

# Emotion Recognition and Behavior Detection System

VibraMed (Version 10.0)

MANUAL

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# 1 Introduction

Welcome to the **VibraImage** World! Thank you for your purchase of **VibraMed** system. This Manual written to help you enjoy **vibraimaging** and open new features in well-known objects!

**VibraImage** technology measures micromovement (micro motion, vibration) of person by standard digital, web or television cameras and image processing. Human head microvibration linked with the vestibular-emotional reflex (VER) of a person and reflects emotion status and personality traits. **VibraMed** system detects human emotions by the control of three dimensional (3D) head-neck movements and fluctuations, accumulated as frame difference in several video frames.

## 1.1 Basic applications

**VibraMed** software solves the following targets:

- Psychophysiological parameters monitoring and detection;
- Emotion recognition;
- Monitoring of person physiological parameters;
- Video surveillance in real time by vibraimage and suspicious person detection;
- Psychological testing.

## 1.2 System specifications

### 1.2.1 Vibrainage system parameters

- |   |          |
|---|----------|
| • Resolution, TVL, not less                 | 400      |
| • Noise level of VibraImage, bit, less than | 0.1      |
| • Frame rate, frame/sec, not less           | 25       |
| • Frequency range, Hz, more than            | 0.1 ÷ 10 |

### 1.2.2 Digital (web) camera requirements

- |                                |                         |
|--------------------------------|-------------------------|
| • Sensor                       | CCD or CMOS             |
| • Resolution, pixel., not less | 640 x 480               |
| • USB compatible               | USB 3.0, USB 2.0, IP    |
| • Frame rate, f/s, not less    | 25                      |
| • Microphone                   | external                |
| • Exposition control           | auto and manual         |
| • Color mode                   | color and B/W switch    |
| • Flicker mode                 | Flicker 50 Hz and 60 Hz |

### 1.2.3 System requirements for local module computer

- |                      |   |
|----------------------|---|
| • Operation System   | Windows 7/8/10 or later <b>64 bit only</b>                  |
| • Processor          | Intel I3 2400 MHz or later                                  |
| • RAM                | more than 4 Gb  |
| • HDD                | more than 10 Gb free space                                  |
| • USB port           | 1 free USB ports version USB 2.0                            |
| • Installed software | Microsoft Office Excel 2010 ( <b>64 bit only</b> ) or later |
| • Video capture      | WDM-compatible video device                                 |

### 1.3 Package contents

- |                                |     |
|--------------------------------|-----|
| 1. <b>VibraMed</b> software    | - 1 |
| 2. Activation code             | - 1 |
| 3. User's manual               | - 1 |
| 4. Digital USB camera (option) | - 1 |
| 5. Microphone (option)         | - 1 |
| 6. Personal computer (option)  | - 1 |

## 2 VibraMed software installation

To install **VibraMed** please follow steps below:

1. Go to Web page [www.psymaker.com/support/downloads/](http://www.psymaker.com/support/downloads/)
2. Load file setupVibraMed10.exe [www.psymaker.com/downloads/VibraimageMed10.exe](http://www.psymaker.com/downloads/VibraimageMed10.exe)
3. Run file setupVibraMed10.exe from archive file

**Attention!**

**Please, be careful and paste code without additional gaps!**

4. Select language for installation procedure (fig. 2.1).

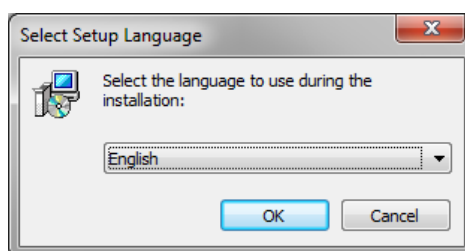


Fig. 2.1. *Choice of language installation*

1. Press button «Next» in the appeared window of the beginning installation.
2. Accept the license agreement and to press button «Next» in the appeared window.
3. In the appeared window specify a way to the catalogue where files of the program will be written down, then to press button «Next».
4. Press button «Next» in the appeared window, allows installation of software files on your computer.
5. In the appeared window select versions of the program which you want to install on the computer (fig. 2.2).

