Vibraimage statistical analysis software

Manual

Version: **VibraStatAdvanced**

ELSYS Corp.

WWW.PSYMAKER.COM

Saint-Petersburg

2018 г.

ОГЛАВЛЕНИЕ

1 Basic applications 3

2 System requirement for computer 3

3 VibraStatAdv installation 3

4 Operating procedure 3

5 Program results 5

5.1 T1 – T10 parameters 5

5.2 File stat2_s.xlsm 9

6 Analysis results 19

7 License 21

1 Basic applications

The VibraStatAdv software is created for statistical processing of VibraImage program results in the mode Micro or VibraMed results. VibraStatAdv works with files describing the psychophysiological state of a person (*****_measurement.xml** и *****_M.xml**).

More detail information there is in the manual "Behavior Detection System VibraImage 10 PRO" http://psymaker.com/downloads/VI10_ManualEng.pdf in the paragraph "MICRO mode".

Program application goal is finding of statistically proved differences in vibraimage parameters between two groups of measurements and visualization of research results. Statistical significant difference presence in vibraimage parameters means biological, psychological or physiological changes, taken place for corresponding groups. The program applies in medicine, psychology, psychophysiology, biology, sociology, sports, and various scientific researches where necessary to reliable defining psychophysiological status of the person.

VibraStatAdv, in contrast to the previous version VibraStat, has more graphs showing comparisons of various statistical parameters.

2 System requirement for computer

To correct work of the program, the user must have the hardware with the following parameters:

Microsoft Office Excel 2010 or later.

3 VibraStatAdv installation

It is necessary to execute the following actions for installation of VibraStatAdv program on your computer:

1. Go to Web page http://www.psymaker.com/support/downloads/
2. Load file VibraStatAdvanced http://psymaker.com/downloads/VibraStat2.zip
3. Extract file stat2_s.xlsm to directory where this default file will be stored as reserved copy.
4. You don't need to reboot computer.

4 Operating procedure

1. Copy stat2_s.xlsm on the hard disk where you will do processing of results. For example, named this directory TEST. This file is basic for outputting the results of processing statistical comparison data for two groups.

The file stat.xlsm will change after processing.

2. On the said directory (TEST) computer create 2 catalogues. Catalogues are sorted and numbered on a disk by alphabetically. The first catalogue is intended for initial measurements of patients (group 1), the second - for the next measurements of parameters (group 2). As a result of program work the comparison of parameters of « groups 1 » and « groups 2 » patients will be made. The user can choose the name of catalogues any way, for example, the first catalogue it is possible to name Norma, the second - Pathology or, for example, Pleasure and Stress, depending on experiments (fig.1).

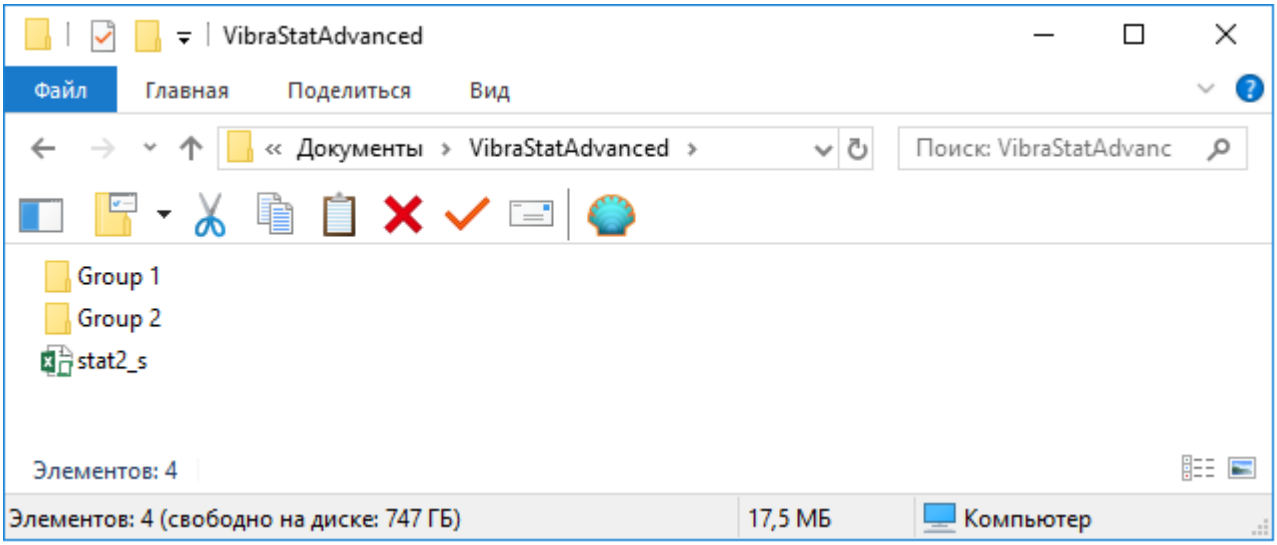


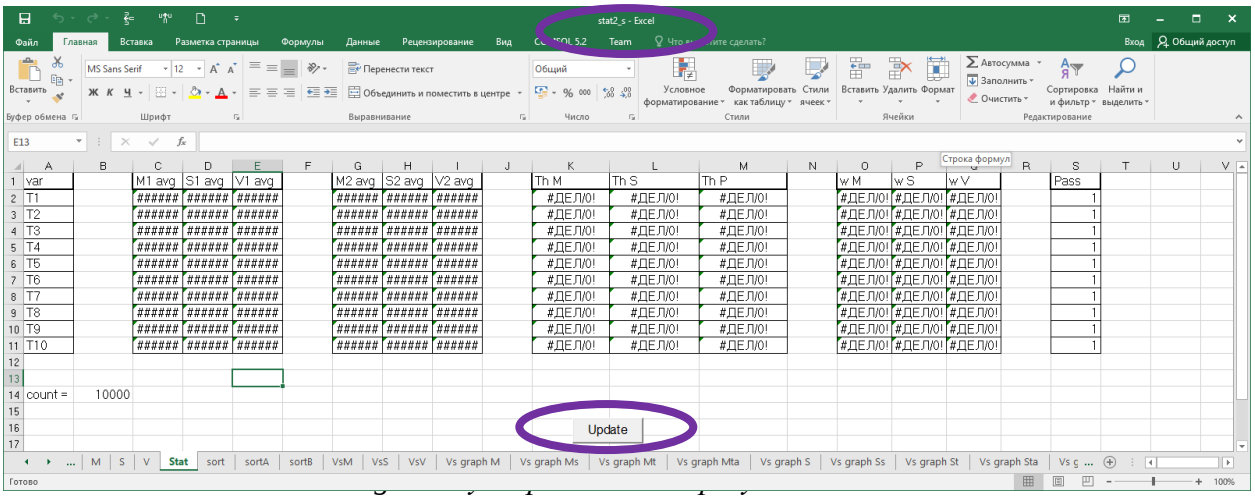
Fig. 1 Creating new work catalogue.

3. Copy subcatalogues with results of individual measurements *****_measurement.xml** and *****_M.xml** and divide them on corresponding groups.

4. Run **stat2_s.xlsm** file.

Note, for correct operating of Stat2_s.xlsm file you need to enable macros in Microsoft Office Excel.

