Social Networks Threats Psychophysiological Validation. A Facebook Study

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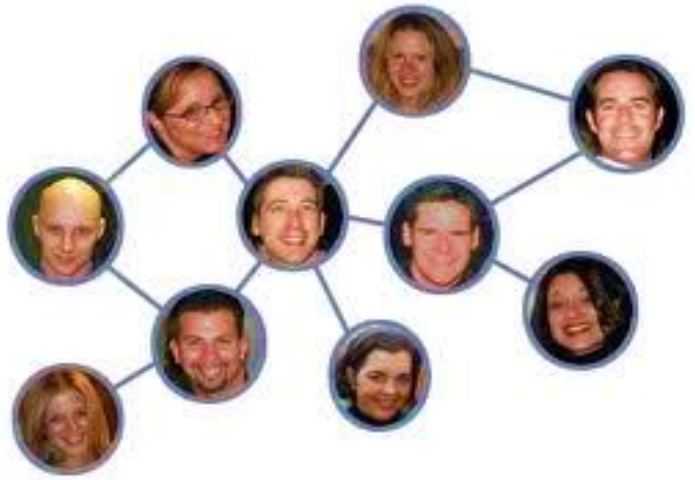
Studied Environment

Social Networks



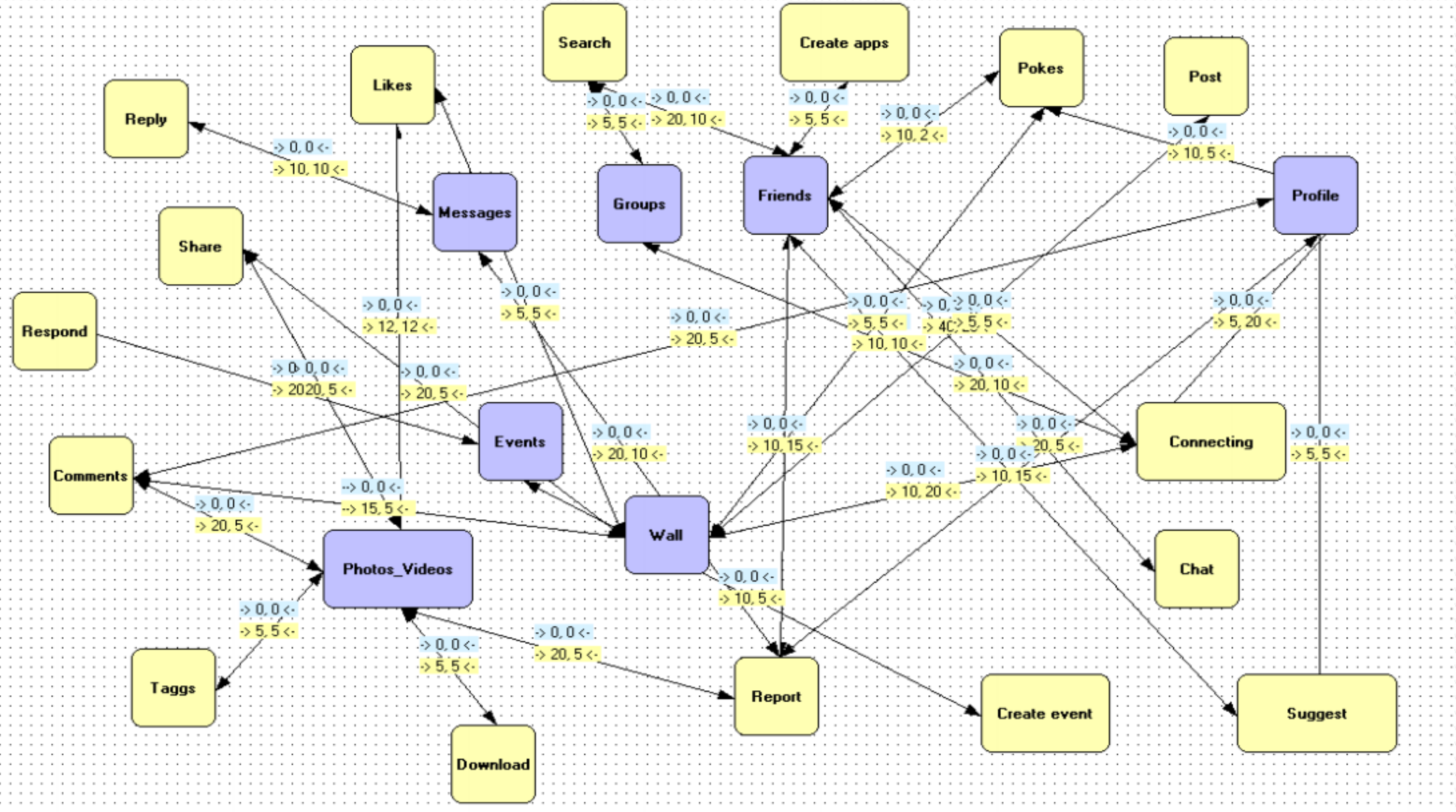
- Over 750 million users;
- Over 80 % in the age in-between 13-45 years;
- People spend over 700 billion minutes per month on Facebook.

http://www.facebook.com/press/info.php?statistics
http://en.wikipedia.org/wiki/Facebook

