Method for assigning and calibrating the psychological indicators in MindMi^{TM} Psychometric Systems

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1. Introduction

The MindMi^{TM} inferential psychometric system, which is based on the phenomenology of electrodermal response, needed integration in the calculation algorithm of a set of connections between its response potentials, of SPL and SPR type, and the measureable parameters of another category of biosignals on which an identification method is applied for identifying the psychological meaning. Such a category is the category of EEG biosignals, measurable with special head pieces, which position the measurement electrodes in agreement with the International Standard 10-20, 10-10 or 10-5.

The method presented here describes the process of assigning the psychological indicators, gradually presenting the steps followed in establishing the closest psychological meanings of the electrodermal biosignals obtained by AC-stimulation of the phasic stage of the palm epidermis, a technique described by the author in the patent RO127615/2013, but also in a series of scientific articles, meanings corresponding to some sets of EEG biosignals, acquired simultaneously by enshrined techniques. It is also presented the procedure for scaling and calibrating these indicators with the purpose to introduce them in the final psychometric reports of the electrodermal inferential system.

2. Equipment and software

The reference equipment used to implement this method is the BioSemi system (Figure 1), in setup 256+2 electrodes (Figure 2).

Figure 1. The BioSemi system in working setup
(source: https://biosemi.com/pics/Praamstra_medium.gif)

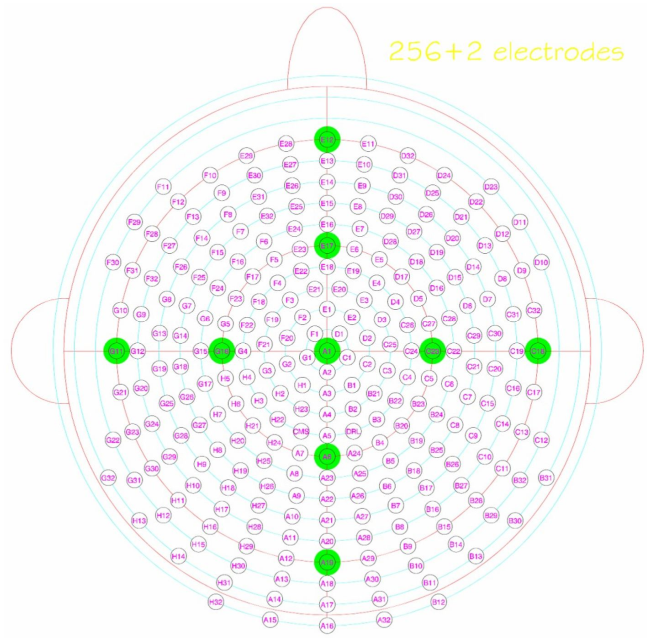

Figure 2: Setup 256+2 electrodes in the BioSemi system.
(source: https://biosemi.com/pics/cap_256_layout_medium.jpg)

BioSemi is compatible with the acquisition server interface type Open VIBE v1.2.2. (Software for Brain Computer Interfaces and Real Time Neuroscience), made available by INRIA (Institut National de Recherche en Informatique et en Automatique) France, an interface used here to implement the assigning method (Figures 3 and 4).

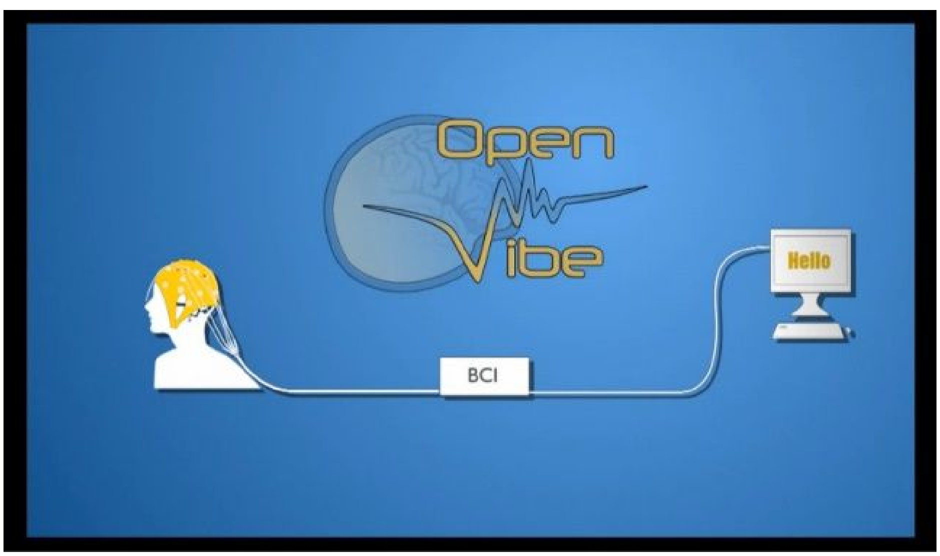

Figure 3: The measurement system with Open VIBE acquisition server interface
(source: http://openvibe.inria.fr/discover/