5. Press on the button «Update» (fig. 2).



6. Program generates graphs with statistical operating results.

5 Program results

The initial data for the VibraStatAdv are values of the parameters T1 - T10 from ***** _ measurement.xml** and ***** _ M.xml** files obtained in the VibraImagePRO or VibraMed programs. The VibraStatAdv analyzes changes in parameters between two comparison groups.

The analysis uses the mathematical expectation **M**, the standard deviation **S** and variability **V**.

5.1 T1 – T10 parameters

T1 – Aggression (P7)

The parameter determines by the frequency histogram and represents the maximum allocation of the frequency and SD vibration frequency of the human face. The higher value of the maximum distribution and higher SD value gives the greater value of the parameter T1.

Aggressive state is not every time coordinates with tension, and tension state is not always coordinates with aggression. However, often these two emotions accompany each other. Aggressive state obligatory characterized by high frequency vibrations and red colors in aura. Aura size is more than normal and gaps could absent, but color and form non uniformity must present (fig 4.1b). Stress level could be low, less than 0,3. Anger level more than 0,7 and tension level more than 0,4.

Frequency histogram distribution has maximum in right part of the range and distribution has amount dispersion. High speed signals spectrum envelope looks like uniform distribution.

$$T1=\frac{F_m+4*\sqrt{\frac{1}{n}\sum_{1}^{n}\left(F_i-\overline{F}\right)^2}}{2Fin},$$

where

F_m – frequency of the maximum in the density histogram of frequency distribution;

F_i – counting number with i -th frequency in the histogram of the density of frequency distribution, obtained during N frames;

Fin – input processing vibraimage frequency;

n – counting number with inter-frame difference above threshold in N frames.

T2 – Stress (P6)

Parameter determines by degree of the external vibraimage (vibra-aura) asymmetry, means asymmetry of micromovements from the left and right parts of the person's head. The great difference in amplitude and frequency movements for the left and right parts of the face (head) characterizes the increased T2 parameter level.

Stress state characterized by amount gaps in aura form and greatly aura colors non uniformity. Aura includes every scale colors and sharp color transfer, like red color could transfer to blue (fig 4.2b). Stress level more than 0,7. Aggression or activity level is low, not more than 0,5 and tension level is high and usually more than 0,4.

Frequency distribution histogram has several modes and high speed vibraimage signals spectrum presents superposition of exponential and uniform distributions.

$$T2=\frac{\sum_{1}^{n}\left(\frac{|A_L^i-A_R^i|}{A_{\max}^i}+\frac{|F_L^i-F_R^i|}{F_{\max}^i}\right)}{2n},$$

where

A_L^i – total amplitude of vibraimage of the i-th line of the object left part;

A_R^i – total amplitude of vibraimage of the i-th line of the object right part;

$A_{\max}^i$ – maximum value between A_L^i and A_R^i;

F_L^i – maximum frequency of vibraimage of the i-th line of the object left part;

F_R^i – maximum frequency of vibraimage of the i-th line of the object right part;

$F_{\max}^i$ – maximum value between F_L^i and F_R^i;

n – the number of lines occupied by the object.

T3 – Tension/Anxiety (F5X)

Parameter is determined by the relation of high-frequency part of a range of vibrations to the general power in a range of micromovements frequency for human head. High value of high-frequency vibrations density characterizes high value of the T3 parameter.

$$T3=\frac{\sum_{\frac{f_{max}}{2}}^{f_{max}} P_i(f)}{\sum_{0,1}^{f_{max}} P_i(f)},$$

where

P_i (f) – spectral power of distribution of vibraimage frequency;

f_{max} – maximum frequency in the spectrum of distribution of vibraimage frequency.

T4 – Suspect (P19)

The parameter is determined as the sum average of the first three conditionally negative emotions (T1, T2, T3) and characterizes the general level of conditionally negative emotions in a person status.

T4=(T1+T2+T3)/3.

T5 – Balance (P16)

The parameter determines by the frequency histogram and characterizes the level of similarity of the current frequency histogram to the Gaussian distribution law. The high level of frequency histogram similarity to the normal law characterized by a high level of balance, and significant deviation from the Gaussian distribution characterized by a low level of the parameter T5.

$$T5=\frac{\sum\left[y(x)*K-y'(x)\right]^2}{\sum\left[y'(x)\right]^2},$$

where K- normalization coefficient obtained frequency histogram:

$$K=\frac{\sum y'(x)}{\sum y(x)},$$

y' - normal distribution density:

$$y'=\frac{1}{\sqrt{2\pi}}e^{-\frac{(x-M)^2}{2\sigma^2}},$$

where σ – standard deviation determined from the frequency histogram.

T6 – Charm (P17)

The parameter is determined by the symmetry (left-right) of the head and face micromovements, the maximum symmetry of movements (including frequency and amplitude) represents a high level of charm T6.

$$T6 = \frac{\sum \frac{|W_{li} - W_{ri}|}{\max(W_{li}, W_{ri})} + \sum \frac{|C_{li} - C_{ri}|}{255}}{N},$$

where

$|W_{li}-W_{ri}|$ - difference between left and right side average amplitudes of the external vibraimage for each row;

$|C_{li} - C_{ri}|$ - difference between left and right side max frequencies of the external vibraimage for each row.

T7 – Energy (P8)

The parameter determines by the frequency histogram and characterizes the difference of the maximum density of the vibration frequency and vibration frequency SD for the face and human head. The higher value of the maximum density and lower SD or variation of vibration gives the higher value of energy T7.

$$T7 = \frac{M - \sigma}{Fps},$$

where

M – maximum value on frequency histogram;

σ – standard deviation determined from the frequency histogram;

Fps – maximum input processing vibraimage frequency.

T8 – Selfregulation (P18);

The parameter is determined as the sum average for conditionally positive emotions (T5, T6) and characterizes the general level of conditionally positive person emotions at the measurement time.

$$T8 = \frac{T5 + T6}{2}.$$

T9 – Inhibition (F6);

It has a real physical dimension (time in seconds) and characterizes the minimum time of the person reaction for the shown event (the stimulus). The value of the parameter T1 = 0,1 means that the reaction time is 0,1 s. The greater the reaction time corresponds to a higher level of inhibition.

T10 – Neuroticism (F9)

The parameter characterizes the SD measured value of the inhibition level (T9) at the measurement time (default 60 seconds). High level for inhibition SD of psycho-physiological state characterized by instability and indicates high level of neuroticism T10.

$$T10=10\ \sigma(T9),$$

where σ(T9) – standard deviation of T9.

Set of the T1–T10 parameters is selected so that with the maximum information content to record all micromovements of a human head. Thus, the name of each T_i parameter can characterize different psychophysiological characteristics depending on use of Vibraimage. For the characteristic of each parameter its name is primary not, it can be read the conditional, and a formula by which this parameter is determined.

Integral coefficient K, characterizing the general functional state of the person based on parameters T1 - T10 is calculated using the formula:

$$K=\sum_{1}^{10} m\left(T_i - T_n\right)$$

where K - integral indicator of the general condition (IIGC); T_i - measured value of the mathematical estimation (M, S, V) of these parameters; T_n - mathematical average value of (M, S, V) i-th parameter in the sample, and m - the normalization factor.

Thus three integrated indicators K of functional states (IIGC) were defined. The first K_M is calculated based on measured values of a mathematical expectation (M) of parameters T1 – T10, the second K_S – based on the standard deviation of parameters (S), the third K_V – based on the variability of parameters (V).

