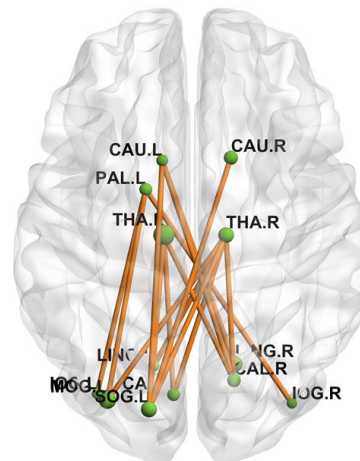
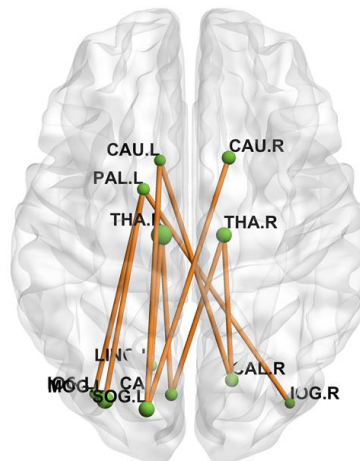
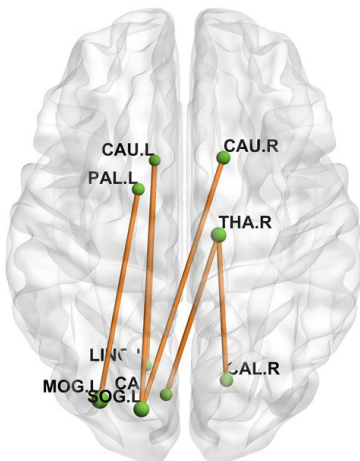


Pay attention to evaluation of the HRV respect to its frequency content.

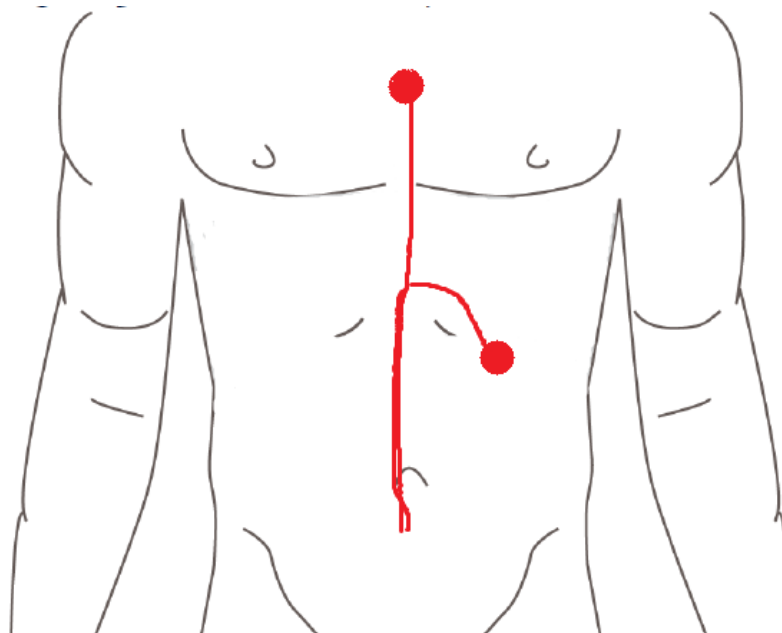
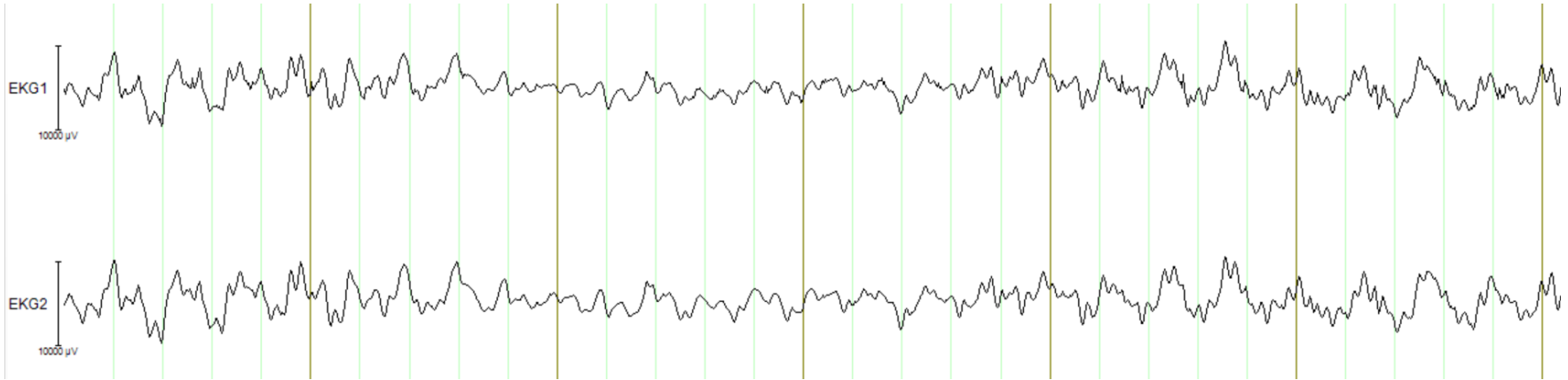
$$\text{HRV}(i) = \frac{1}{\Delta_i}$$