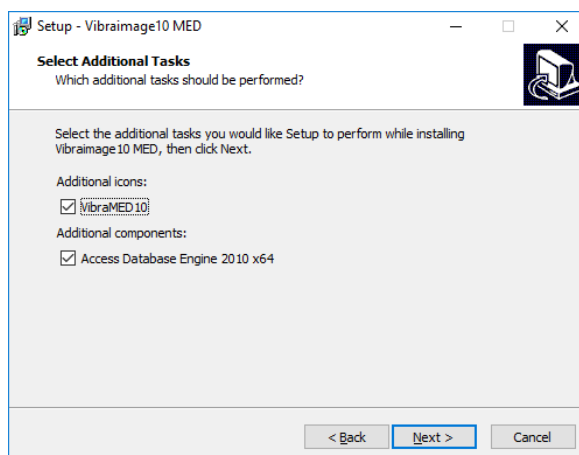


Fig. 2.2. *Choice of additional tasks during installation*

6. Press button «Install» at the start of installation.

7. If you want to have the **VibraMed** program with other programs, in the appeared window it is necessary to choose item of installation of virtual camera drivers, and press «Next».
8. Press button «Finish» at the end of installation.
9. **VibraMed** program pictogram appears after the end of installation in system menu and on desktop of your computer.
10. To reboot a computer.

## 2.1 **VibraMed** software activation

### Attention:

1. Procedure of activation is necessary only at the first start of the program.
2. Before the program activation it is necessary to buy this modification of the program in the online shop Psymaker <http://www.psymaker.com/ru/shop/>
3. Activation procedure requests access to the Internet for receiving answer code from server.
4. Activation code has the structure given in the table.

Key type	Software modification
VIXX_XXXX_MED	<b>VibraMed</b> software is intended for: <ul style="list-style-type: none"> <li>- behavior detection and psychophysiological control of person;</li> <li>- psychophysiological personal diagnostics based on corresponding statistic norms;</li> <li>- vibra-aura (external vibraimage) real time surveillance, research, analysis and interpretation</li> </ul>

### 2.1.1 Standard activation

1. To start activation it is necessary to get starts the program **VibraMed**.
2. At the first start of the program the activation window will be displayed (fig. 2.3).

Fig. 2.3. Activation window

3. In the field «**Request**» it is necessary to enter the activation code received by e-mail or specified by the seller. After input of activation code to press the button «**Get Answer code using HTTP**».

4. The activation code will be checked up through the Internet and, in case of successful end of activation procedure, the answer code will be sent (fig. 2.4).

Fig. 2.4. Successful activation

5. Press button «OK». **VibraMed** will be automatically started.

**Attention!**

**The first launch must be carried out with administrator rights!**

## 2.1.2 DEMO activation

**Note, for each modification you have a possibility of the program start in the DEMO mode only 5 times. Then the Internet code is required to be bought.**

1. To start activation it is necessary to get starts the program **VibraMed**.
2. At the first start of the program the activation window will be displayed (fig. 2.5).

Fig. 2.5. DEMO activation window

3. In the field «**Request**» it is necessary to enter uppercase letters of «**DEMO\_MED**» (fig. 2.5). After input of an demo activation code to press the button «**Get Answer code using HTTP**».
4. The activation code will be checked up through the Internet and, in case of successful end of activation procedure, the answer code will be sent and will be appeared in the field «**Answer**» (fig. 2.6).

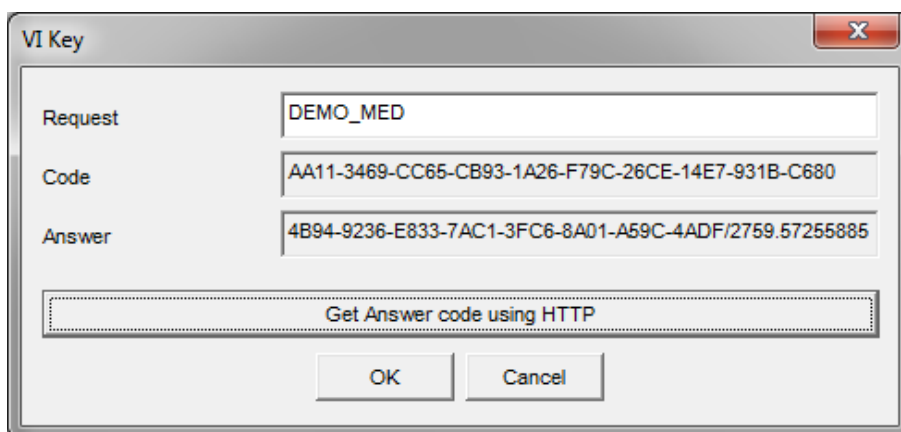


Fig. 2.6. Successful DEMO activation

5. Further items 5-8 as in case «**Standard activation**».

## 2.2 Reinstallation of **VibraMed**

**Note**, the ability to reinstall **VibraMed** software on a new computer is given to user. For this purpose, it is necessary to execute the following actions:

1. Connect computer to the Internet.
2. Start **VibraMed** program for reinstallation on a new computer.
3. In the menu «Help» choose item «**About VibraMed...**» (fig. 2.7).

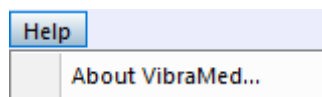


Fig. 2.7. Menu «Help»

4. In the opened window press the button «**Unregister key**» (fig. 2.8).

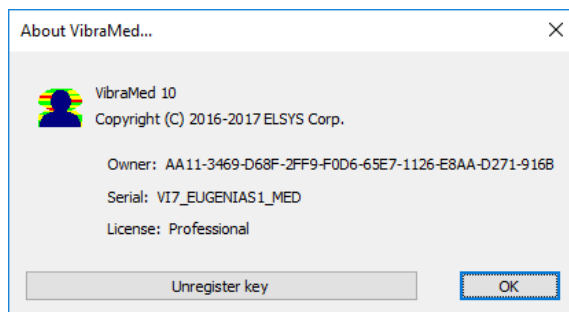


Fig. 2.8. Information about the program

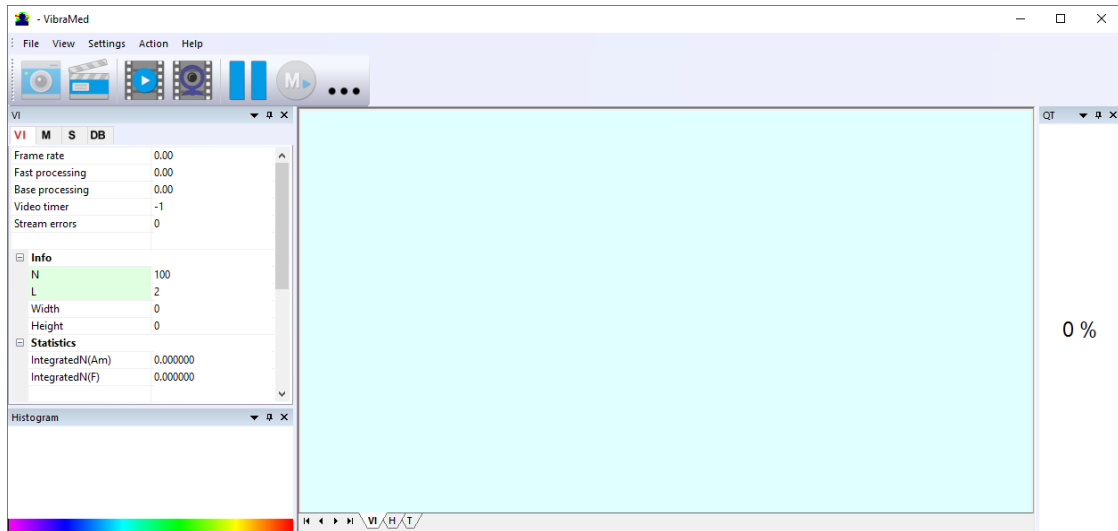
5. Close the program.
6. Connect a new computer to Internet.
7. On the new computer install the program and make registration of an «old» modification activation code through the Internet, according to recommendations of section 2.1.



- After successful program registration the given activation code will be fixed to the given computer.

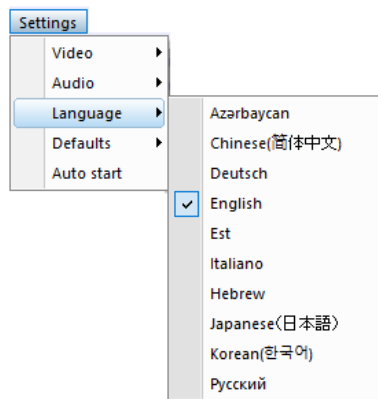
## 2.3 First start of **VibraImage** system

- After the first start of system you will see the program window shown in fig. 2.9.