Note

1. All measured by vibraimage system psychophysiological parameters are resulted in a range of 0 – 1 (0 – 100) % with the use of experimentally picked up fixed factors specified in formulas.

2. For everyone measured psychophysiological parameter the mathematical formula is primary, and secondary the conditional name of parameter. The psychophysiological sense of each T1–T10 parameter can change depending on conditions of experiments.

3. Set of measured parameters T1–T10 defines the general psychophysiological (psychosomatically, functional) a condition of the person based on integrated coefficient K.

5.2 File stat2_s.xlsm

The results of the program are formed in the **stat2_s.xlsm** file.

The file contains the following sheets:

User	information about the processed data
M	mathematical expectation of parameters T1 – T10
S	standard deviation of parameters T1 – T10
V	variability of parameters T1-T10
Stat	summary statistics for the parameters M, S, V
Sort	sorting the variability of the parameters M, S, V without reference to dates
SortA	sorting the variability of the parameters M, S, V with references to dates and with averaging by dates inside for group 1
SortB	sorting the variability of the parameters M, S, V with references to dates and with averaging by dates inside for group 2
VsM	variability of mathematical expectation of parameters T1 – T10
VsS	variability of standard deviation of parameters T1 – T10
VsV	variability of variability of parameters T1-T10
Vs graph M*, Vs graph Ms, Vs graph Mt, Vs graph Mta	histograms of the mathematical expectation of the integral indicator K
Vs graph S*, Vs graph Ss, Vs graph St, Vs graph Sta	histograms of the standard deviation of the integral indicator K
Vs graph V*, Vs graph Vs, Vs graph Vt, Vs graph Vta	histograms of the variability of the integral indicator K
M-S	histograms M and S of parameters T1 – T10 of 2 groups
M1 – M2	histograms M of parameters T1 – T10 of 2 groups
S1 – S2	histograms S of parameters T1 – T10 of 2 groups
V1 – V2	histograms V of parameters T1 – T10 of 2 groups
* The results are sorted on the graphs: - without an index (Vs graph M) in groups separately in chronological order without reference to dates of measurements; - with the index "s" (Vs graph Ms) for both groups together in chronological order without reference to dates of measurements; - with the index "t" (Vs graph Mt) all measurements in chronological order with reference to the dates of measurements; - with the “ta” index (Vs graph Mta), the averaged measurements per day separately by groups in chronological sequence with reference to the measurement dates.	

Next, detailed contents of the sheet with the results of statistical processing of the data measurements.

Sheet User – contains the following information:

- GR - the name of two catalogues (two groups)
- User - a name of the patient
- BD - date of a birth
- SD - date of creation of a patient folder
- File - a name of a ***_measurement.xml file with results of measurements
- Path - a path to results ***_measurement.xml file

M sheet - contain calculation of M (the center of weights of frequency distribution) for all parameters T1-T10. The number of lines in the table corresponds to number of ***_measurement.xml files found in subdirectories «Groups 1» and «Groups 2». If parameter Pass=1 than the selected table line concerns to Group 1. If Pass=0 - to Group 2 (fig. 3).

gr	user	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		Pass
VibraStat	Alergy	38	33,6	37,9	36,4	75,1	70,3	21,2	73,2	13,8	22,3		1
VibraStat	Alergy	47	20,9	12,6	27,5	58,2	79,1	32,5	68,3	20,2	74,4		1
Mammae	Назарова В Г	46,7	45	36,8	42,4	71,5	28,1	19,2	49,6	13,4	14		0
Mammae	Назарова В Г	33,5	35,2	40,6	38	71,6	23,1	14,1	48,1	13,7	18,9		0
Mammae	Мессерман Е Я	52,8	27,4	34,1	37,7	66,9	82,3	18,1	74,4	13,3	12,7		0
Mammae	Мессерман Е Я	54,4	31,7	36,9	42,9	56,5	79,7	16,2	67,3	13,2	11,8		0
Mammae	Пронина В Н	43	29	27,6	33,3	73,8	72	28,1	72,5	20,1	33,6		0

Fig. 3. M sheet

S Sheet - contain calculation of σ, S (root-mean-square deviation of frequency distribution) for all parameters T1-T10. The number of lines in the table corresponds to number of ***_measurement.xml files found in subdirectories «Groups 1» and «Groups 2». If parameter Pass=1 than the selected table line concerns to Group 1. If Pass=0 - to Group 2 (fig. 4).

gr	user	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		Pass
VibraStat	Alergy	4,033	2,936	7,789	2,927	3,271	5,254	2,31	3,632	2,226	4,161		1
VibraStat	Alergy	6,539	1,874	8,971	3,807	12,16	2,73	11,269	6,991	7,441	15,717		1
Mammae	Назарова В Г	3,705	3,439	8,504	2,924	2,685	7,913	2,531	4,566	1,404	2,725		0
Mammae	Назарова В Г	10,15	5,957	7,364	4,829	4,503	21,819	3,524	10,614	1,894	3,916		0
Mammae	Мессерман Е Я	9,529	0,807	4,052	2,367	2,758	3,477	1,994	1,274	1,268	2,99		0
Mammae	Мессерман Е Я	17,267	1,464	3,453	12,207	9,042	7,428	2,094	2,47	1,179	2,335		0
Mammae	Пронина В Н	2,331	0,743	6,94	1,979	3,218	2,683	2,19	2,28	3,356	9,411		0

Fig. 4. S sheet

V Sheet - is resulted calculation of variability (V = (σ / M) or the same V=(S/M)) for all parameters T1-T10. The number of lines in the table corresponds to number of ***_measurement.xml files found in subdirectories «Groups 1» and «Groups 2». If parameter Pass=1 than the selected table line concerns to Group 1. If Pass=0 - to Group 2 (fig. 5).

gr	user	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Pass
VibraStat	Alergy	10,6	8,7	20,6	8	4,4	7,5	10,9	5	16,1	18,7	1
VibraStat	Alergy	13,9	9	71,2	13,8	20,9	3,5	34,7	10,2	36,8	21,1	1
Mammae	Назарова В Г	7,93362	7,64222	23,1087	6,89623	3,75524	28,1601	13,1823	9,20565	10,4776	19,4643	0
Mammae	Назарова В Г	30,2985	16,9233	18,1379	12,7079	6,28911	94,4545	24,9929	22,0665	13,8248	20,7196	0
Mammae	Мессерман Е Я	18,0473	2,94526	11,8827	6,27851	4,12257	4,22479	11,0166	1,71237	9,53383	23,5433	0
Mammae	Мессерман Е Я	31,7408	4,6183	9,35772	28,4545	16,0035	9,31995	12,9259	3,67013	8,93182	19,7881	0
Mammae	Пронина В Н	5,42093	2,56207	25,1449	5,94294	4,36043	3,72639	7,79359	3,14483	16,6965	28,0089	0

Fig. 5. Sheet V sheet

Stat Sheet - the generalized statistics for parameters of M, S, V is resulted. If parameter Pass=1 the given parameter Ti takes part in calculations. If parameter Pass=0 parameter Ti is excluded from calculations.