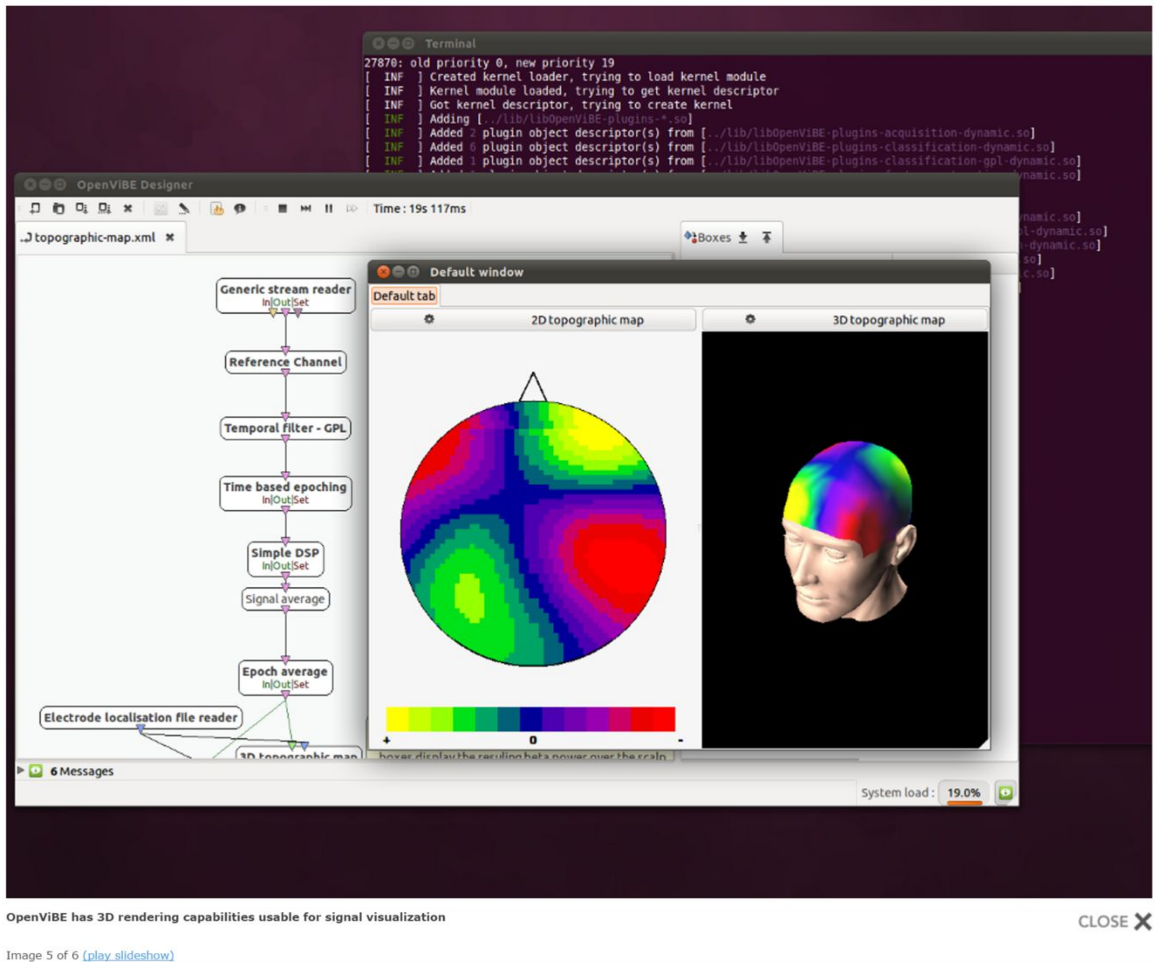

Figure 4. Viewing the active areas of the brain cortex using the Open VIBE v1.2.2 acquisition server interface. (source: http://openvibe.inria.fr/)

Other software used in mapping the brain cortex are EEGLAB, provided by: Swartz Center for Computational Neuroscience (Figure 5), and BRAINSTORM - *a MATLAB Based, Open-Source Application for Advanced MEG/EEG Data Processing and Visualization* (Figure 6).

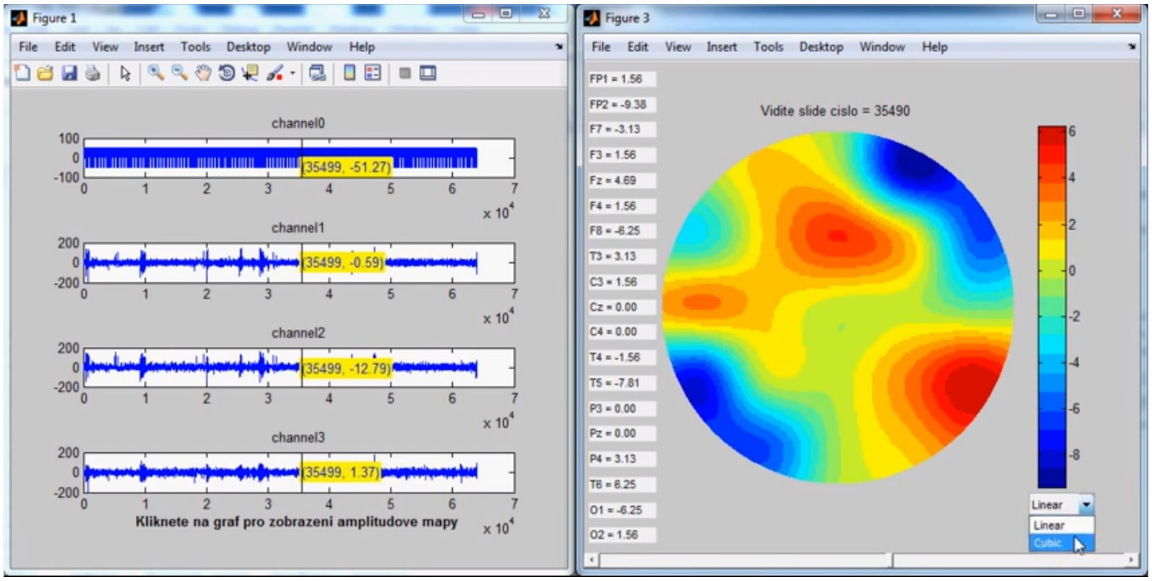

Figure 5: Brain mapping with EEGLAB
(source: https://sccn.ucsd.edu/eeglab/downloadtoolbox.php)