*Fig. 2.9. First program start*

- In menu «**Settings**» => «**Language**» select interface language (fig. 2.10).



*Fig. 2.10. Select language*

- Once connected to the computer camera in the menu "**Settings**" => "**Video**" (fig 2.11) you need to select the camera to work (in fig 2.11 -. Microsoft Lifecam Cinema camera).

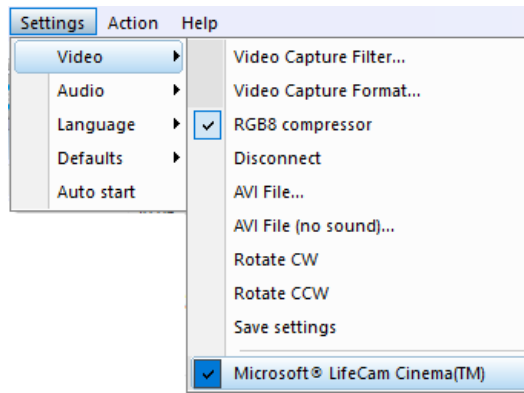


Fig. 2.11. Video camera connecting

4. After correct connecting of camera, the image appears on the screen.
5. Perform video camera settings (see. ch. 2.4).
6. Perform quality control of video image (see. ch. 2.5) and, if it is necessary, eliminate the causes of low-quality video.
7. Select the directories for recording video information and log files (see. ch. 3.4.4).
8. Get started in accordance with the program description, for example, you can press button



on the toolbar.

- 9.

## 2.4 Camera's setting

### 2.4.1 Video camera choice

It is necessary to select in the main menu «**Settings**» => «**Video**» => «**.../name used camera/...**». In figure 2.11 the process of selecting the camera «Microsoft LifeCam Cinema» is shown. If the camera is connected, selected and works, then the left of the name there will be an icon «✓», and the menu will be extended with the «**Video capture filter...**» and «**Video capture format...**».

**Note**, use free program CamIP for the IP network camera connection (<http://www.psymaker.com/downloads/CamIP64.exe>). Parameter setting procedure described in the CamIp manual [http://www.psymaker.com/downloads/CamIP\\_eng.pdf](http://www.psymaker.com/downloads/CamIP_eng.pdf)

### 2.4.2 Video capture filter

To open the menu of the camera settings you must be select «**Video capture filter...**» in the submenu «**Video**» (fig. 2.12). Item «**Video capture filter...**» appears in the menu only in case of the correct installation of drivers of the camera and a choice of the working camera.