var	M1 avg	S1 avg	V1 avg	M2 avg	S2 avg	V2 avg	Th M	Th S	Th P	w M	w S	w V	Pass
T1	42,5	5,286	12,25	46,08	8,5964	18,688	44,29	6,9412	15,469115	-0,078	-0,385	-0,345	0
T2	27,25	2,405	8,85	33,66	2,482	6,9382	30,455	2,4435	7,894115	-0,19	-0,031	0,216	0
T3	25,25	8,38	45,9	35,2	6,0626	17,526	30,225	7,2213	31,713192	-0,283	0,2765	0,6182	1
T4	31,95	3,367	10,9	38,86	4,8612	12,056	35,405	4,1141	11,478008	-0,178	-0,307	-0,096	0
T5	66,65	7,7155	12,65	68,06	4,4412	6,9062	67,355	6,07835	9,778085	-0,021	0,4244	0,4541	0
T6	74,7	3,992	5,5	57,04	8,664	27,977	65,87	6,328	16,738573	0,2364	-0,539	-0,803	1
T7	26,85	6,7895	22,8	19,14	2,4666	13,982	22,995	4,62805	18,391129	0,2872	0,6367	0,3867	0
T8	70,75	5,3115	7,6	62,38	4,2408	7,9599	66,565	4,77615	7,779948	0,1183	0,2016	-0,045	0
T9	17	4,8335	26,45	14,74	1,8202	11,893	15,87	3,32685	19,171455	0,1329	0,6234	0,5504	1
T10	48,35	9,939	19,9	18,2	4,2754	22,305	33,275	7,1072	21,10242	0,6236	0,5698	-0,108	0

Fig. 6. Stat sheet

Sheets sort, sortA, sortB, VsM, VsS, VsV are service to creating various graphs of variability parameters by groups.

Sheet Vs graph M – histogram of comparison of average variability in two groups. The number of columns on histograms corresponds to number of ***_measurement.xml files on which the analysis was process. Dark blue color shows the data on «Group 1», red - on «Group 2». (fig. 7).

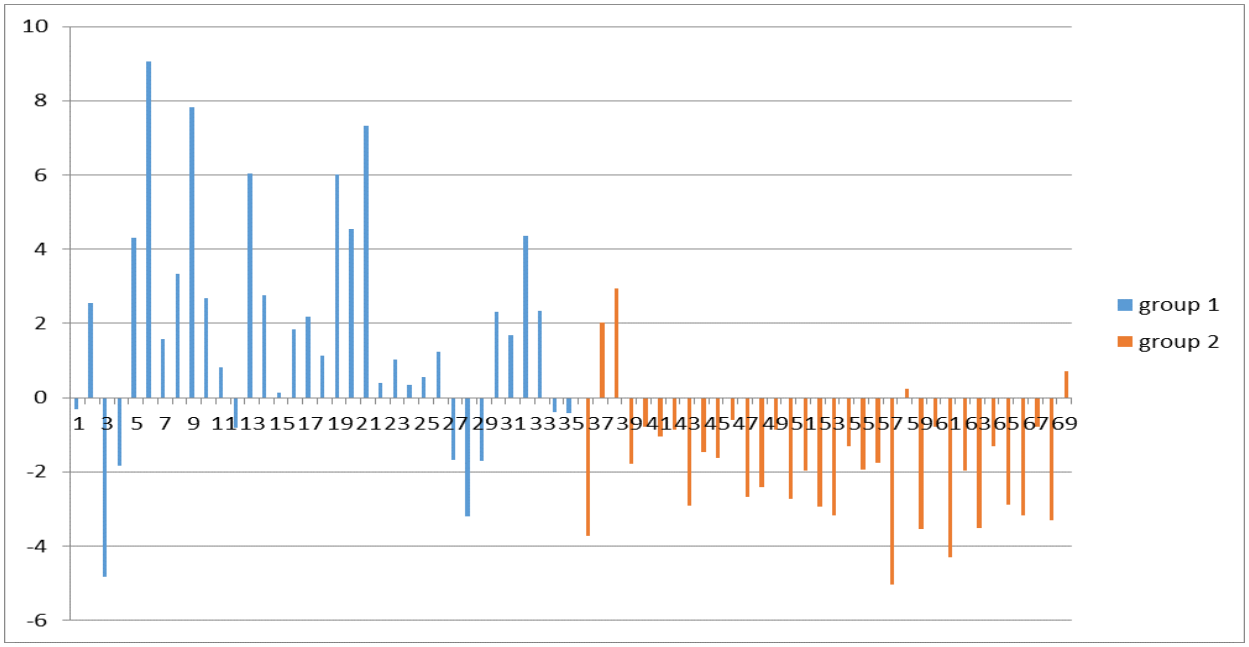


Fig. 7. Vs graph M

Sheet Vs graph Ms – histogram of comparison of average variability in two groups with sorting chronologically together across all measurements in two groups without reference to dates (fig. 8).

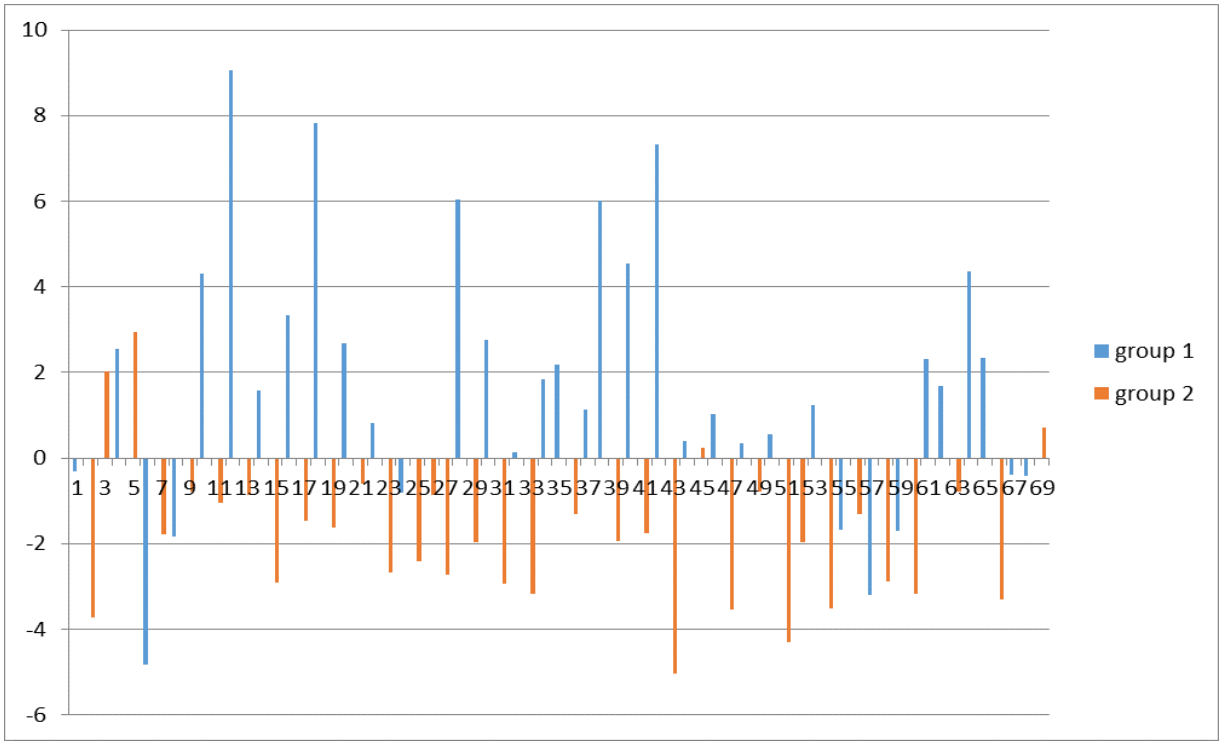


Fig. 8. Vs graph Ms

Sheet Vs graph Mt – histogram of comparison of average variability (mathematical expectation of variability) in two groups with sorting chronologically together across all measurements in two groups with references to dates (fig. 9).