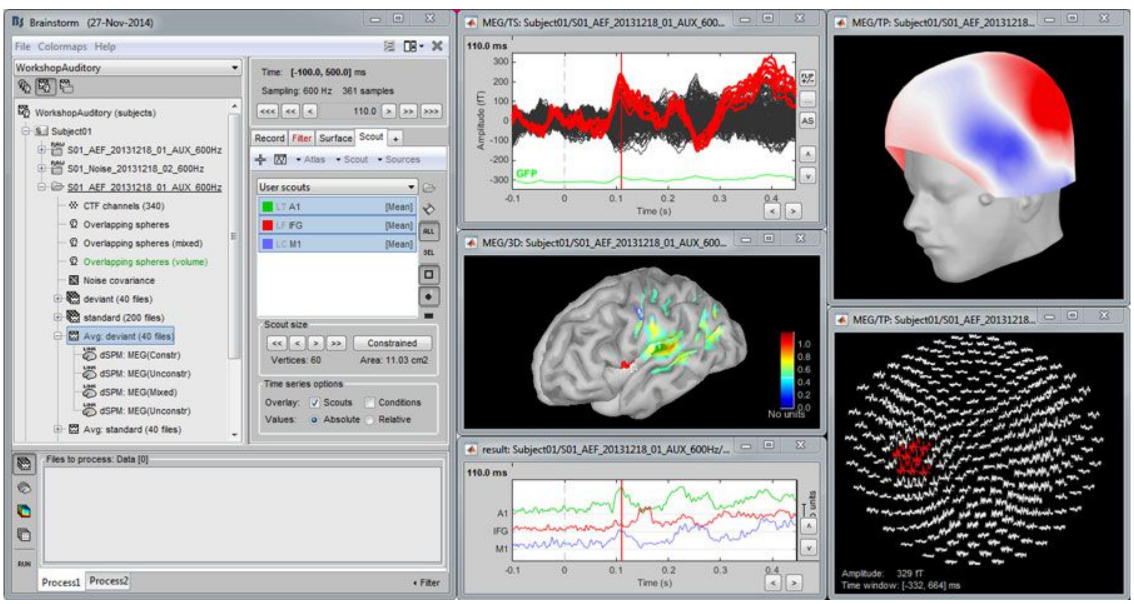

Figure 6: Brain mapping with BRAINSTORM
(source: https://www.mathworks.com)

The data from the palms were acquired with the MindSpring™ palm scanner of the MindMi™ system (Figure 7), through its software interface.

Figure 7: The MindMi™ psychometric system
(source: https://www.mindmisystem.com)

3. Conceptual support

a. The general brain mapping chart

Advanced techniques and technologies are currently used to study the brain, among which, it's worth mentioning the magnetic resonance imaging. This provides valuable information on the brain areas that are activated under the action of stimuli, images that, reproduced by evocation, confirm and certify the concept of *pattern recognition*, being particularly useful in mapping procedures. Electroencephalography (EEG) techniques are also used for brain mapping, but on a lower resolution.

An exhaustive brain mapping is not yet available. Enormous financial efforts are made for such a research. See the American Project, suggestively named ”BRAIN” (Brain Research through Advancing Innovative Neurotechnologies) that, since from the start, set to achieve some dynamic images, at very high speeds, of the interactions taking place in the neural networks, through advanced technologies, capable to explain matters still hidden, over processing, memorizing and decision-making, with the purpose to clarify the deep connections between behaviour and brain functions.

Human Brain Project was also a highly costly initiative of the European Commission through the ”European Month of the Brain” having as target an *atlas of the human brain*. This assumes designing some new mathematical models, used to simulate processes on various levels of cortical organization, but also databases unified in a Neuro Computer Platform providing information to another brain simulation platform: *Brain Simulation Platform.*

With respect to our research, which led to completing the evaluation reports provided by the MindMi™, psychometric system, the pursued aim was a high correlation between the electrodermal and the electroencephalographic biosignals, for which sets of mediated value data were used on optimum time sessions. In the assigning process, we considered the most known brain mapping charts (e.g. Figure 8), but also a fractal concept that facilitated the functional identification of the measuring areas, for the EEG signals, and an inferential tensor pattern used to mark the EDA biosignals for assignment purposes.

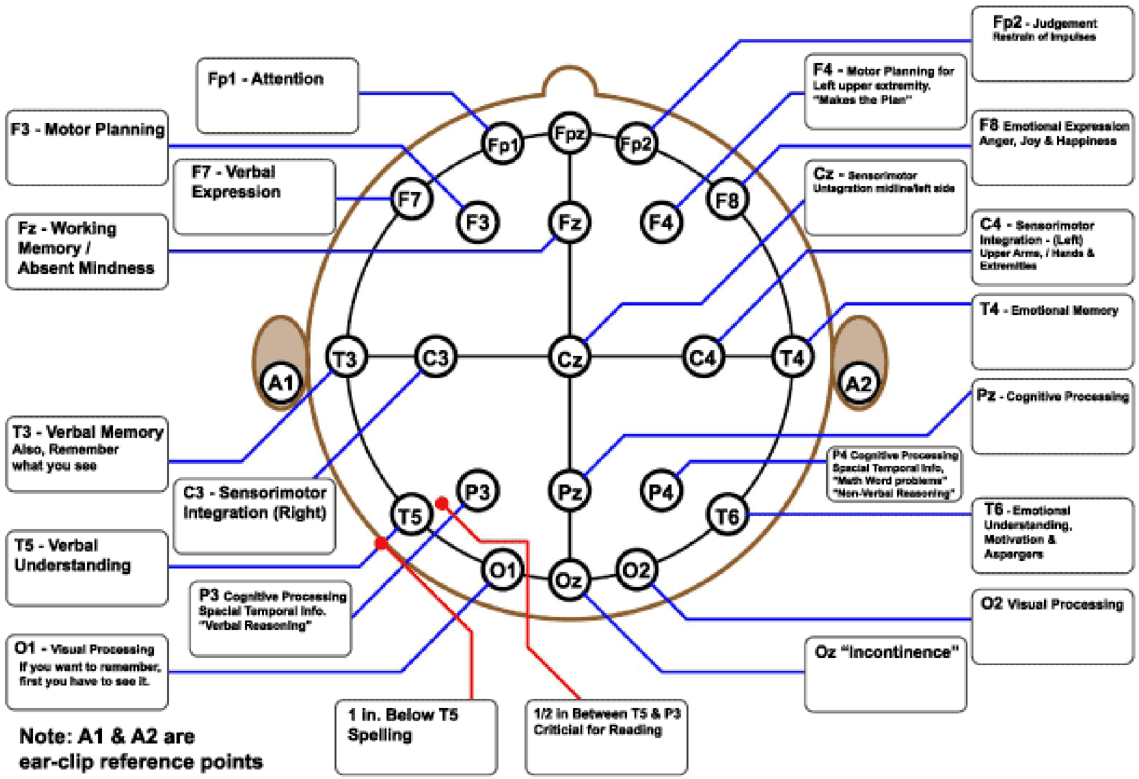

Figure 8: Brain function mapping system 10-20
(source: http://www.diytdcs.com/tag/10-20-positioning/;
http://www.edmontonneurotherapy.com/)