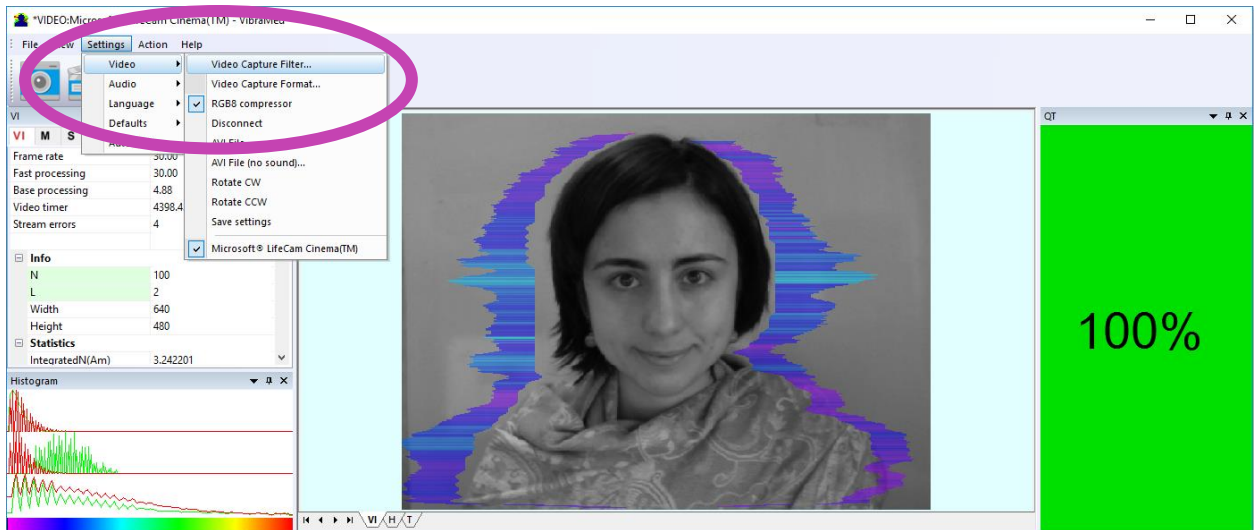


Fig. 2.12. Opening of the camera's settings menu («Video capture filter...»)

After a choice of the «**Video capture filter...**» the window «**Settings**» will open. Settings window differs depends on camera type. The first tab of this window is usually devoted to the image setup (Brightness, Contrast, etc.). In a figure 2.13 the window «**Settings**» for the camera «**Microsoft LifeCam Cinema**» is shown. Camera Microsoft LifeCam Cinema has low noise level and is preferable for vibraimage applications among webcams.

«Brightness», «Contrast» and other parameters should be set up so that image of object has more contrast. Switching on/off flicker-effect from artificial lighting could be necessary for some illumination types.

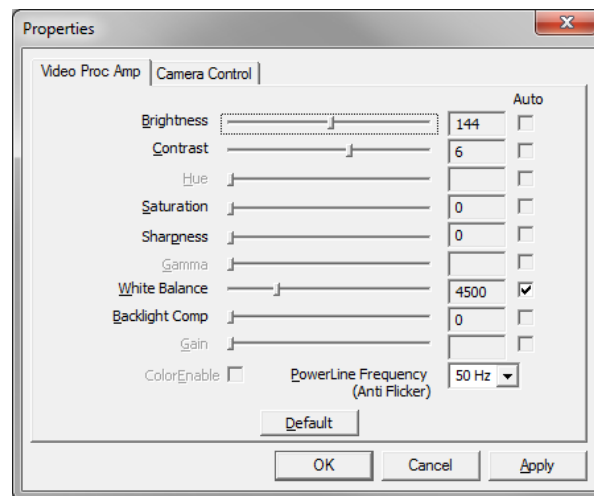


Fig. 2.13. Video setting, camera « Microsoft LifeCam Cinema»

After a choice of the «**Video capture filter...**» the window «**Settings**» will open. Settings window differs depends on camera type. When adjusting the camera settings, you must fulfill the following general requirements:

- The «**Brightness**», «**Contrast** » and others parameters should be configured so that the image of the object was the maximum contrast
- Switch on «**Flicker**» mode for setting lighting power line frequency (repayment flicker), in most countries it is 50 Hz.
- If your camera supports, then switch on the black-and- white image «**B / W mode**». If the camera works only in color mode, it is recommended to set «**Saturation**» parameter to minimum value.
- Depending on the experimental conditions and light to use automatic or manual setting «**Exposure**» parameter. If constant lighting, it is recommended to use the manual adjustment. If changes (for example, an object depends on the lighting street lighting), it is better to use the automatic adjustment mode setting.
- Parameters «**Zoom**» and «**Focus** » recommended using in the manual mode and changing their values not due to electronic image processing, but by approaching / removing the camera from the object. The «**Scale**» (Zoom) recommended selecting based on two factors. Firstly, you need to have maximum image size of control object and it is preferably to stand maximum zoom level. From the other side high level of electronic zoom in some cameras could go down the frame rate and it is necessary to control this parameter and fixed frame rate more than 25 f/s. Therefore, for webcam Microsoft LifeCam Cinema the optimal meaning of zoom for personal control is 4. For other cameras is possible to adjust other optimal zoom settings.

### 2.4.3 Video capture format

To open the menu of the camera settings you must be select «**Video capture filter...**» in the submenu «**Video**» (fig. 2.14). Item «**Video capture format...**» appears in the menu only in case of the correct installation of drivers of the camera and a choice of the working camera. Frame rate is necessary to set 30 and the frame size to set («**Output Size**») 640 x 480 elements (fig. 2.15).