$$\text{HRV}(i) = \left(\frac{1}{\Delta_i} \right)_f$$

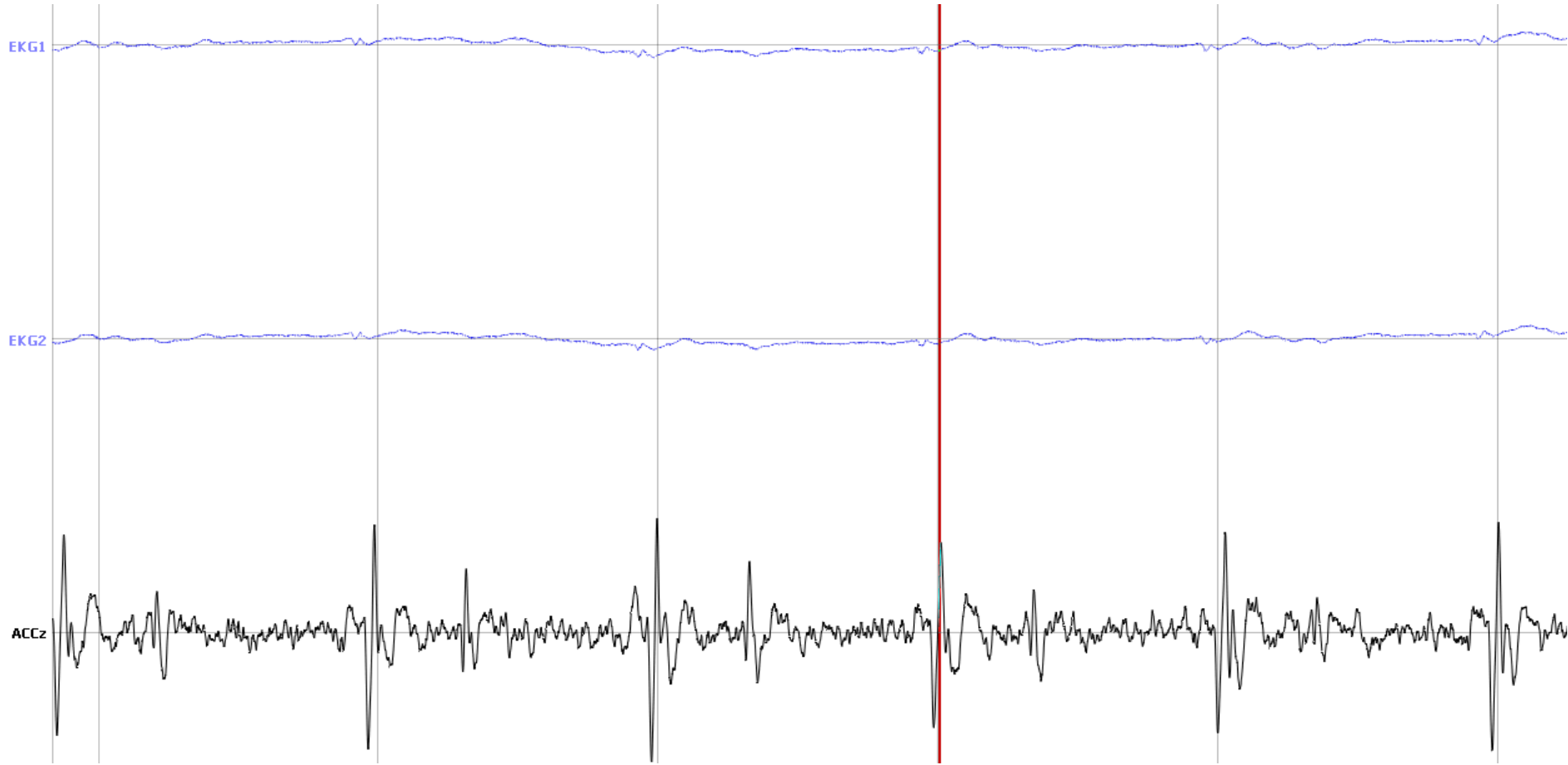
$$\text{HRV}(w_t) = \left(\frac{1}{N_t} \sum_{i \in [t, t+T]} \left(\frac{1}{\Delta_i} \right)^2 \right)^{1/2}$$