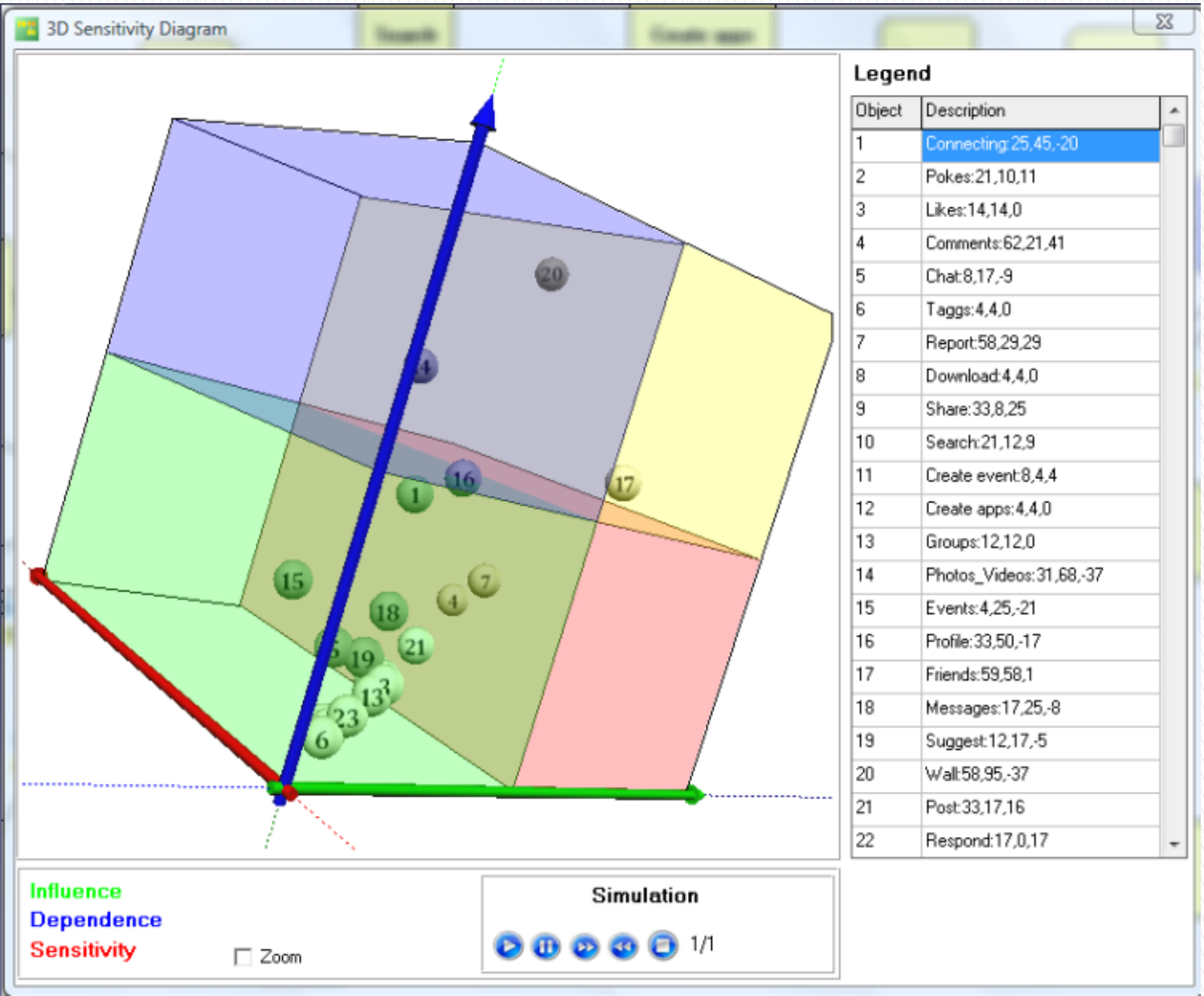
Methodological Context

I-SCIP®

Minchev & Petkova, Facebook Threats Analysis Model, 2010



Resulting Classification from the Model



Objects Classification

- Critical: *Friends*

- Passive: *Photos_Videos, Profile, Wall*

- The rest are buffering ☺

syssec

EU Network of Excellence in Managing Threats and Vulnerabilities in the Future Internet

syssec

http://www.syssec-project.eu/

Human Factors Analysis Framework

Materials

- Self-reporting questionnaires and personality psychometric tests;
- User screen activities records during Facebook exploration;
- Physiological records of specific bioelectrical signals;
- Matlab® R2011a & Borland Delphi® 2008 Software Environments.

Methods

- Inquiry method and Eysenk personality test;
- Time-frequency and spectral analysis.

Participants

15 men and 3 women (inbetween 15–18 years) participants in XI Mathematics and Informatics Summer School, Varna, Bulgaria, August 17–19, 2011.

5 men (inbetween 26–42 years) volunteers for electrophysiological monitoring

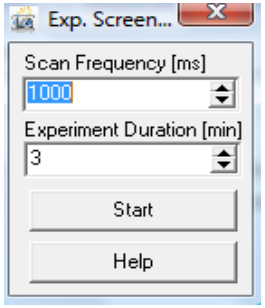
Hypothesis

Emotional behavior is correlated with users' personality profiles, ECG, EMG and EEG bioelectrical signal records lead from the participating subjects. The hidden threats in this social network's case study may be related to this behavior.