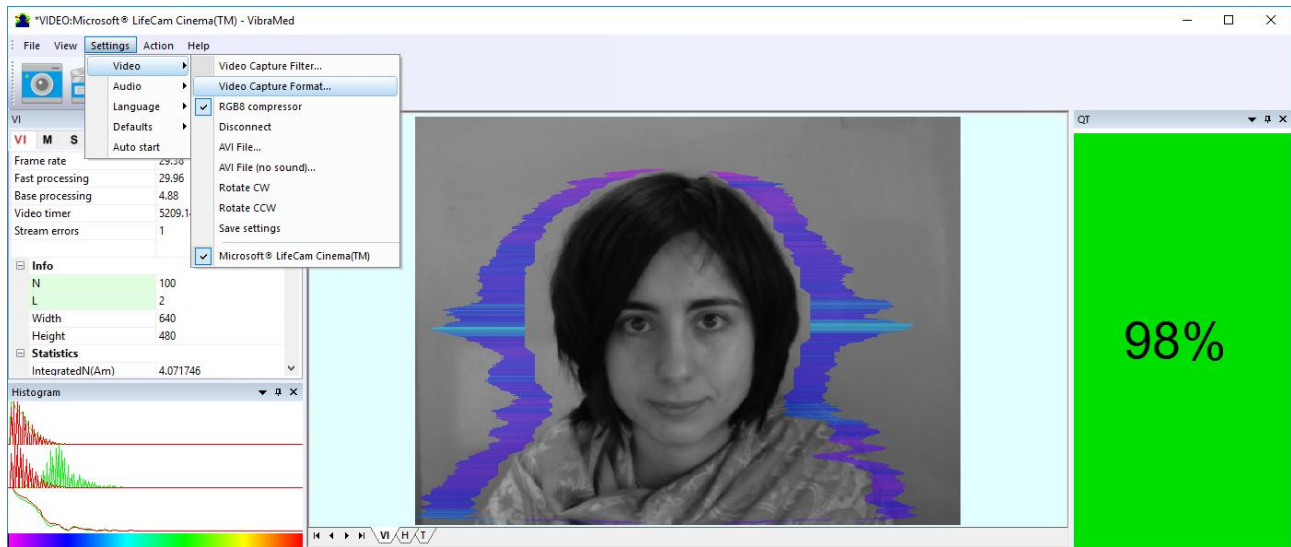


Fig. 2.14. Opening the settings window «Video capture format»

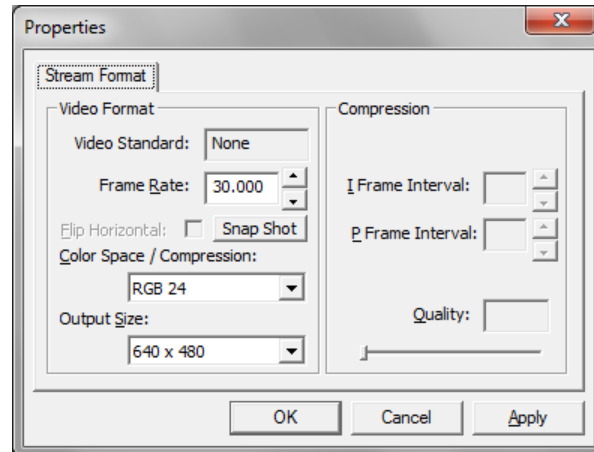


Fig. 2.15. Window «Video capture format»

**Note**, when changing camera settings in the program **VibraMed** frame rate «In» should be in the range of 25 - 30 frames/s. The parameter IntegratedN (Am) must be minimum, but not exceeding 0.1.

#### 2.4.4 Checking the settings on the test table

During the first start of Vibraimage system and periodically recommends testing image quality by the test table. It is required to place a test pattern opposite to the camera so that the image of the table occupies the entire space of the frame. To achieve the optimal contrast range of object is need to stand in camera settings auto regulation of illumination in case of unstable illumination (fig. 2.16) and manual regulation of illumination in case of a constant illumination (fig. 2.17).