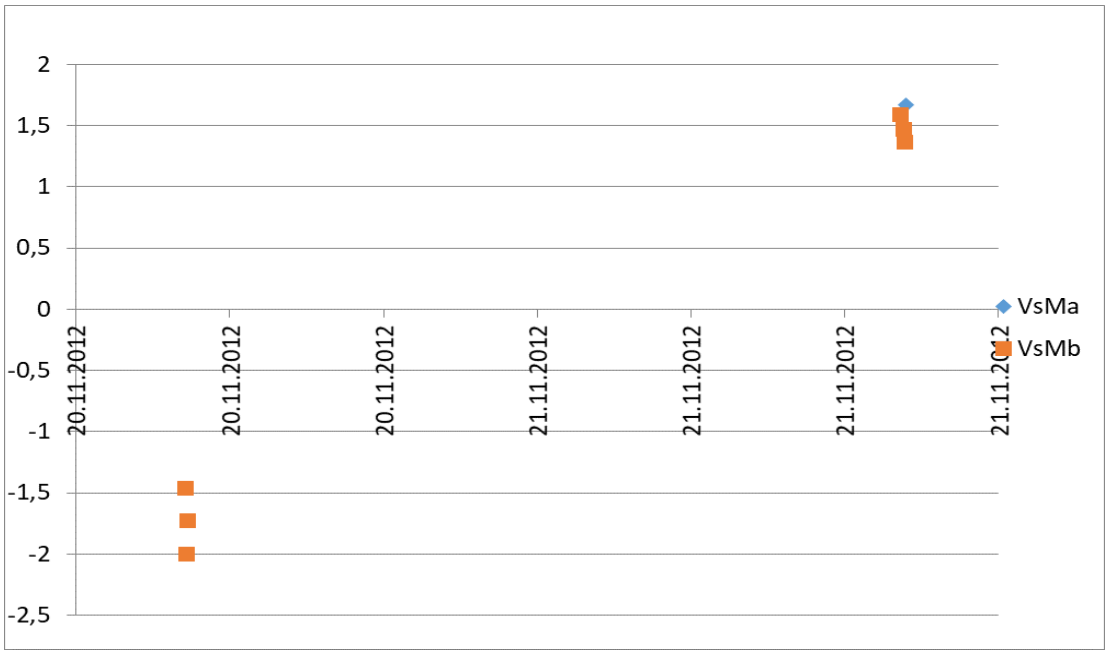


Fig. 9. Vs graph Mt

Sheet Vs graph Mta – histogram of the comparison of the average variability in two groups with sorting chronologically with reference to dates together across all measurements in two groups with averaging of values for one group at one day (fig. 10). Unlike the three dots on the Vs graph Mt graph, corresponding to the three measurements on 20/11/2012 for Group 2 (red color), on the Vs graph Mta graph, we observe 1 dot corresponding to the average of these three measurements.

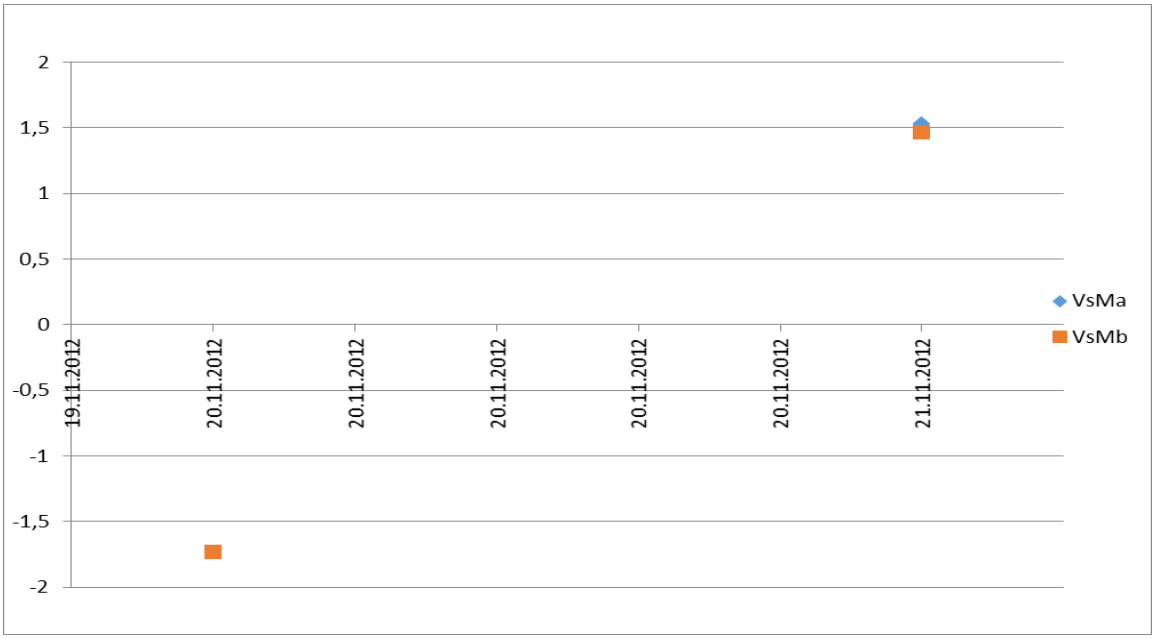


Fig. 10. Vs graph Mta

Vs graph S, Vs graph Ss, Vs graph St, Vs graph Sta – histogram of the comparison of the variability of the standard deviation in two groups with different sorting (by analogy with the graphs of the average variability). On fig. 11 shows an example of the variability of the standard deviation of the integral indicator K by groups chronologically without reference to dates.