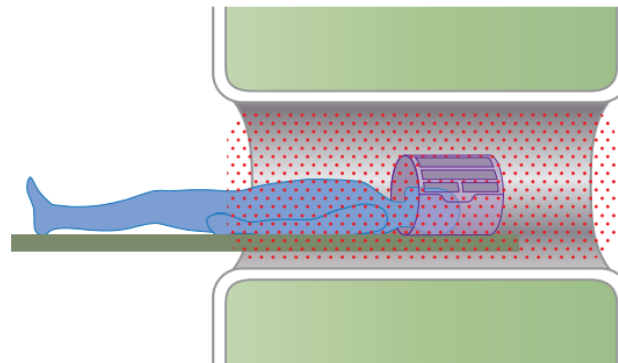
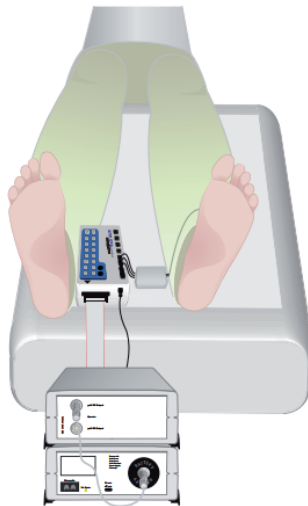
Bad ECG – game over?



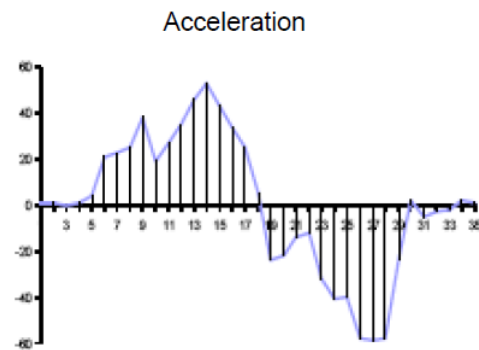
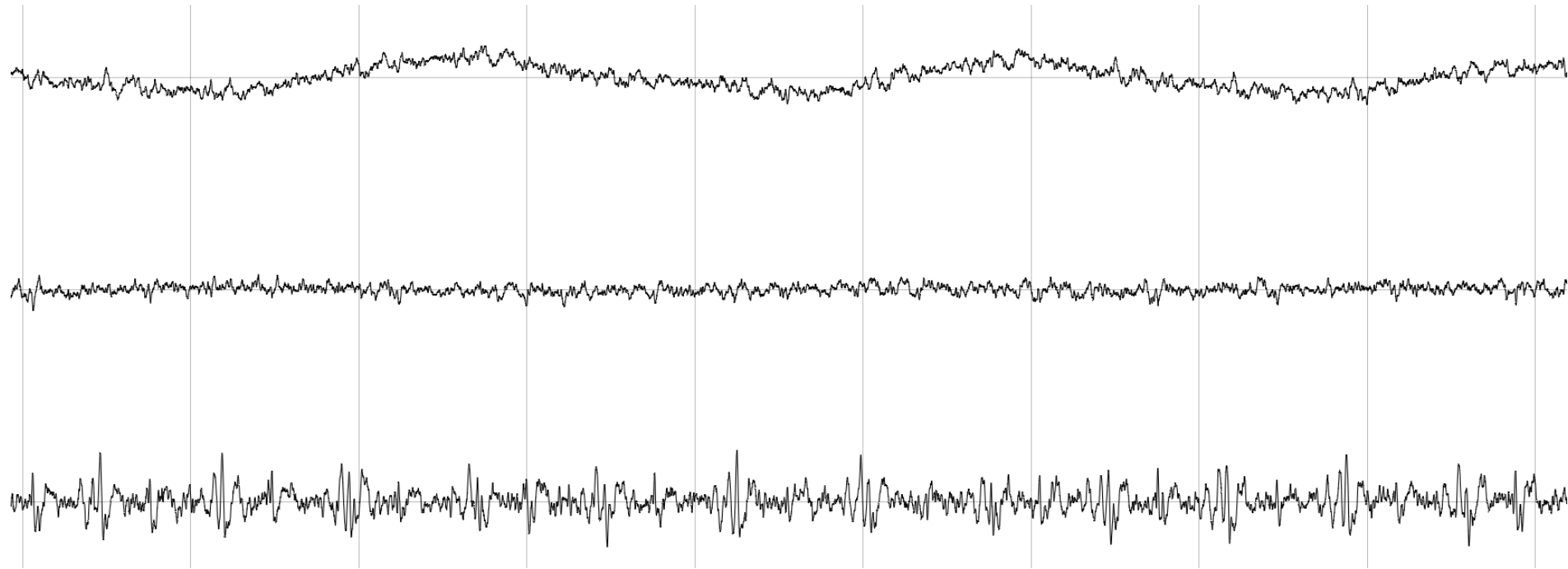
Accelerometer sensor - ECG