Experiments Set-Up

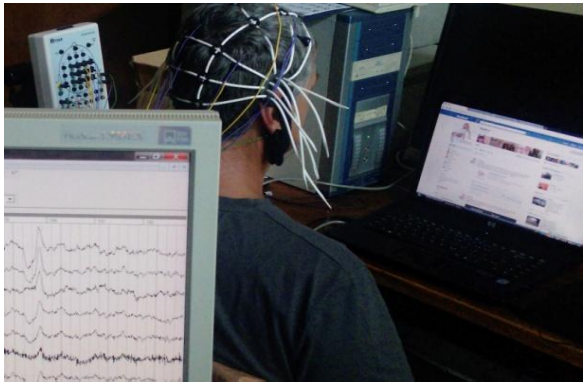
Psychological monitoring

www.cleverstance.com



http://www.facebook.com/shakira

Physiological monitoring

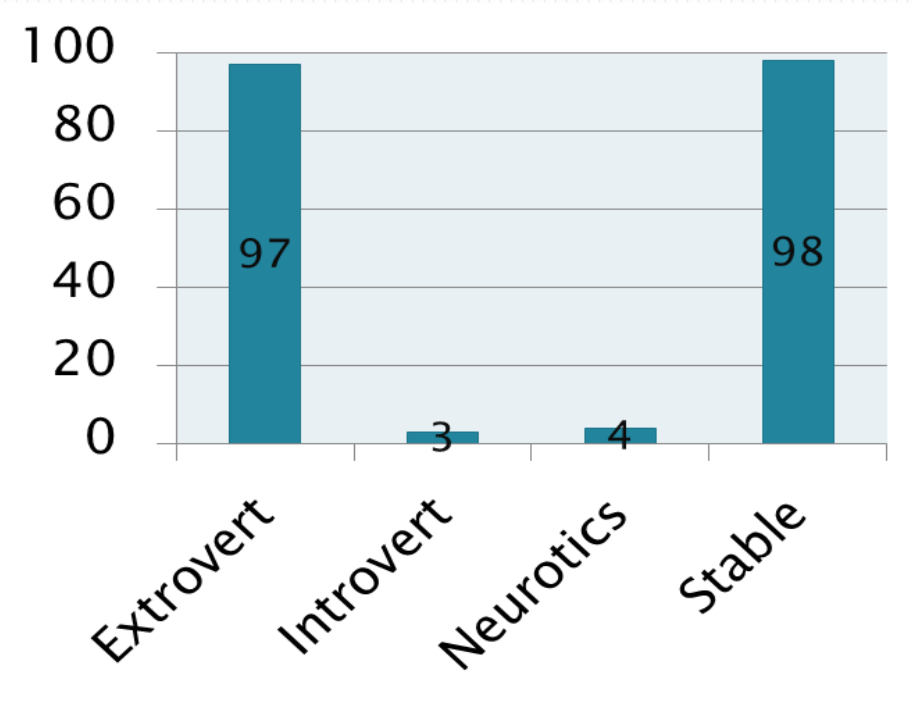


www.mitsar-medical.com

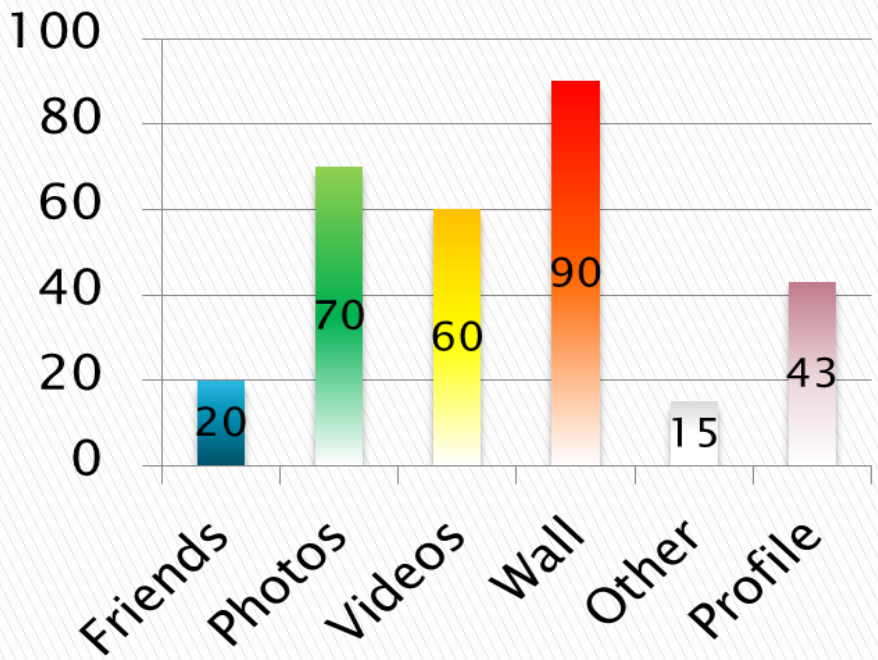
Results

PSYCHOLOGICAL MONITORING

Eysenk personality test

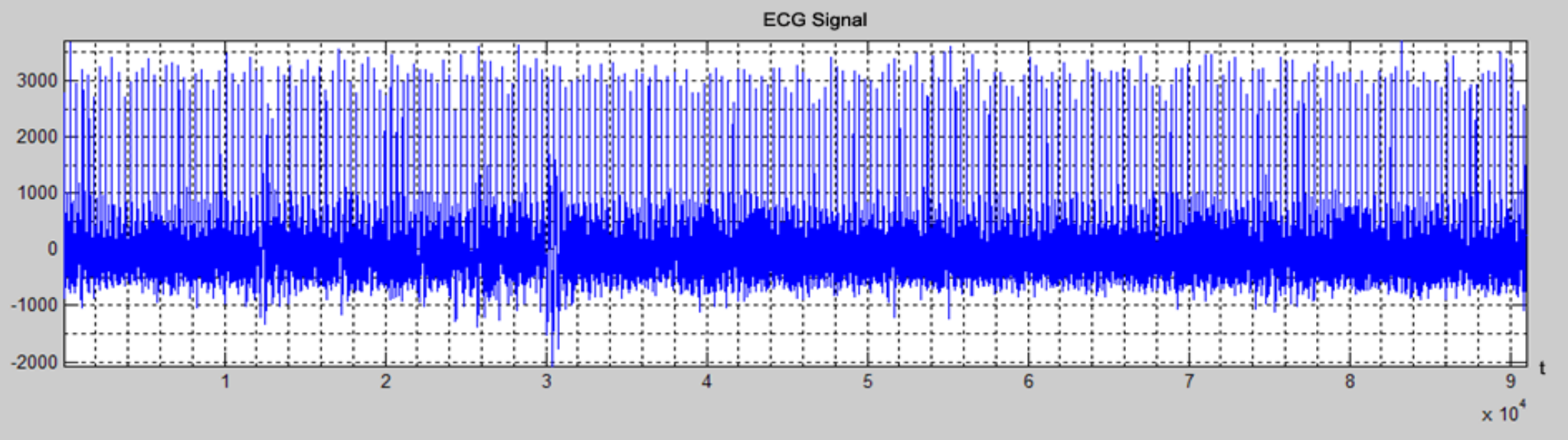


Facebook zone usage

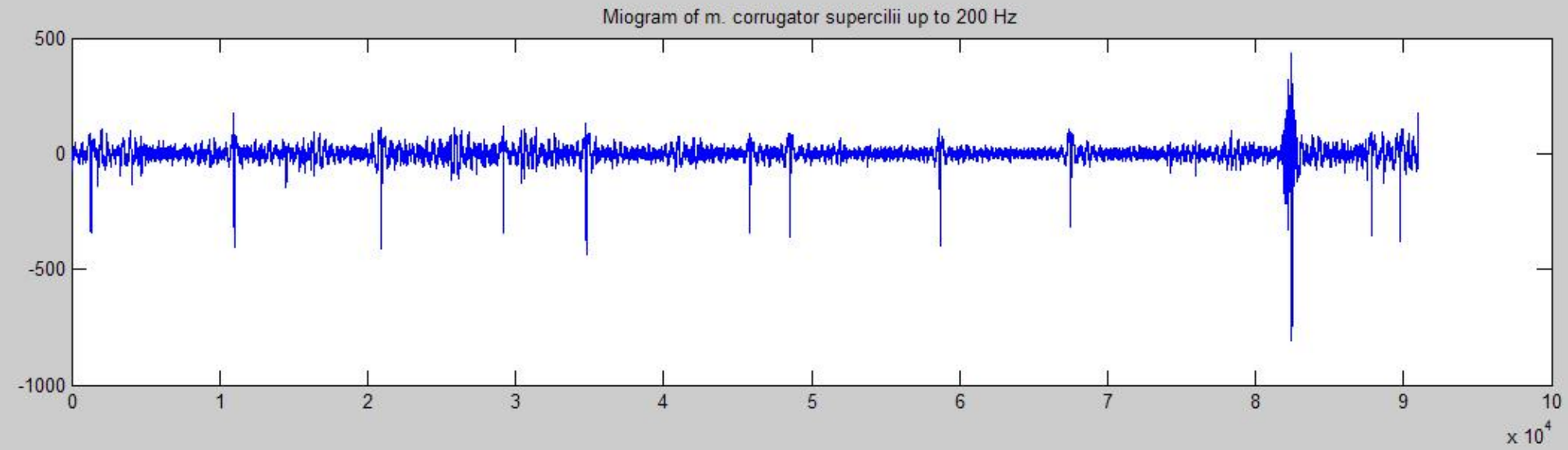


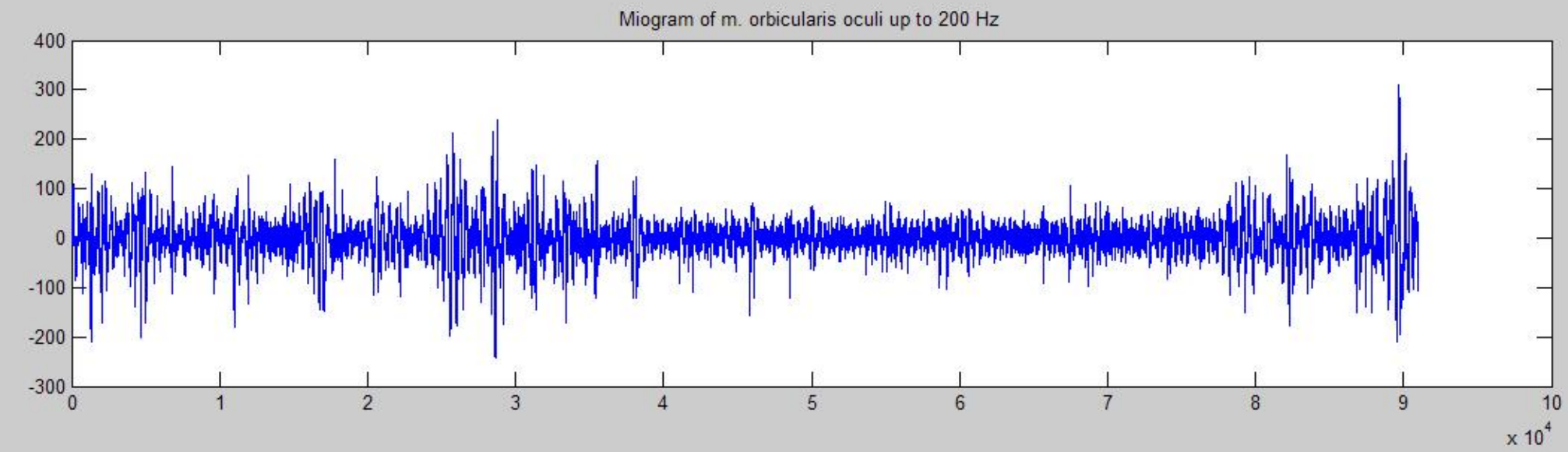
PHYSIOLOGICAL MONITORING

ECG Monitoring

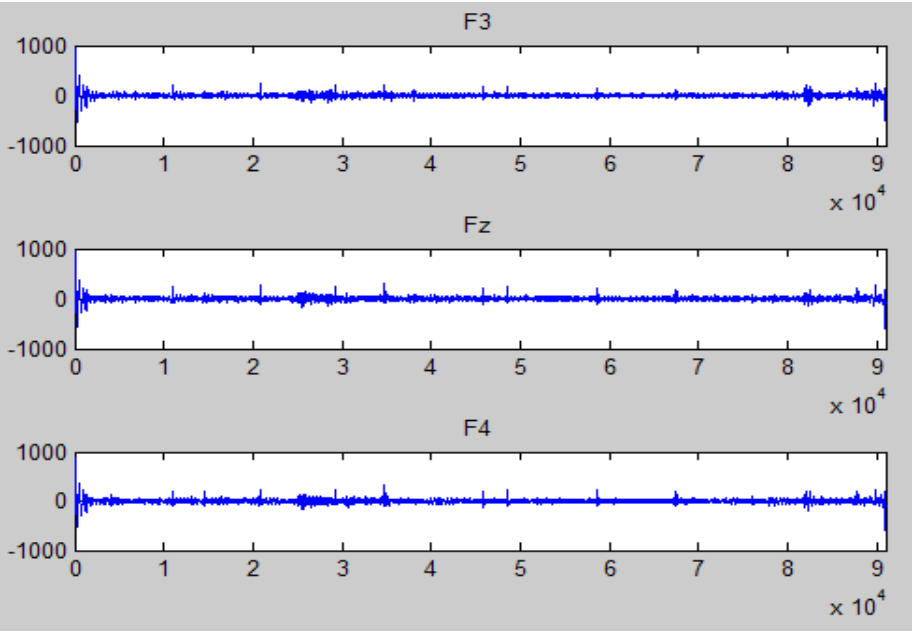


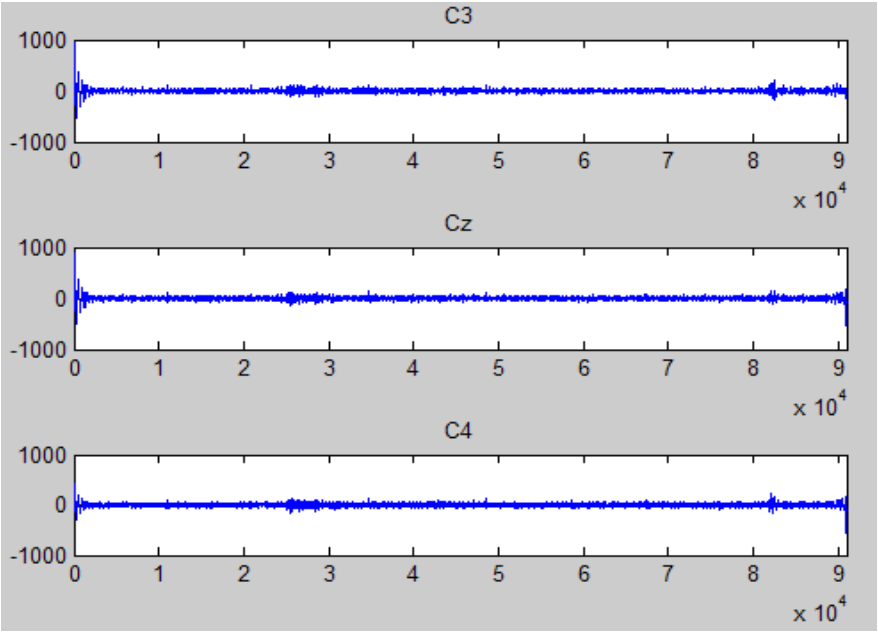
EMG Monitoring

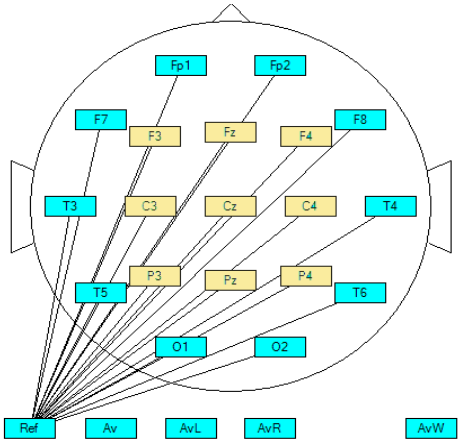