Important aspects concerning the functions of the two brain hemispheres are provided by authors such as Betty Edwards[1] or, more recently, J. F. Lavach[2]. Also, a significant contribution to clarifying the matters of cerebral dominance is made by Ned Herrmann[3] who proposes the pattern of the two quadrants and a questionnaire named Herrmann Brain Dominance Instrument (HBDI). With his model, Ned Hermann makes the synthesis of the horizontal and vertical specialization of the brain hemispheres and of the limbic system, providing the possibility for an explanation on account of the diversity of human behaviours, which could be described in the combinations of the four quadrants.

Table 1 shows a synthesis of the results concerning the mind processes proposed by the quoted authors, matters that were considered in making the fractal model of analysis of the brain functions.

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[1] Edwards, B., The New Drawing on The Right Side of the Brain. Penguin Putnam. 1999

[2] Lavach, J. F., Self-maintenance therapy in Alzheimer's disease, Oxford Journals, Archive of Clinical Neuropsychology (1999)

[3] Herrmann, N., The Creative Brain, Brain Books, Lake Lure, North Carolina, 1990.

Table 1: Brain model - mind processes

Front left	**Brain module** **Mind processes**		**Front right**
COGNITIVE **-** **ANALYTICAL**	Logic Analytic Vertical Rational Convergent Verbal Technical Quantitative Factual Critical Structured Orderly Mathematical	Perceptive Synthetic Lateral Intuitive Divergent Visual - Holistic Artistic Global Conceptual Contemplative Symbolic Integrative Philosophic	**INTEGRATIVE** **-** **EXPERIMENTAL**
OBJECTIVE **-** **SYSTEMATIC**	Tempverbal Cursive-Sequential Realistic Explicit Ad-literam Offensive Planned Detailing Repetition Time management Control, Self-control	Timeless Spontaneous-Random Imaginary, oneiric Implicit Metaphoric Defensive Unpredictable Inter-personality Kinesthetic Emotions Sensations (Music, Images)	**EMOTIONAL** **-** **RELATIONAL**
Rear left	**Limbic module** **Mind processes**		**Rear right**

b. The psychological functions associated to cortical modules

The correlation analysis used in the method of assigning and calibrating the psychological indicators uses the sets of functions presented in Table 2:

Table 2: The associated psychological functions

Module **COGNITIVE - ANALYTIC**	**Module** **EXPERIMENTAL - INTEGRATIVE**
- Cognitive-analytic functions	- Experimental-creative functions - Offensive-exploratory functions
Module **OBJECTIVE - SYSTEMATIC**	**Module** **EMOTIONAL - RELATIONAL**
- The functions of mind quality - The expectative-defensive functions	- The functions of emotional expression - The relational-passive functions - The relational-active functions - The relational-qualitative functions

In the following, the psychological functions associated with the brain modules are listed. Autonomous functions are those functions of which presence may be directly identified at scalp level, while derived functions are established through the sorting method according to the used fractal model.

A. Cognitive-analytic functions

- *Autonomous functions:* Attention (Fp1); Verbal expression (F7); Working memory (Fz);
- *Derived functions:* Linguistic ability; Mathematical ability; Decision-making;

B. Objective-systematic functions

- *Autonomous functions:* Verbal memory (T3); Verbal understanding (T5); Verbal reasoning (P3); Visual processing (O1);
- *The functions of mind quality* (derived): Lucidity; Clarity of mind; Mental agility; Mind flexibility; Mental calm; Focus capacity;
- *Expectative-defensive functions* (derived): Realism; Awareness; Self-preservation; Ego index; Prudence; Patience; Objectivity;

C. Emotional-relational functions

- *Autonomous functions:* Emotional memory (T4); Emotional understanding (T6); Non-verbal reasoning (P4); Visual processing (O2);
- *The functions of emotional expression* (derived): Emotionalism; Emotional stability; Emotional comfort; Relaxation; Adaptation to stress;
- *Relational-passive functions* (derived): Sociability; Membership spirit; Conformism;
- *Relational-active functions* (derived): Leadership; Affirmation; Authority; Judicial attitude; Assertiveness; Empathy; Oratory ability;

- *Relational-qualitative functions* (derived): Mutual trust; Respect for others; Tolerance to opposing opinions; Altruism; Strength of character; Responsibility; Generosity; Probity; Temperance; Sincerity;