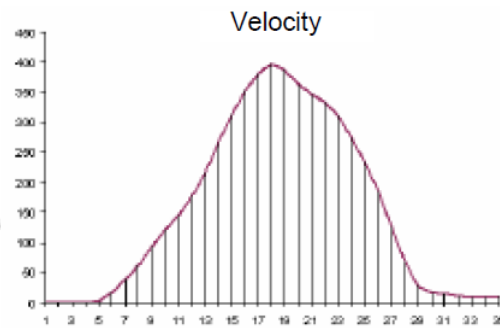
Movement - accelerometer



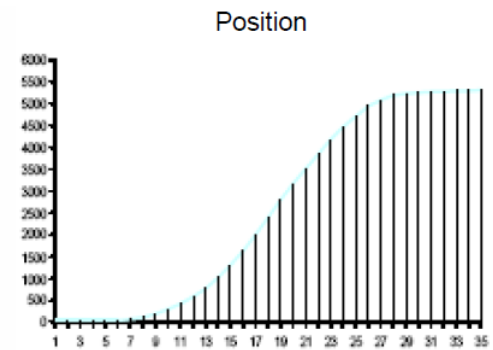
Movement - accelerometer



A) Real accelerometer data

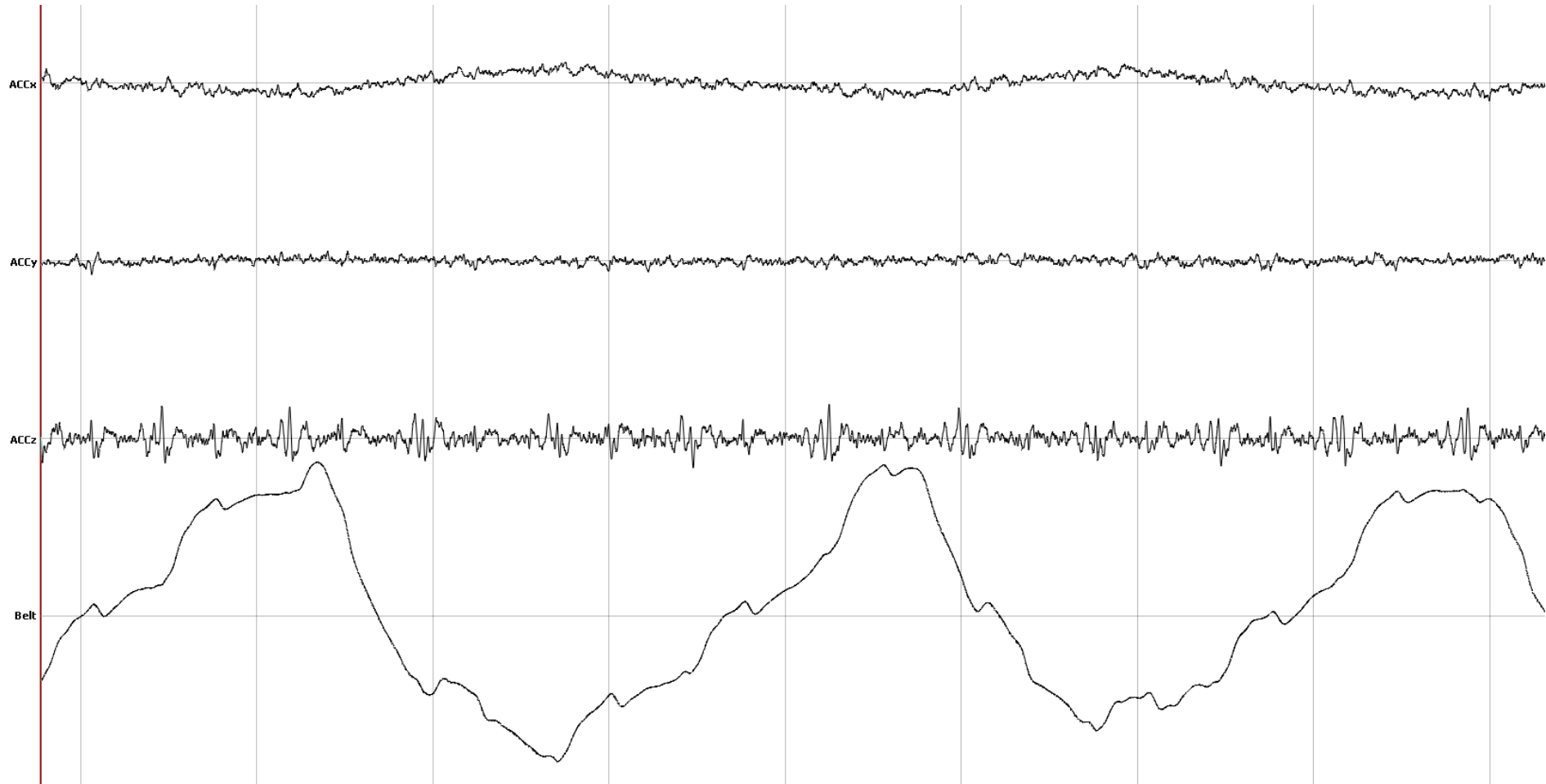


B) Result of the first
Integration velocity

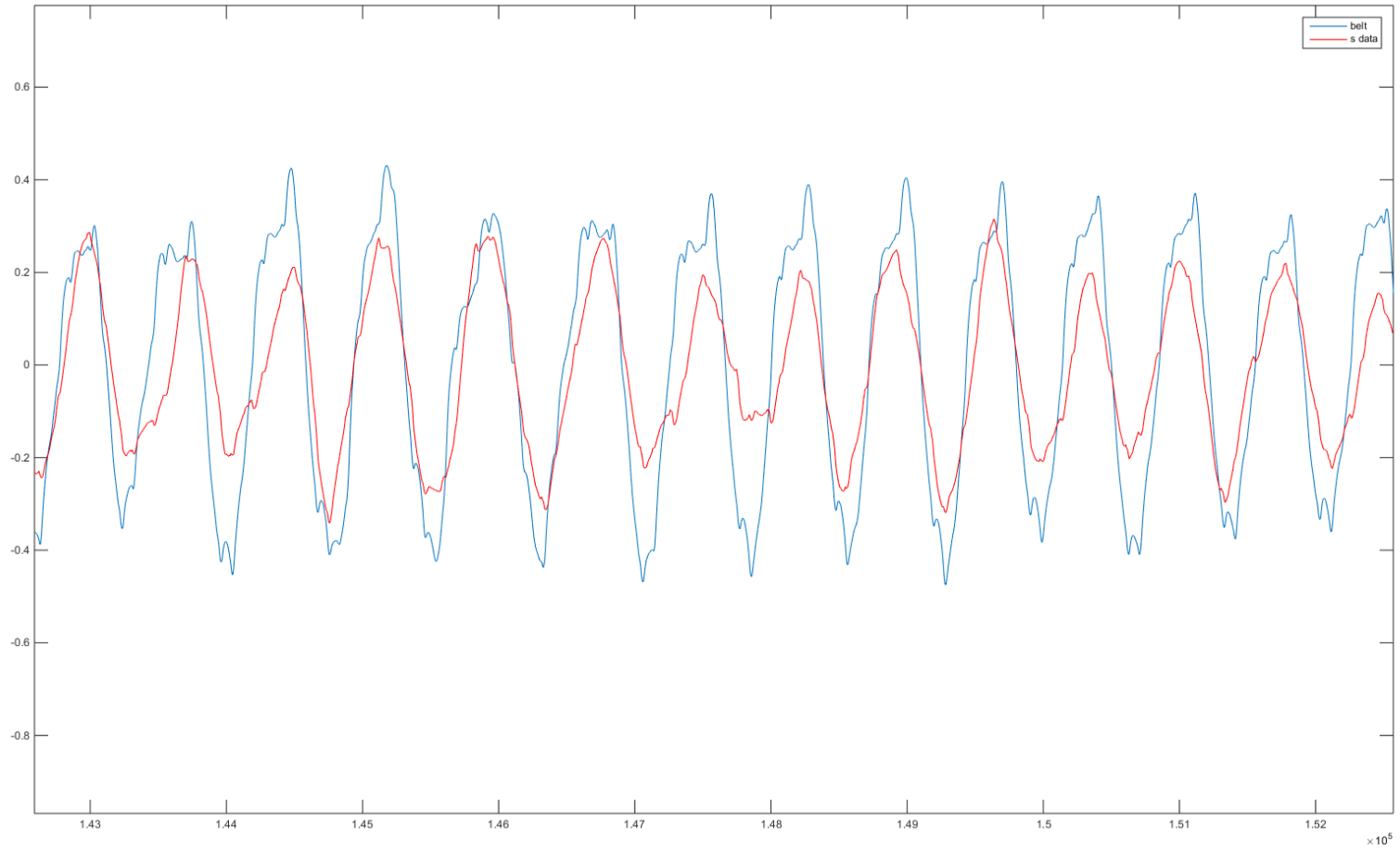