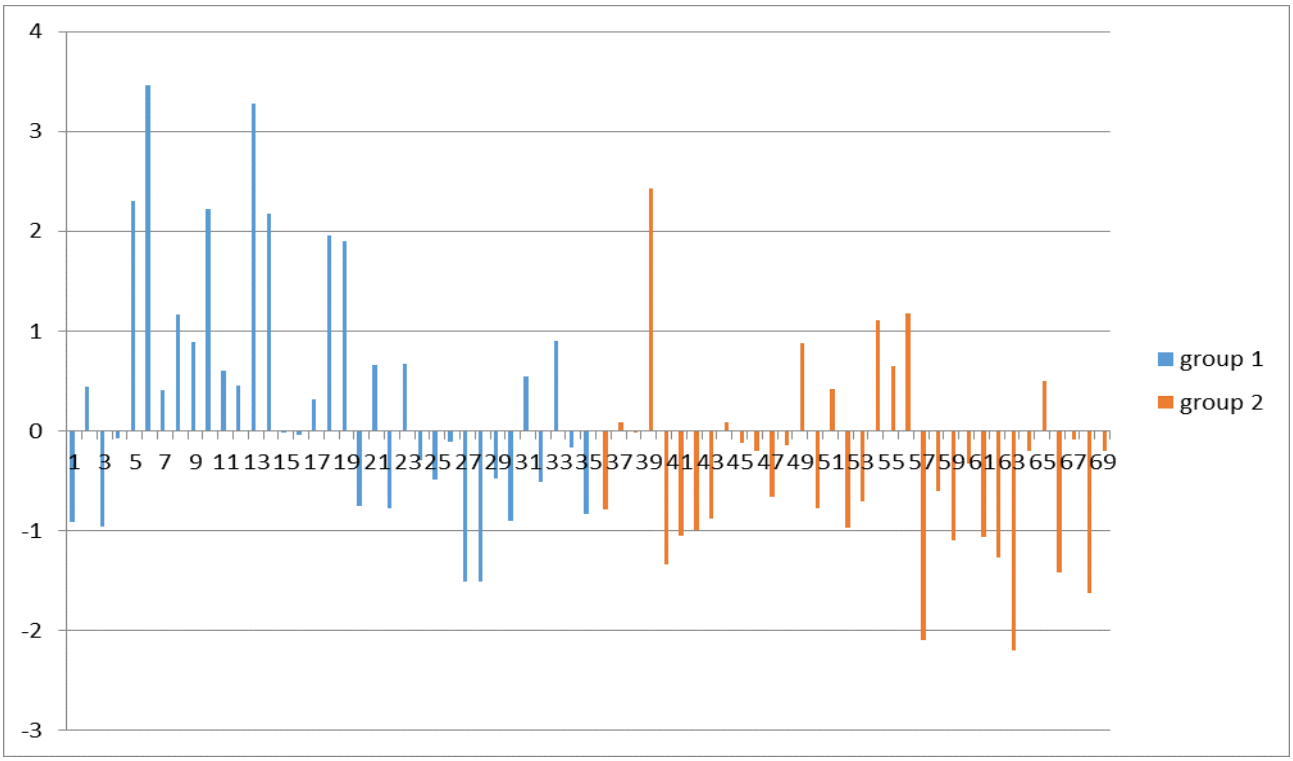


Fig. 11. Vs graph S

Vs graph V, Vs graph Vs, Vs graph Vt, Vs graph Vta – histogram of the comparison of the variability of the variability in two groups with different sorting (by analogy with the graphs of the average variability). On fig. 11 there is an example of the variability of the variability of the integral indicator K by groups chronologically without reference to dates.

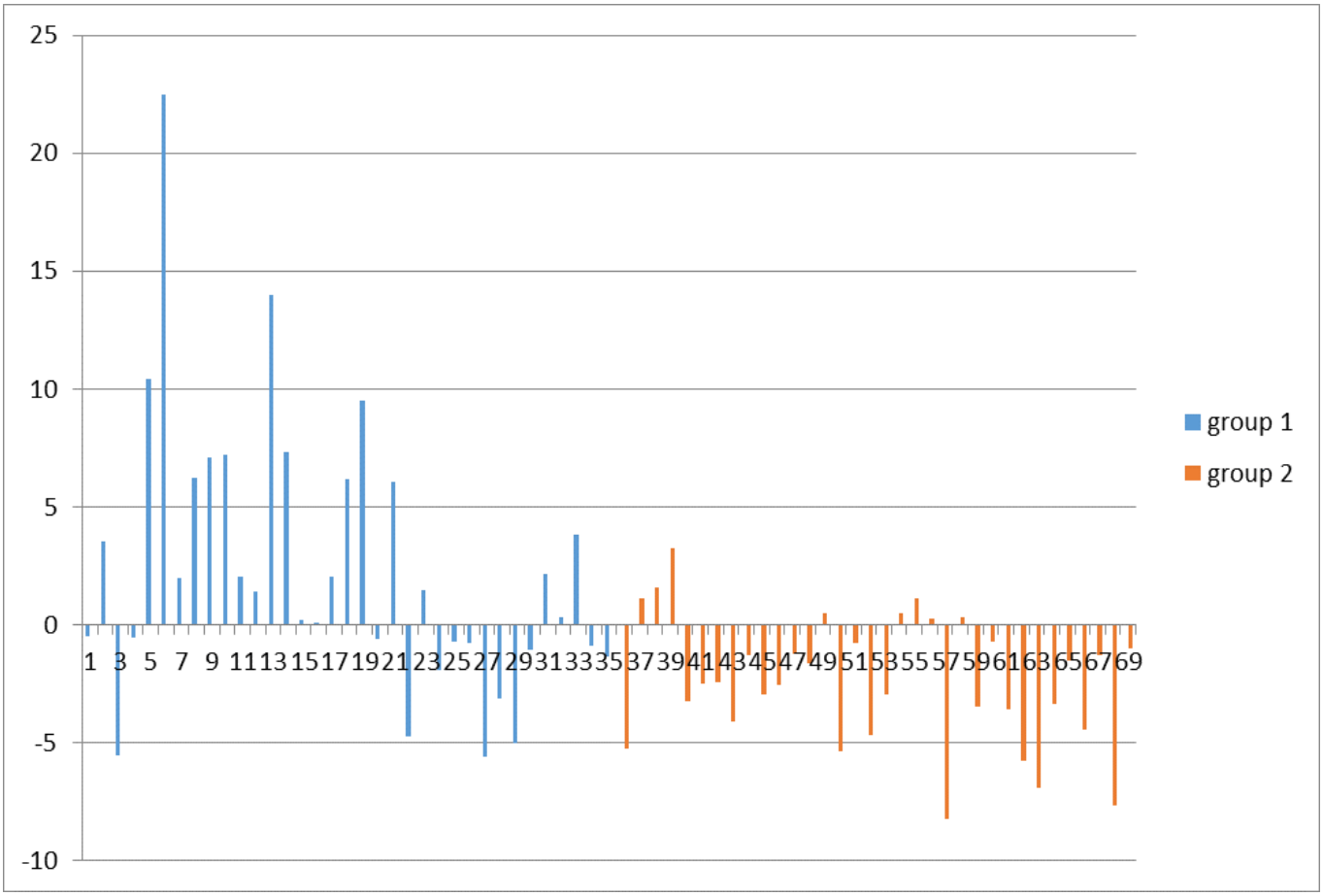


Fig. 12. Vs graph V

M-S Sheet – the histogram of comparison results of M parameters (the first pair columns) and S (the second pair columns) for all parameters T1-T10. Dark blue color shows the data on «Group 1», red - on «Group 2» (fig.13).

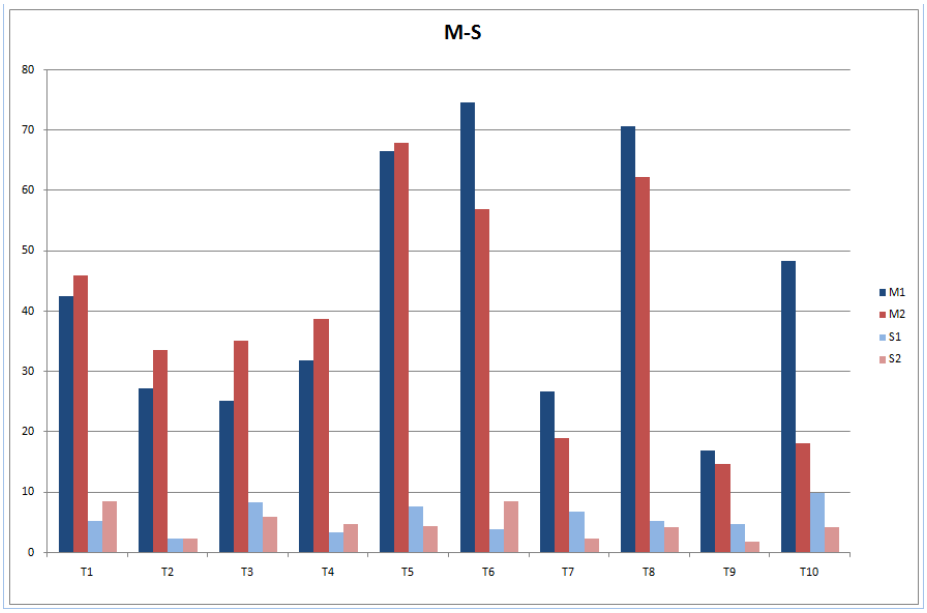


Fig. 13. M-S Sheet

M1-M2 Sheet - the histogram of results of M parameters comparison for all parameters T1-T10. Dark blue color shows the data on «Group 1», red - on «Group 2» (fig.14).