D. *The experimental-integrative functions*

- *Autonomous functions:* Determination, Withholding impulses (Fp2); Emotional expression (F8);
- *Experimental-creative functions* (derived): Intuition; Creativity; Inventiveness; Visual ability;
- *Offensive-exploratory functions* (derived): Curiosity; Courage; Self-trust; Optimism; Adaptability; Perseverance; Dynamism; Ambition; Autonomy; Vitality; Diligence; Impulsivity; Impulse control; Self-control;

c. EEG fractal inferential model

The mathematical general form of the inferential [4]function, which is behind the psychological function, is deducted from the specific EEG paces recorded at an individual's scalp level. This assumes setting out a correspondence between *the spectral power density on* every band and the categories of psychological indicators, which are considered inferential channels. To this respect, on every channel *i,* a specific inference is made for a band *j*. For this, it is important to know in which way does the *spectral power density* $\overline{S}_B$ from a band *j,* correspond by the inference γ_{EEG} *,* with some psychological aspects understood on a channel i of analysis. The description of this relation is as follows:

$$S_{ij} = \begin{pmatrix} \chi_{11}\overline{S_{B1}} & \chi_{12}\overline{S_{B2}} & \cdot & \cdot & \chi_{1j}\overline{S_{Bj}} \\ \chi_{21}\overline{S_{B1}} & \chi_{22}\overline{S_{B2}} & \cdot & \cdot & \chi_{2j}\overline{S_{Bj}} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \chi_{i1}\overline{S_{B1}} & \chi_{i2}\overline{S_{B2}} & \cdot & \cdot & \chi_{ij}\overline{S_{Bj}} \end{pmatrix} \tag{1}$$

for $(\forall) i = \overline{1,m}; (\forall) j = \overline{1,n}$, where χ_{ij} is a function expressing the impact of the average *spectral power density* $\overline{S}_B$ on a band j and a channel i, so the relation between $\overline{S_B}$ and γ_{EEG} will be:

$$\gamma_{EEG\,ij} = \beta \chi_{ij} \overline{S_{Bj}} \tag{2}$$

where β is a scale factor $\tau / \left| \overline{S_{Bn}} - \overline{S_{B1}} \right|$, τ is a technological constant $\overline{S_{Bn}}$ and $\overline{S_{B1}}$ are the spectral power densities on the bands n and 1.

[4] Grigore, D., "*Determinarea tipologiei de personalitate prin inferență psihofiziologică din biosemnale EEG și EDA*", chapter 2.4.2, 2017. https://www.mindmisystem.com/wordpress/wp-content/uploads/2017/05/Studiu-Experimental.pdf

Considering that the psychophysiological inference ratio assumes an inferential reproduction of the panel of psychological functions $\Psi_{EEG_{ij}}$, it is established that, starting with (2), the inferential relationship between elements will be as follows:

$$\psi_{EEG_{ij}} = \rho_{EEG_i}\gamma_{EEGij} \tag{3}$$

where ρ_{EEG_i} is the output of the EEG signal of spectral power density $\overline{S_{Bj}}$ that can produce inference on a channel *i*:

$$\rho_{EEG_i} = m\frac{\sum_{j=1}^{n}\chi_{ij}\overline{S_{Bj}}}{\sum_{i=1}^{m}\sum_{j=1}^{n}\chi_{ij}\overline{S_{Bj}}} \tag{4}$$

relation that can be used to write the final form of an *EEG inferential indicator* ψ_{ij}:

$$\psi_{EEG_{ij}} = \frac{m\tau}{\left|\overline{S_{Bn}} - \overline{S_{B1}}\right|}\frac{\chi_{ij}\overline{S_{Bj}}\cdot\sum_{j=1}^{n}\chi_{ij}\overline{S_{Bj}}}{\sum_{i=1}^{m}\sum_{j=1}^{n}\chi_{ij}\overline{S_{Bj}}} \tag{5}$$

The formulas (2) and (3) make the connection of the inferential function with the average *spectral power density* $\overline{S}_{Bij}$ measured at scalp level.

The deduction of the inferential function value (5) is resumed to establishing its form χ_{ij}, *the function that weighs the impact of the average spectral power density* $\overline{S}_B$ *from a band j to a channel i.* To identify its sizes, the fractal model from Figure 9 was used.

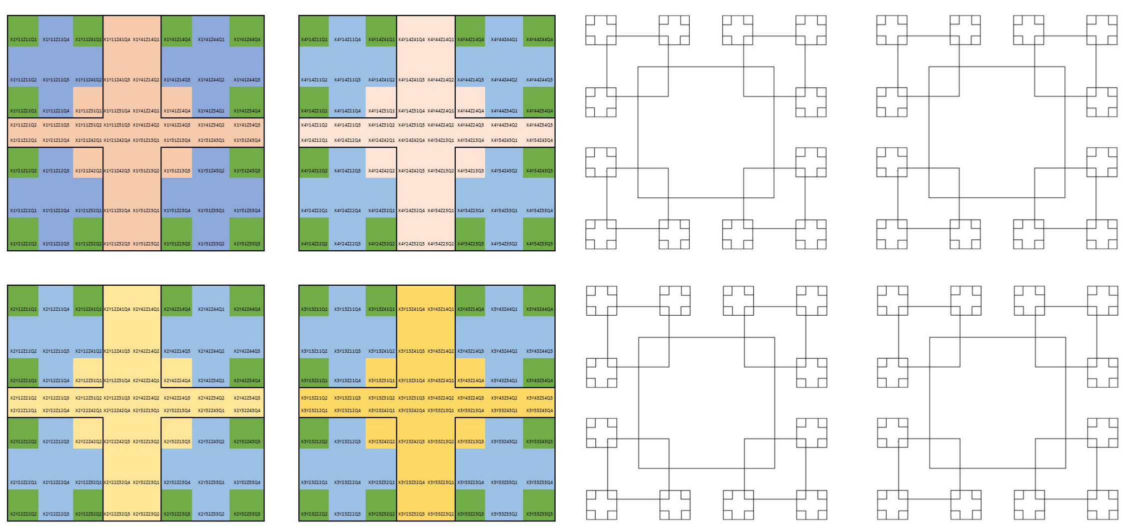

Figure 9. The fractal model for distribution of inferred psychological functions from EEG biosignals

The geometric shape from Figure 9 integrates up to level 4 one matrix of operators forming the function χ_{ij}. The fractal levels are made depending on the frequency and power of the set of biosignals located in the bands and channels of the clusters that make the cortical modules. The selection of the fractal levels is presented in figure 10 and the operator matrix structures are described in Tables 3, 4, 5 and 6.