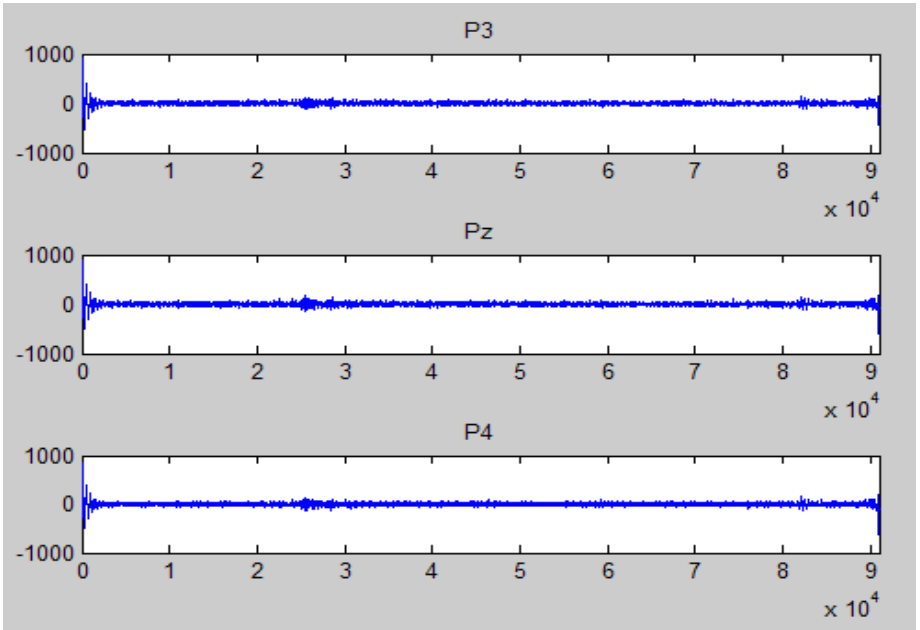
EEG Monitoring







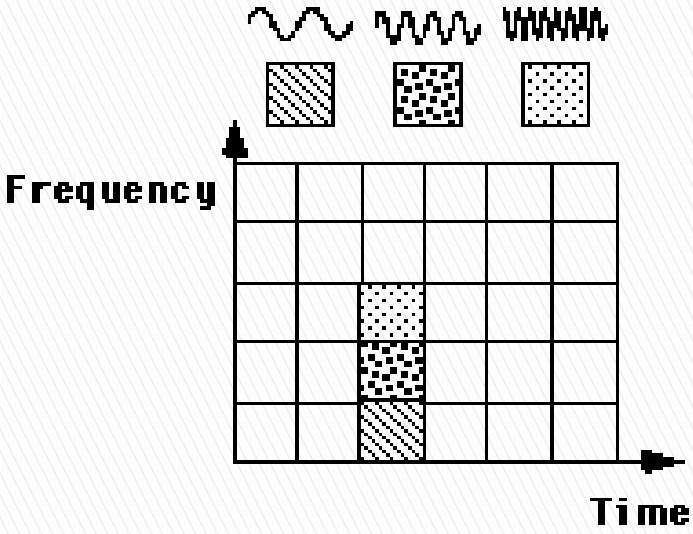
10/20 system selected leads and reference



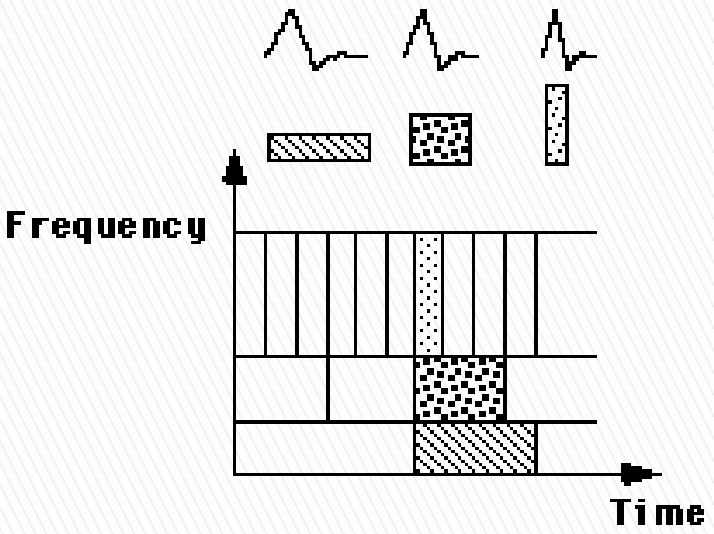
Assembled Mathematics for Time Series Analysis

Wavelet Analysis

Fourier Analysis



Wavelet Analysis

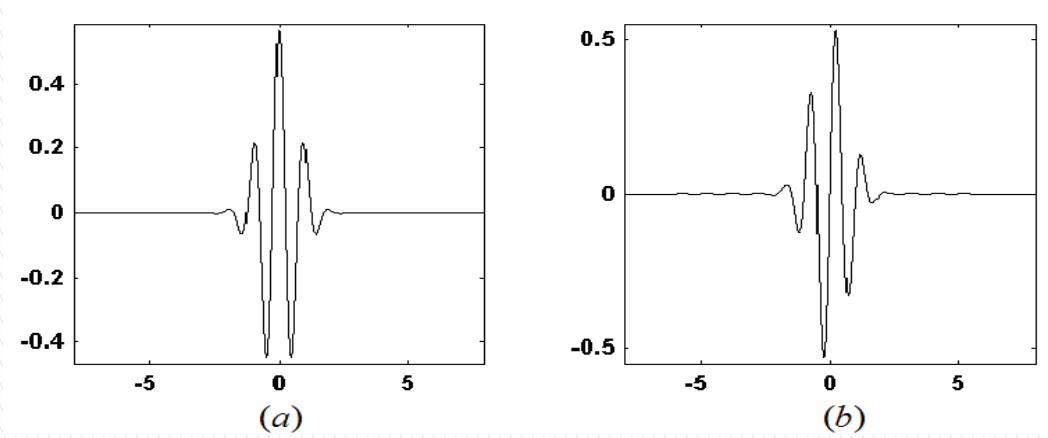


"…One thing to remember is that wavelet transforms do not have a single set of basis functions like the Fourier transform, which utilizes just the sine and cosine functions. Instead, wavelet transforms have an infinite set of possible basis functions. Thus wavelet analysis provides immediate access to information that can be obscured by other time-frequency methods such as Fourier analysis..."

http://www.amara.com/IEEEwave/IEEEwavelet.html

Adopted Wavelet Functions

Real (a) and Imaginary (b) parts of the Morlet wavelet function:



$$\psi(x) = e^{-\frac{x^2}{2}} \cdot \cos 5x$$

$$\mathrm{WPS} = [\mathrm{Re}(W(t,s))]^2 + [\mathrm{Im}(W(t,s))]^2$$

$$\psi(x) = \sqrt{\pi . f_b} \cdot e^{2\pi i f_c x} \cdot e^{-\frac{x^2}{f_b}}$$

Where: the bandwidth fb=1 and wavelet center frequency fc=1

"…CWT scales were analytically determined by generating a set of cosine waves with known frequencies (from 1 to 50 Hz) and computing the scales at which the WPS reaches its maximum for each known frequency…"; After Meyers et al, 1993.