C) Result of the second
Integration velocity

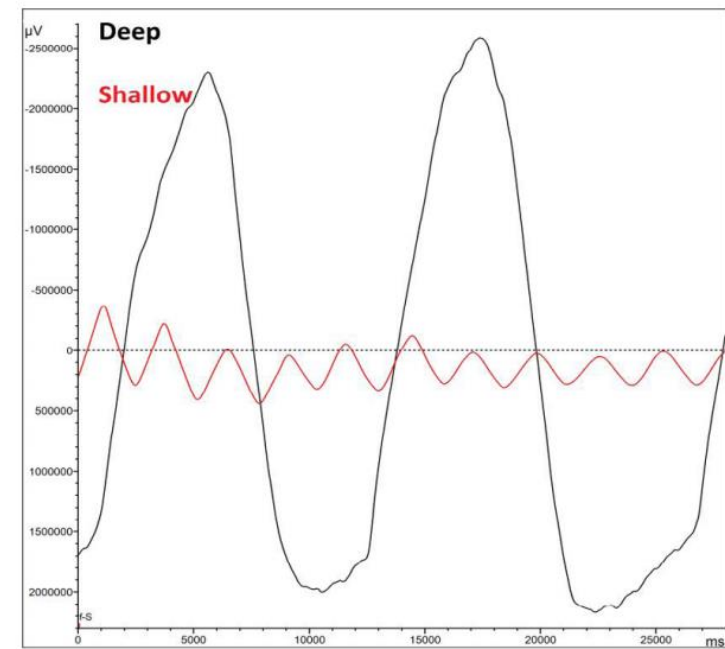
Accelerometer sensor - respiration



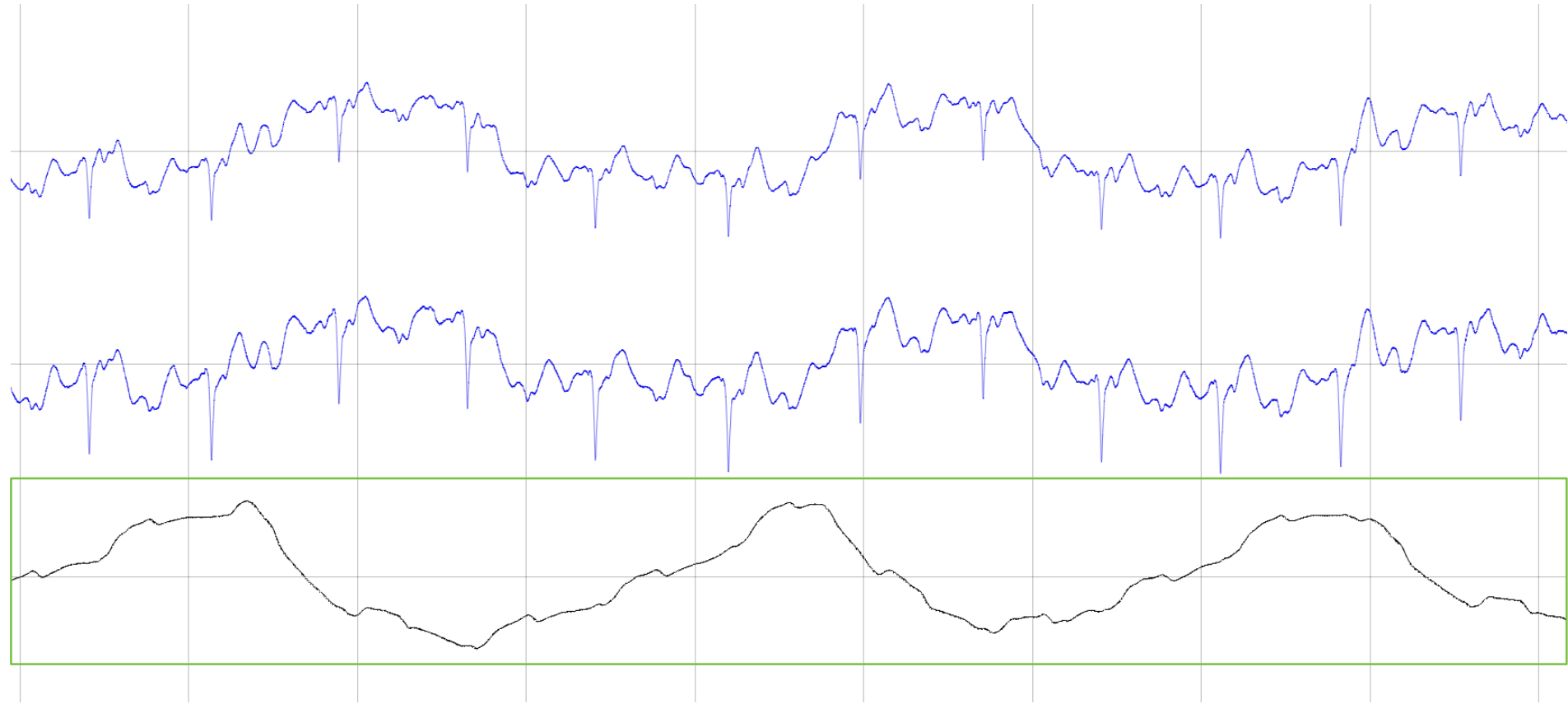