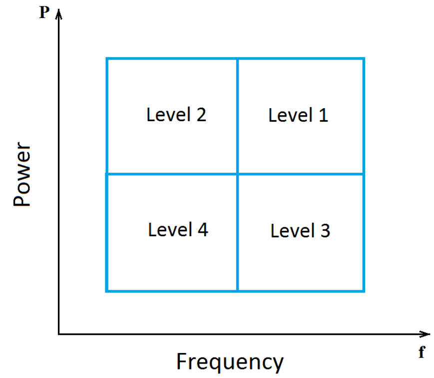

Figure 10: Fractal levels depending on frequency and power

Table 3: The components of function χ_{ij} at level 1

X_1	X_2
X_3	X_4

Table 4: The components of function χ_{ij} at level 2

Y_{11}	Y_{41}	Y_{14}	Y_{44}
Y_{21}	Y_{31}	Y_{24}	Y_{34}
Y_{12}	Y_{42}	Y_{13}	Y_{43}
Y_{22}	Y_{32}	Y_{23}	Y_{33}

Table 5: The components of function χ_{ij} at level 3

Z_{11}	Z_{41}	Z_{14}	Z_{44}
Z_{21}	Z_{31}	Z_{24}	Z_{34}
Z_{12}	Z_{42}	Z_{13}	Z_{43}
Z_{22}	Z_{32}	Z_{23}	Z_{33}

Table 6: The components of function χ_{ij} at level 4

Q_1	Q_4
Q_2	Q_3

The full form of the matrix of assignment of the operational components of the function χ_{ij} is given in Table 6. Based on these matrixes, an encoded inferential function is assigned to every psychological indicator, with the formula (5).

Table 6: Full matrix of the codes of function operators χ_{ij}

X1Y11Z11Q1	X1Y11Z11Q4	X1Y11Z41Q1	X1Y11Z41Q4	X1Y41Z14Q1	X1Y41Z14Q4	X1Y41Z44Q1	X1Y41Z44Q4	X4Y14Z11Q1	X4Y14Z11Q4	X4Y14Z41Q1	X4Y14Z41Q4	X4Y44Z14Q1	X4Y44Z14Q4	X4Y44Z44Q1	X4Y44Z44Q4
X1Y11Z11Q2	X1Y11Z11Q3	X1Y11Z41Q2	X1Y11Z41Q3	X1Y41Z14Q2	X1Y41Z14Q3	X1Y41Z44Q2	X1Y41Z44Q3	X4Y14Z11Q2	X4Y14Z11Q3	X4Y14Z41Q2	X4Y14Z41Q3	X4Y44Z14Q2	X4Y44Z14Q3	X4Y44Z44Q2	X4Y44Z44Q3
X1Y11Z21Q1	X1Y11Z21Q4	X1Y11Z31Q1	X1Y11Z31Q4	X1Y41Z24Q1	X1Y41Z24Q4	X1Y41Z34Q1	X1Y41Z34Q4	X4Y14Z21Q1	X4Y14Z21Q4	X4Y14Z31Q1	X4Y14Z31Q4	X4Y44Z24Q1	X4Y44Z24Q4	X4Y44Z34Q1	X4Y44Z34Q4
X1Y11Z21Q2	X1Y11Z21Q3	X1Y11Z31Q2	X1Y11Z31Q3	X1Y41Z24Q2	X1Y41Z24Q3	X1Y41Z34Q2	X1Y41Z34Q3	X4Y14Z21Q2	X4Y14Z21Q3	X4Y14Z31Q2	X4Y14Z31Q3	X4Y44Z24Q2	X4Y44Z24Q3	X4Y44Z34Q2	X4Y44Z34Q3
X1Y21Z12Q1	X1Y21Z12Q4	X1Y21Z42Q1	X1Y21Z42Q4	X1Y31Z13Q1	X1Y31Z13Q4	X1Y31Z43Q1	X1Y31Z43Q4	X4Y24Z12Q1	X4Y24Z12Q4	X4Y24Z42Q1	X4Y24Z42Q4	X4Y34Z13Q1	X4Y34Z13Q4	X4Y34Z43Q1	X4Y34Z43Q4
X1Y21Z12Q2	X1Y21Z12Q3	X1Y21Z42Q2	X1Y21Z42Q3	X1Y31Z13Q2	X1Y31Z13Q3	X1Y31Z43Q2	X1Y31Z43Q3	X4Y24Z12Q2	X4Y24Z12Q3	X4Y24Z42Q2	X4Y24Z42Q3	X4Y34Z13Q2	X4Y34Z13Q3	X4Y34Z43Q2	X4Y34Z43Q3
X1Y21Z22Q1	X1Y21Z22Q4	X1Y21Z32Q1	X1Y21Z32Q4	X1Y31Z23Q1	X1Y31Z23Q4	X1Y31Z33Q1	X1Y31Z33Q4	X4Y24Z22Q1	X4Y24Z22Q4	X4Y24Z32Q1	X4Y24Z32Q4	X4Y34Z23Q1	X4Y34Z23Q4	X4Y34Z33Q1	X4Y34Z33Q4
X1Y21Z22Q2	X1Y21Z22Q3	X1Y21Z32Q2	X1Y21Z32Q3	X1Y31Z23Q2	X1Y31Z23Q3	X1Y31Z33Q2	X1Y31Z33Q3	X4Y24Z22Q2	X4Y24Z22Q3	X4Y24Z32Q2	X4Y24Z32Q3	X4Y34Z23Q2	X4Y34Z23Q3	X4Y34Z33Q2	X4Y34Z33Q3
X2Y12Z11Q1	X2Y12Z11Q4	X2Y12Z41Q1	X2Y12Z41Q4	X2Y42Z14Q1	X2Y42Z14Q4	X2Y42Z44Q1	X2Y42Z44Q4	X3Y13Z11Q1	X3Y13Z11Q4	X3Y13Z41Q1	X3Y13Z41Q4	X3Y43Z14Q1	X3Y43Z14Q4	X3Y43Z44Q1	X3Y43Z44Q4
X2Y12Z11Q2	X2Y12Z11Q3	X2Y12Z41Q2	X2Y12Z41Q3	X2Y42Z14Q2	X2Y42Z14Q3	X2Y42Z44Q2	X2Y42Z44Q3	X3Y13Z11Q2	X3Y13Z11Q3	X3Y13Z41Q2	X3Y13Z41Q3	X3Y43Z14Q2	X3Y43Z14Q3	X3Y43Z44Q2	X3Y43Z44Q3
X2Y12Z21Q1	X2Y12Z21Q4	X2Y12Z31Q1	X2Y12Z31Q4	X2Y42Z24Q1	X2Y42Z24Q4	X2Y42Z34Q1	X2Y42Z34Q4	X3Y13Z21Q1	X3Y13Z21Q4	X3Y13Z31Q1	X3Y13Z31Q4	X3Y43Z24Q1	X3Y43Z24Q4	X3Y43Z34Q1	X3Y43Z34Q4
X2Y12Z21Q2	X2Y12Z21Q3	X2Y12Z31Q2	X2Y12Z31Q3	X2Y42Z24Q2	X2Y42Z24Q3	X2Y42Z34Q2	X2Y42Z34Q3	X3Y13Z21Q2	X3Y13Z21Q3	X3Y13Z31Q2	X3Y13Z31Q3	X3Y43Z24Q2	X3Y43Z24Q3	X3Y43Z34Q2	X3Y43Z34Q3
X2Y22Z12Q1	X2Y22Z12Q4	X2Y22Z42Q1	X2Y22Z42Q4	X2Y32Z13Q1	X2Y32Z13Q4	X2Y32Z43Q1	X2Y32Z43Q4	X3Y23Z12Q1	X3Y23Z12Q4	X3Y23Z42Q1	X3Y23Z42Q4	X3Y33Z13Q1	X3Y33Z13Q4	X3Y33Z43Q1	X3Y33Z43Q4
X2Y22Z12Q2	X2Y22Z12Q3	X2Y22Z42Q2	X2Y22Z42Q3	X2Y32Z13Q2	X2Y32Z13Q3	X2Y32Z43Q2	X2Y32Z43Q3	X3Y23Z12Q2	X3Y23Z12Q3	X3Y23Z42Q2	X3Y23Z42Q3	X3Y33Z13Q2	X3Y33Z13Q3	X3Y33Z43Q2	X3Y33Z43Q3