HRV Calculation

Sampling Frequency - f_s

HRV – Heart Rate Variability

HRV = R-R diff / 60 * f_s

**Wavelet Multiresolution Analysis for QRS complexes detection*

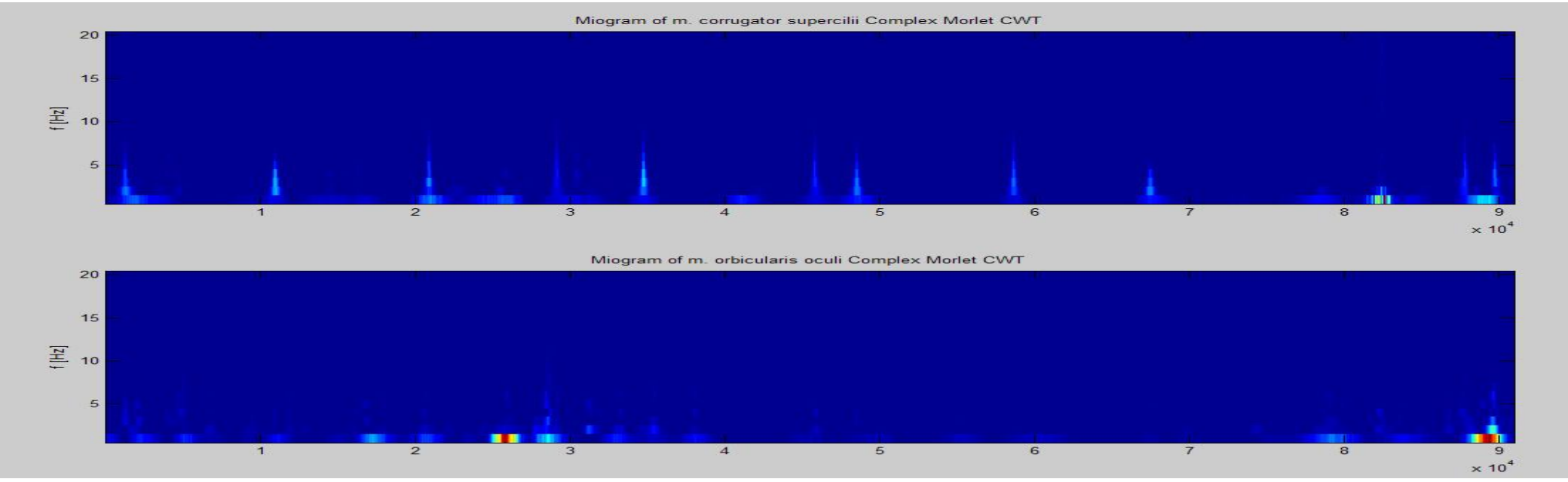
S-transform

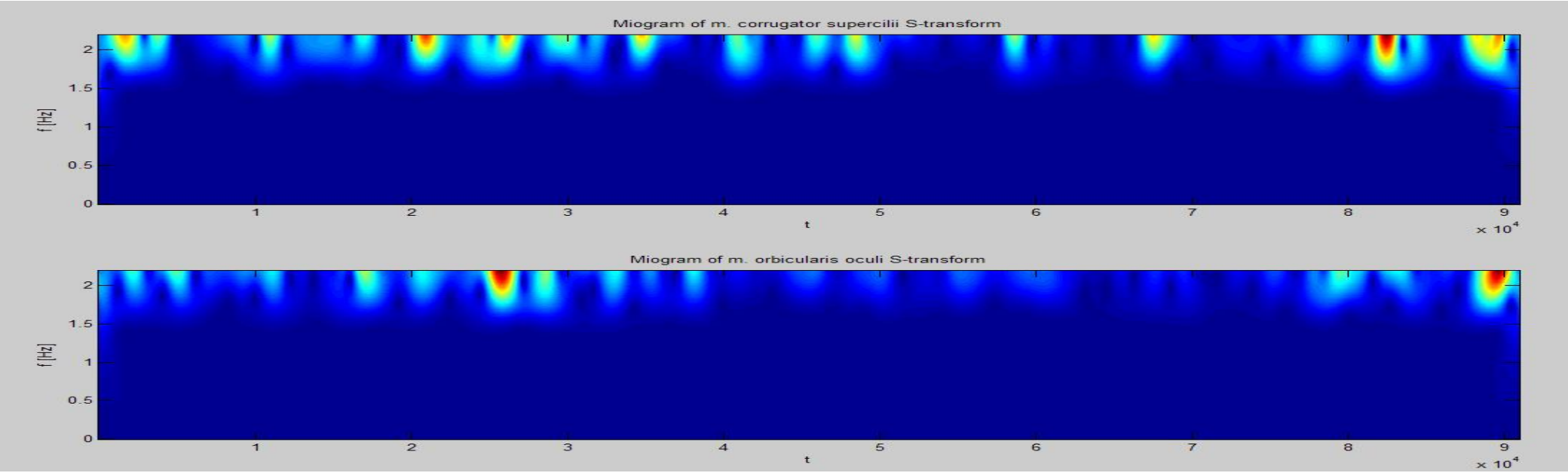
The S-transform is a type of time-frequency analysis that uses different window length depending on the analyzed frequency:

$$ST(\tau, f) = \int_{-\infty}^{+\infty} x(t) w(t-\tau, f\ ) e^{-2\pi i f t} dt$$

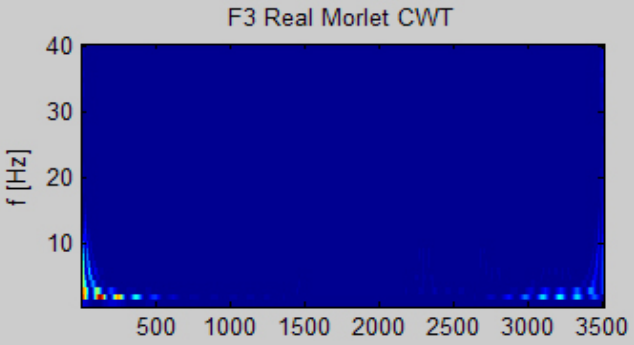
"…The S-transform is in general a phase correction of the definition of the Wavelet Transform. The S-transform localizes the real and the imaginary components of the spectrum independently, localizing the phase spectrum as well as the amplitude spectrum…"; After Stockwell et al, 1996.

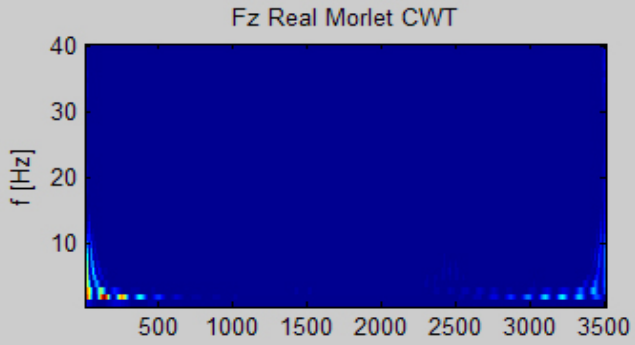
EMG CWT & S-transform

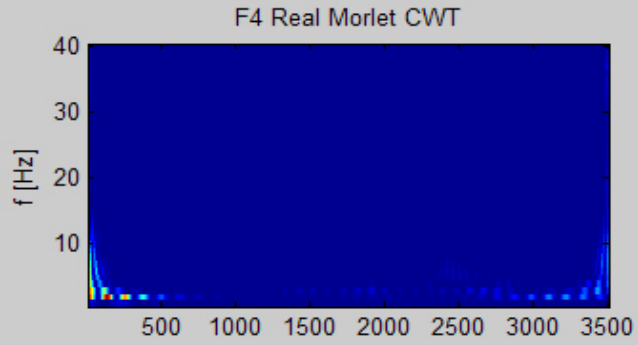


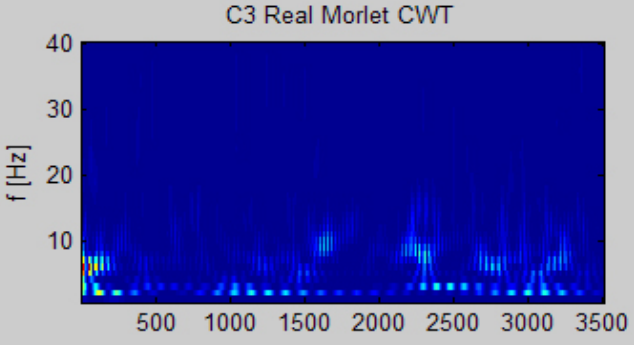


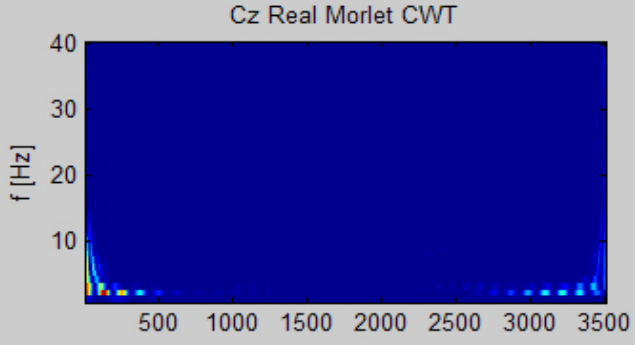
EEG Continuous Wavelet Transformation (CWT)