Accelerometer sensor - respiration



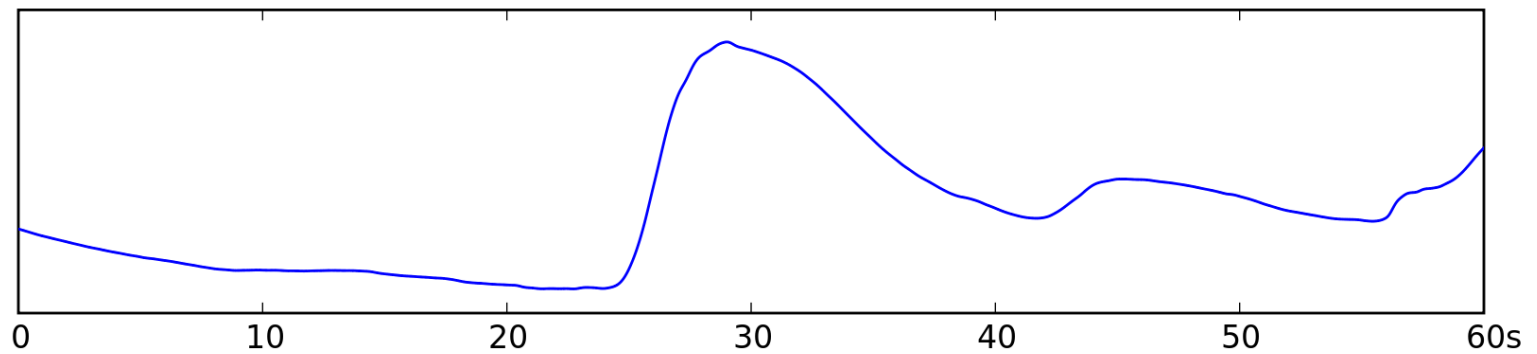
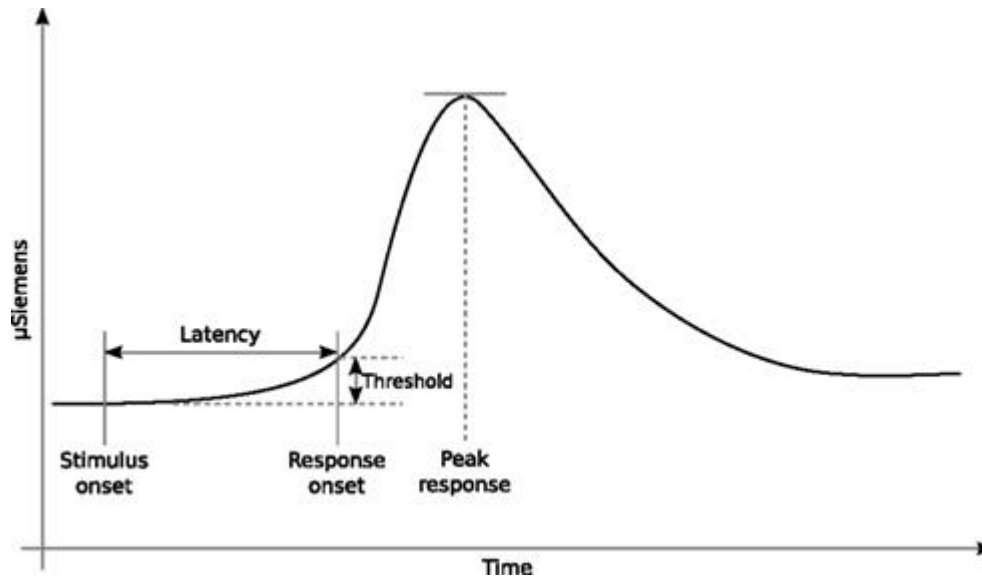
Respiration