Example 1:

The inferential function of ***inventiveness***:

$$\Psi_{Inventiveness} = \frac{m\tau}{\left|\overline{S_{Bn}} - \overline{S_{B1}}\right|} \frac{\chi_{ij}\overline{S_{Bj}} \cdot \sum_{j=1}^{n} \chi_{ij}\overline{S_{Bj}}}{\sum_{i=1}^{m}\sum_{j=1}^{n} \chi_{ij}\overline{S_{Bj}}}\Bigg|_{X4Y14Z21Q1} \quad (6)$$

d. The EDA tensor inferential model

In the case of EDA biosignals, the general mathematical form of the inferential function that is behind the psychological function is deducted from the SPL and SPR potential measured on the palms of a subject. In this case, it was considered that every source of neurostimulation, related to a *ch*annel i, makes a specific inferen[5]ce for a band *j*, $(\forall) j = \overline{1,n}$.

The final form of an *electrodermal inferential indicator* $\psi_{EDA_{ij}}$ is given by the formula>

$$\psi_{EDA_{ij}} = \frac{u_{1i}\tau i}{u_{max} - u_0} \frac{u_{1j} - u_0}{u_{1i} - u_{2i}} \frac{\int_{t_1}^{t_2} u_i(t)dt}{\int_{t_1}^{t_2} \left(u_1(t) + u_2(t) + \cdots + u_i(t)\right)dt} \quad (7)$$

where $\tau/(u_{max}$-$u_0)$ is a scale factor, u_{max} is the maximum potential on the scale, u_0 is the minimum value of the response potential, up to which a psychophysiological inference can be intercepted, and u_{1i}; u_{1j} and u_{2i} are potentials related to the stimulation channel and to the inference band gradient and u_i is the response potential measured on channel i. [Grigore, 2016].

For the classification of the EDA inferential functions, two criteria have been considered:

1. *The electrodermal response factor* ζ defined as the ratio obtained from mediated values: u_{SPR}/u_{SPL}; $0 <= \zeta < 1$
2. *The electrodermal lability* λ, defined as a number of responses on acquisition session; $0 < \lambda <= 10$;

As with establishing the fractal levels of the EEG inferential functions, the criteria ζ and λ establish four levels of classification of the EDA inferential functions as in Figure 11.

[5] Grigore, D., "*Determinarea tipologiei de personalitate prin inferență psihofiziologică din biosemnale EEG și EDA*", chapter 4.2.2, 2017. https://www.mindmisystem.com/wordpress/wp-content/uploads/2017/05/Studiu-Experimental.pdf

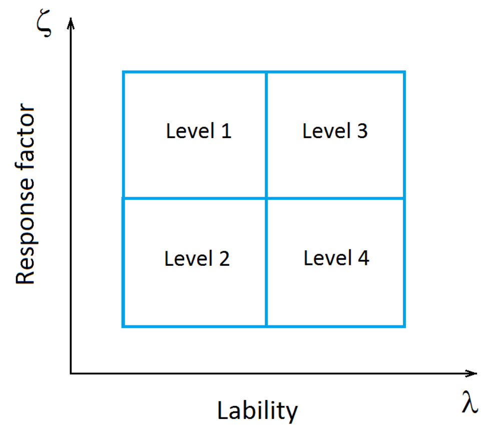

Figure 11. The classification levels of the EDA inferential functions

The pursued method leads to establishing an inferential tensor of which coordinates are presented in Table 7.