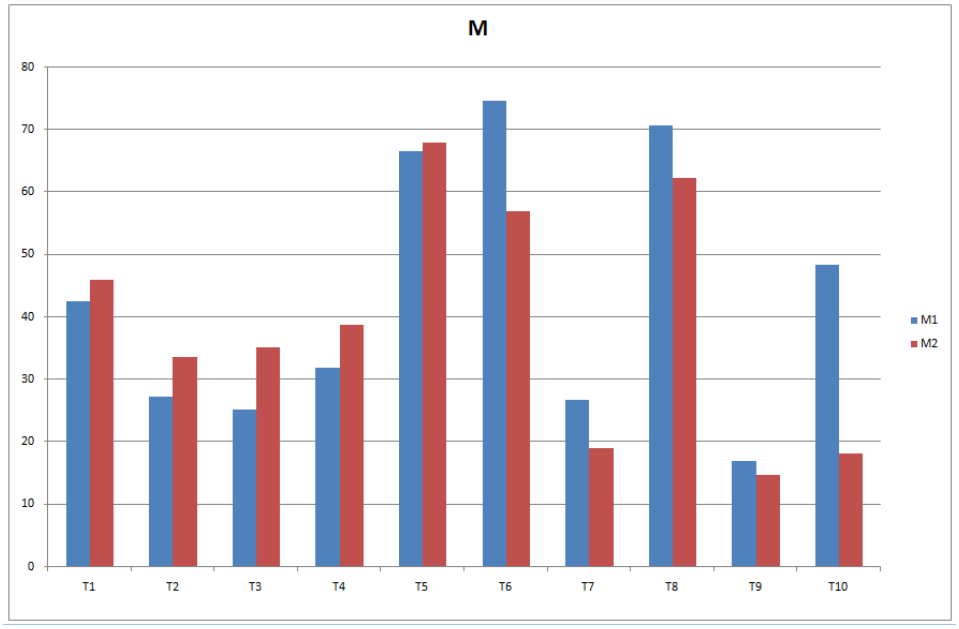


Fig. 14. M1-M2 Sheet

Sheet S1-S2 - the histogram of results of S parameters comparison for all parameters T1-T10. Dark blue color shows the data on «Group 1», red - on «Group 2». (fig.15).

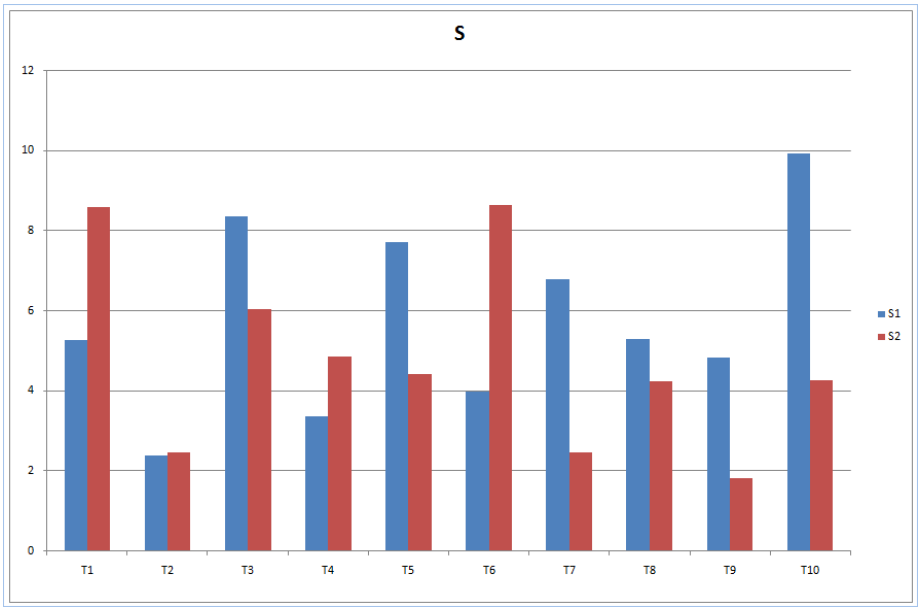


Fig. 15. S1-S2 Sheet

V1-V2 Sheet - the histogram of results of V (variability) parameters comparison for all parameters T1-T10. Dark blue color shows the data on «Group 1», red - on «Group 2». The big differences in graph for two groups testify to the occurred physical deviations between patients of groups (fig. 16).

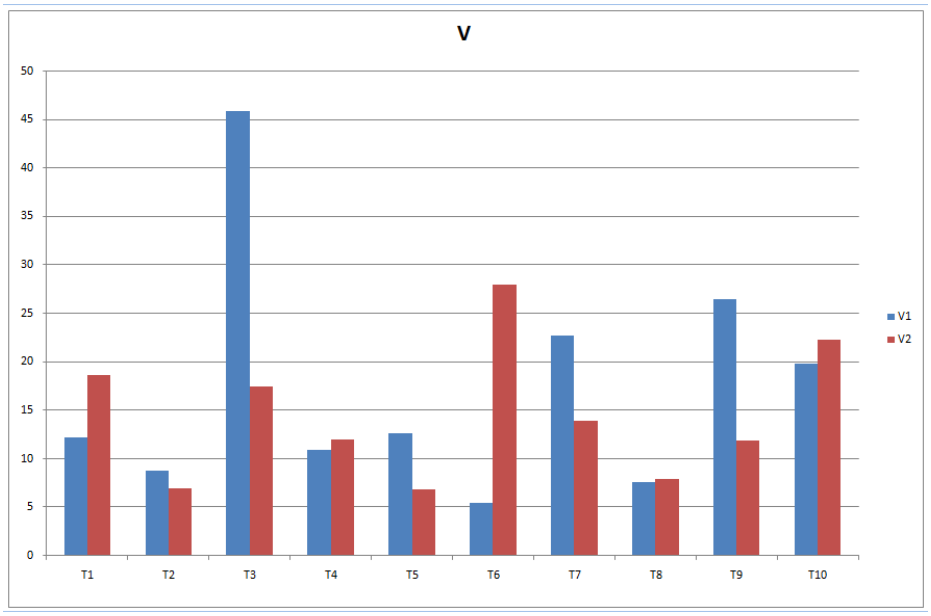


Fig. 16. V1-V2 Sheet

6 Analysis results

Provided results analysis mostly depends on the research aim. It is often necessary to define parameters - markers of status changes which are significantly differ between two groups. Listing 10 psychophysiological parameters (as emotion 10 print) characterizing various single properties of a person status and a general status of the person, too. Micromovements parameters of person are changed during a deviation of a person status from normal, that shows a deviation of the corresponding vibraimage parameters. The analysis of person reflex micromovements in the biological nature is similar, for example, to the biochemical analysis of person blood which reflects biochemical and energy exchange process in an organism. Only with the help of vibraimage technology the analysis of micromovements is carried out simply, remote, friendly and nonintrusive.