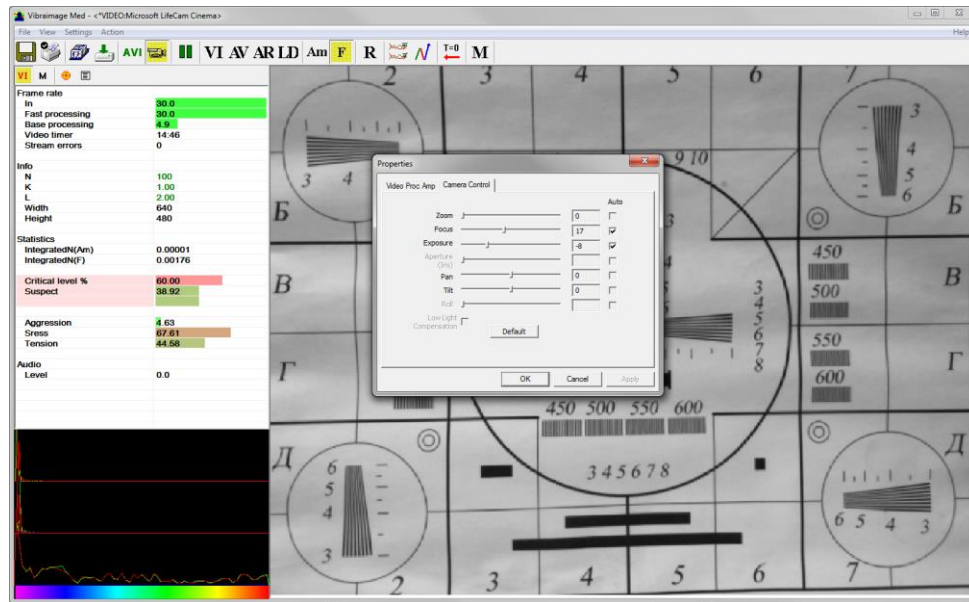


Fig. 2.16. Checking the camera settings on the test table, automatic regulation of the exposure (mode is recommended for unstable object illumination).

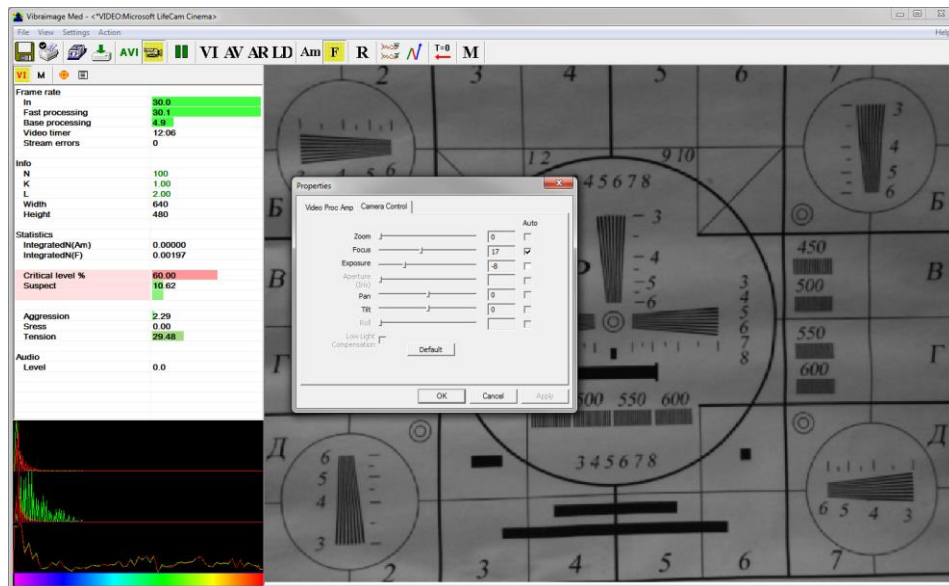


Fig. 2.17. Checking the camera settings on the test table, manual regulation of the exposure (mode is recommended for stable object illumination).