Table 7: The contents of the EDA inferential tensor

Measurement areas		Inferential functions associated to the left cortex				Inferential functions associated to the right cortex			
		Level N_1	Level N_2	Level N_3	Level N_4	Level N_1	Level N_2	Level N_3	Level N_4
RIGHT	1	Ψ_{11}	Ψ_{12}	Ψ_{13}	Ψ_{14}				
	2	Ψ_{21}	Ψ_{22}	Ψ_{23}	Ψ_{24}				
	3	Ψ_{31}	Ψ_{32}	Ψ_{33}	Ψ_{34}				
	.	.	.	.	.				
	.	.	.	.	.				
	.	.	.	.	.				
	n	Ψ_{n1}	Ψ_{n2}	Ψ_{n3}	Ψ_{n4}				
LEFT	1					Ψ'_{11}	Ψ'_{12}	Ψ'_{13}	Ψ'_{14}
	2					Ψ'_{21}	Ψ'_{22}	Ψ'_{23}	Ψ'_{24}
	3					Ψ'_{31}	Ψ'_{32}	Ψ'_{33}	Ψ'_{34}
	.					.	.	.	.
	.					.	.	.	.
	.					.	.	.	.
	n					Ψ'_{n1}	Ψ'_{n2}	Ψ'_{n3}	Ψ'_{n4}

4. Sorting sub-routine

After establishing the two categories of inferential functions, a sorting sub-routine was used, of which algorithm is presented in Figure 13.

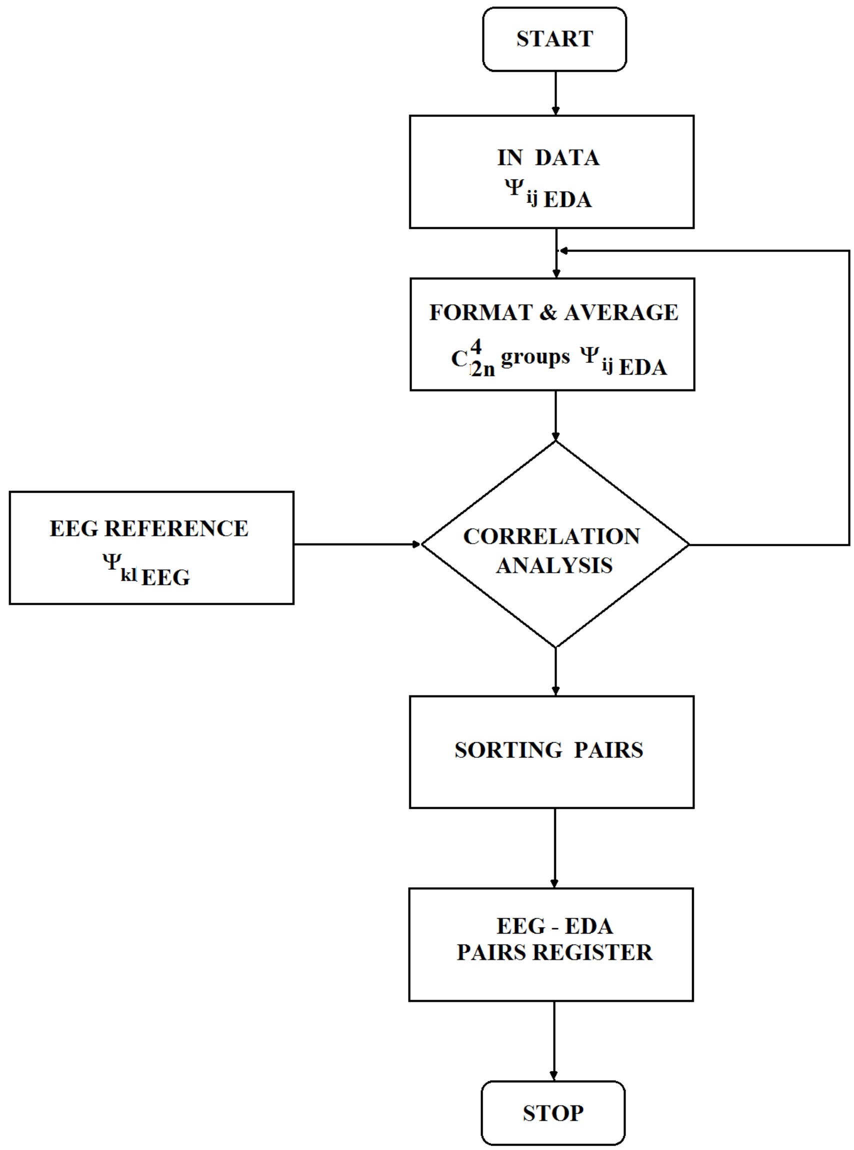

Figure 13: The sorting sub-routine of the EEG-EDA inferential functions

In the sorting sub-routine, an EEG function is a reference in relation to which an EDA function is sorted. After individually reviewing every EDA function related to the EEG reference, they are subject to a grouping and progressive mediation process. The composed mediated processes o obtained are further subject to the correlation analysis. The purpose of this method is to identify the highest correlation between an EEG and an EDA function, simple or composed. The pairs that correlate after a pre-established threshold are listed, hierarchized and sorted. The sorting results found in the pairs register of EEG-EDA inferential functions constituted the psychological identity assignment base, integrated in the MindMi™ psychometric system.

Example 2:

The pair function of ***inventiveness***: $\Psi_{inventiveness\ EEG} \sim \Psi'_{EDA23}$

5. **Calibration**

- Electrodermal response potentials: linear range 0 – 5000 [mV];
- Inferential functions, for both categories of biosignals: linear range 0 – 100 [u.inf.] inferential conventional units;
- Brain frequencies: linear range 0.5 – 30 [Hz]
- Spectral power densities: scale (0-12) accuracy units [aq.u.PSD], specific to the measurement instrument;
- Electrodermal response factor: linear range 0 – 1;
- Electrodermal lability: linear range 0 – 10;

6. **Final specifications**

For high resolution, as also for a wider age category, a sample of 400 individuals aged between 18 and 65 years was used in the assignment-calibration procedure.

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