On an example (fig. 16) it is visible, that the most significant distinction is observed between parameters of variability T3, T6 and T9 which should be chosen as the basic markers of status changes for results of the experiment showed in figure. It is natural, that quantity of measurements and test specifications can have influence to the results. It is important to fulfill the main principles of Vibraimage technology in detail enough stated in the Manual Vibraimage PRO during providing source measurements.

Below (fig. 17) given sample of test for two different statuses of one person, the first group of measurements show vibraimage testing of person in active status, the second group of measurements show vibraimage testing of person in drowsiness status. Fig.17 shows a strong difference of vibraimage parameters for person in these different statuses.

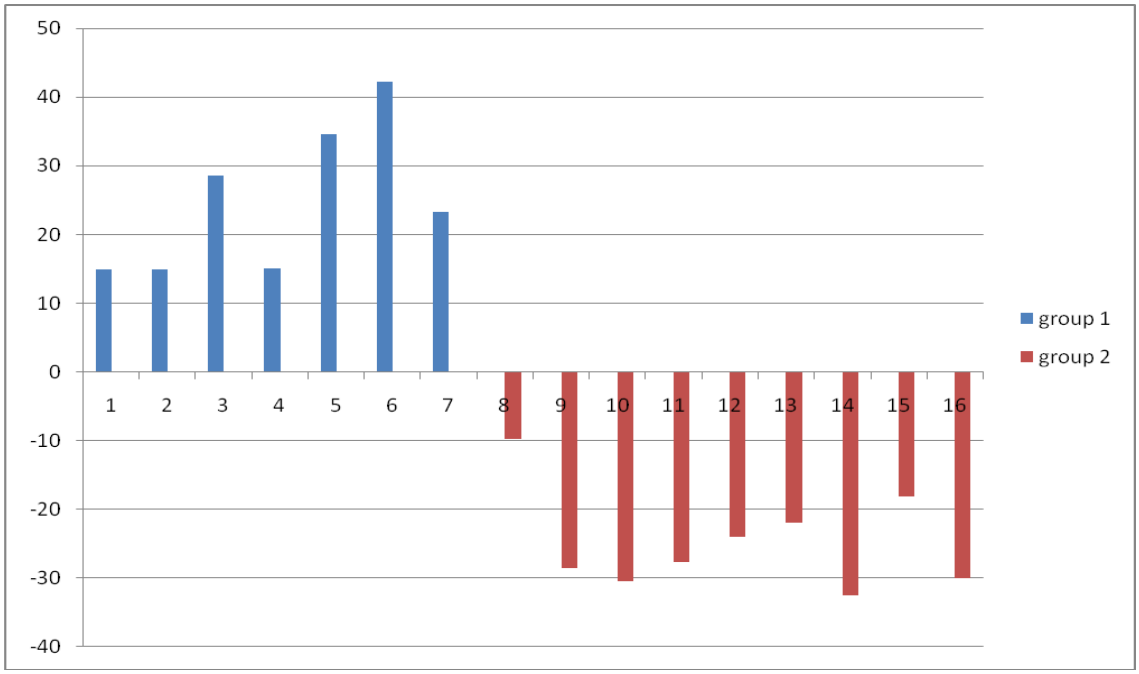


Fig. 17. List Vs graph. Compatibility results for status Active (1)- Drowsiness (2)

On the Fig 18 given V1-V2 list - results comparison histograms of variability (V) parameters for previous measurements status Active (1) - Drowsiness (2). This histogram indicates what

statistics difference of concrete vibraimage parameters divide Active status from Drowsiness status. This is significant difference in variability of T1, T4 and T7 parameters.

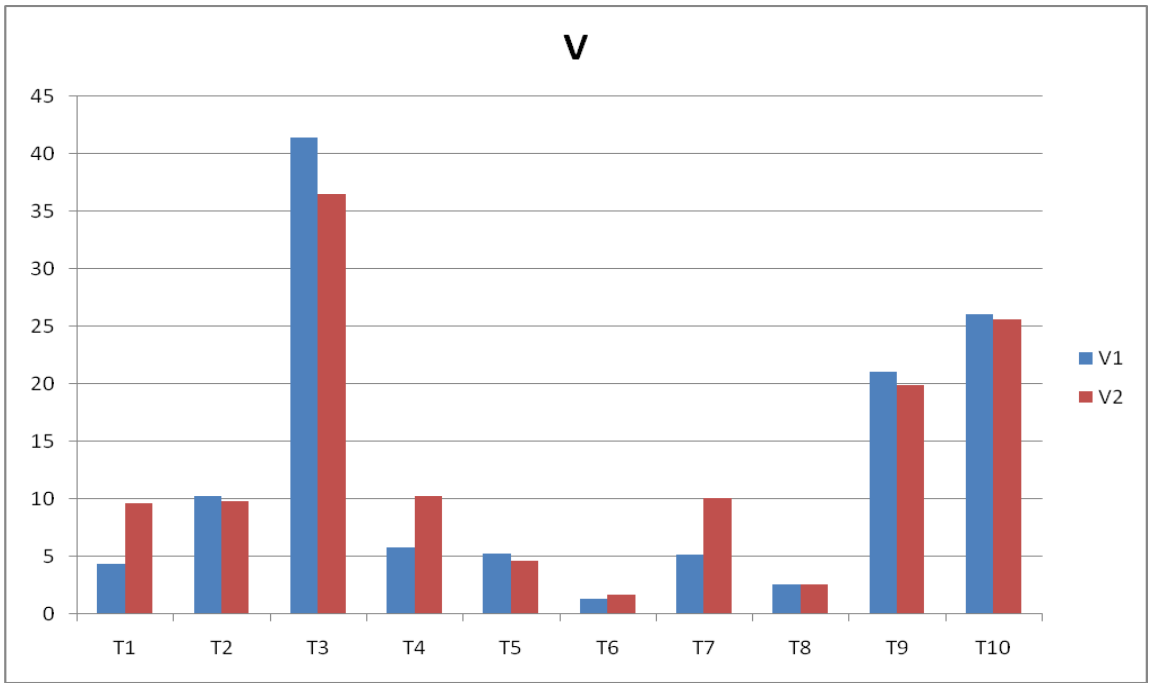


Fig. 18. List Vs graph. V1-V2 list. Results comparison histograms of variability (V) parameters for status Active (1) - Drowsiness (2)

So, VibraStatAdv obviously shows if there are significant difference between two statuses (or groups of people) like on Figs. 7, 17. Or in other way both groups results could be similar like on Fig. 18.

7 License

VibraStatAdv program presented for open access to all licensed users of program **Vibraimage PRO**.

Updates and questions on www.psymaker.com

Elsys Corp.

Russia, 194223, Saint-Petersburg, Toreza, 68

ph./fax: +7 (812) 552 67 19

e-mail: minkin@elsys.ru

www.elsys.ru

www.psymaker.com