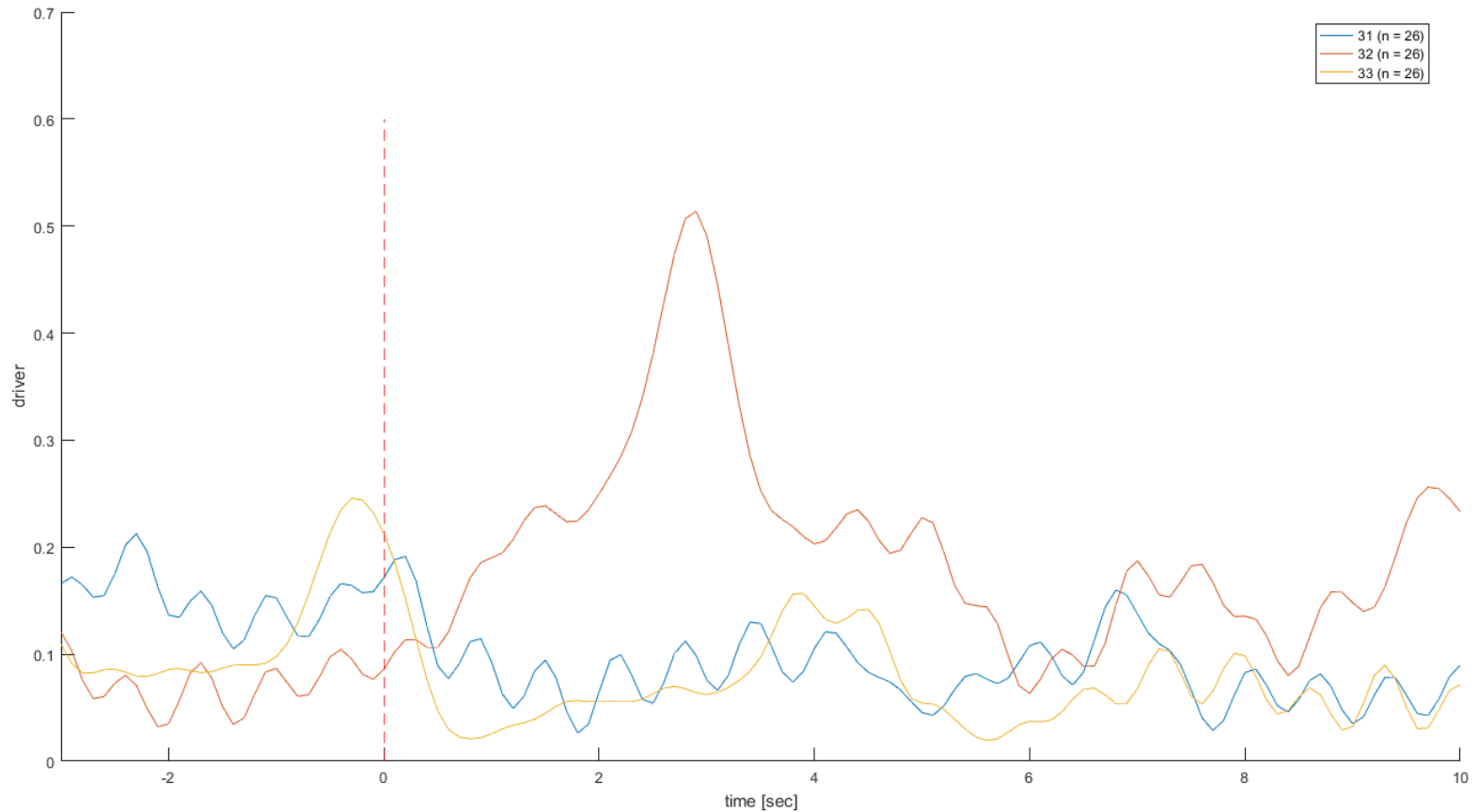
Respiration



Skin Conductance



Skin Conductance - application



Thank you for your attention



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