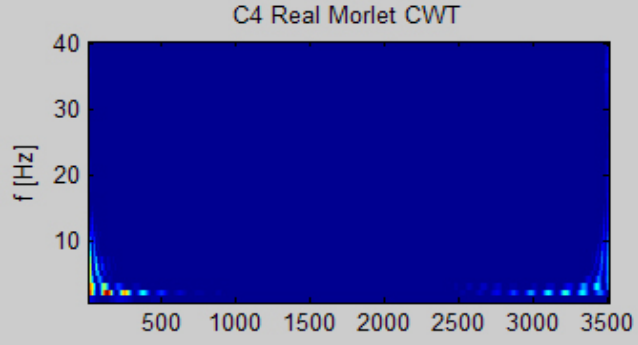


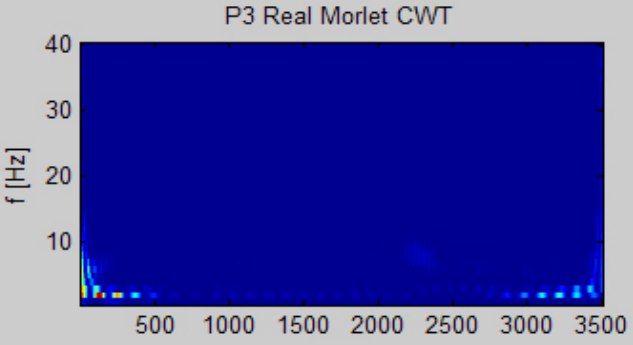


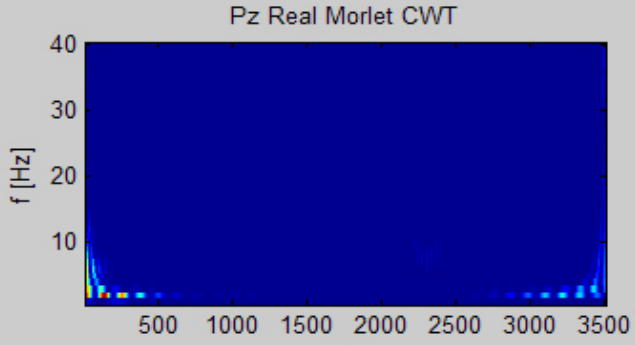


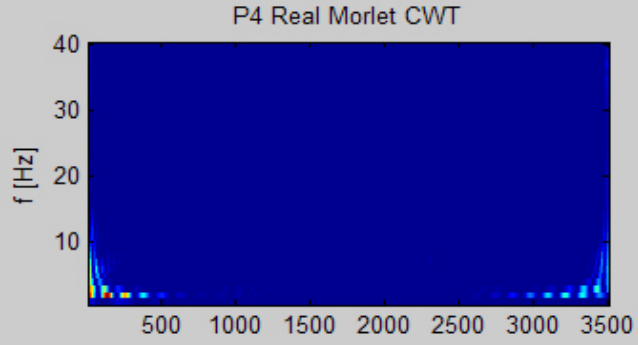




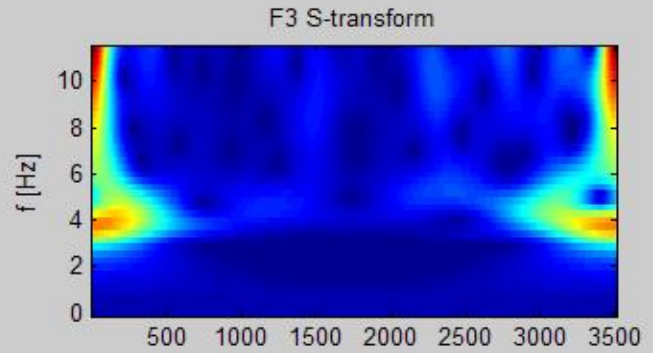


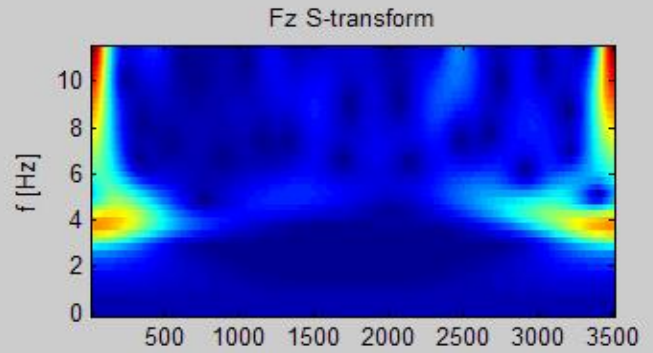


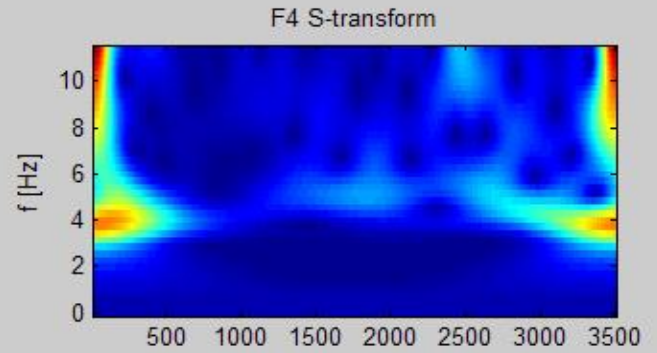


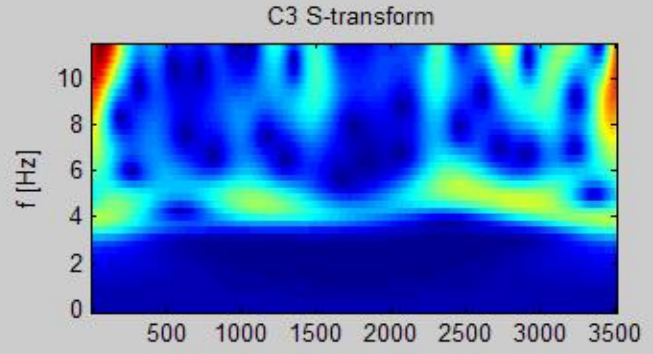


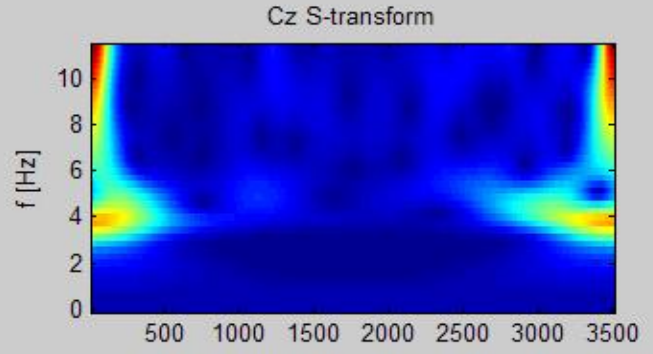
EEG S-transform

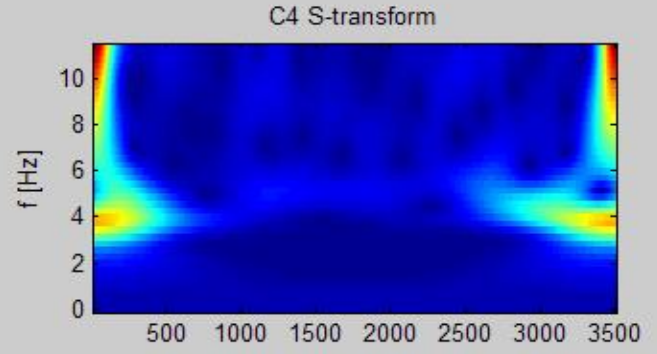


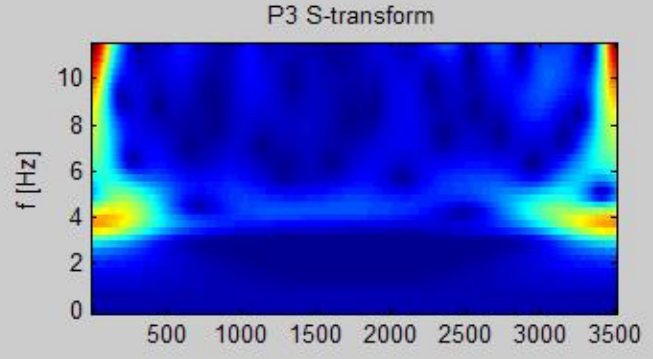


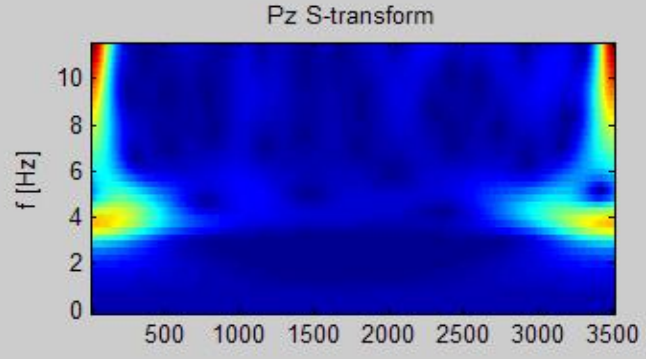


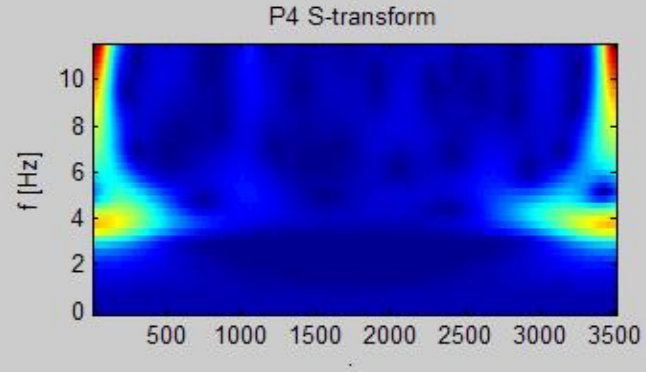




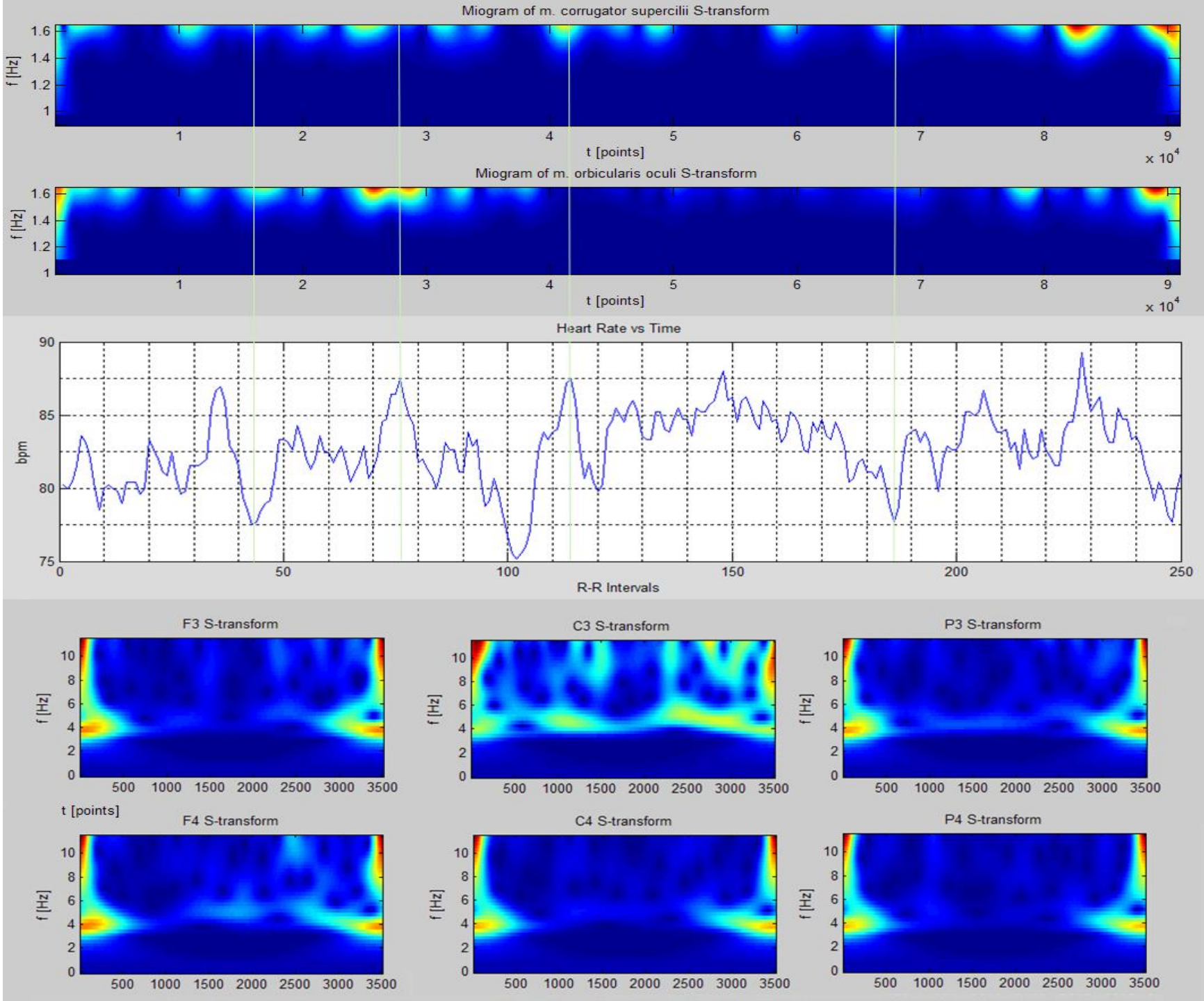








Significant Results Illustration (HRV & L–R brain asymmetry)



Discussion

The presented methodological framework opens a huge area for research of human emotional behavior and its correlations with the social networks threats. This behavioral research could be partially observed with time-frequency and spectral analysis of different bioelectrical signals, mechanical measures of the postural sways, arm movements, facial expressions changes and etc.

The most important value of such studies is the correlation between IT threats, human factor behavior and emotions, virtually caused by mirroring the real world.

Acknowledgements

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Thank you for the attention!

Questions?