### 2.4.5 Video quality auto checking function

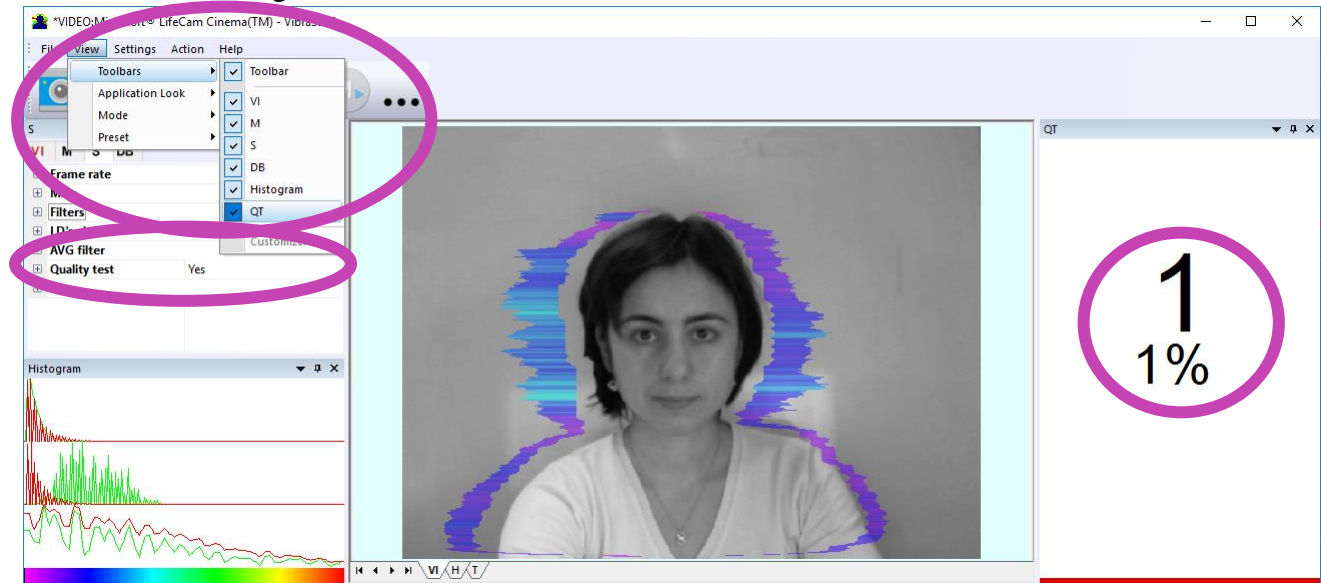
The **VibraMed** program has quality control function image quality control during the test. Since the calculation of human reaction using the video image, the quality control for the processed video is necessary to obtain a correct test result. Error message and the low quality of video will appear on top of the **QT** windows (Fig. 2.4), but only if the "**Quality test**" mode in "S" information panel is switch on.

Program gives error indication if the image quality is lower than standard vibraimage requests:

Error 1 – indicates when facial image is lower than necessary. For cancel this error is need to move checked person near to camera or start zoom function on camera.

Error 2 – indicates when camera noise level is higher than necessary. The reason of this error could be low illumination, incorrect camera settings or camera vibration.

Error 3 – indicates when computer input frame rate is lower than necessary. Requested norm for processed frame rate is more than 24 f/s. This errors indication was done for deleting unqualified Med influence during results control.



*Fig. 2.21. Quality test indication stands Yes in settings and Error 1 shows in the image window. Head image size is lower than requested.*

Program gives error indication if the image quality is lower than standard vibraimage requests:

**Error 1** – indicates when facial image is lower than necessary. For cancel this error is need to move checked person near to camera or start zoom function on camera.

**Error 2** – indicates when camera noise level is higher than necessary. The reason of this error could be low illumination, incorrect camera settings or camera vibration.

**Error 3** – indicates when computer input frequency rate is lower than necessary. Requested norm for processed frame frequency is more than 24 f/s. This errors indication done for deleting unqualified Med influence during results control.

The size of the person's head image in the picture elements (pixels), which determines the accuracy of recorded vibrations, requires constant monitoring during testing. When tested with a video image analysis there are no severe restrictions on the movement of the test person, as required by the contact method. This person feels natural, which increases the accuracy of test results.

However, the natural behavior can lead to the fact that during the test response deviates from the camera and the size of the human head image becomes less than required. To resolve this issue vibraimage system constantly monitors a person's head size of the image and displays an error message (1) in the window «QT» in the case of reducing the size below the limit. In addition, vibraimage program includes a permanent face detection algorithm, which ensures elimination of errors from a lack of a real image of the person in the frame during testing.

Temporary noise signal from the video camera includes a video camera noise and illumination instability and can significantly affect the test results. In this case, at the slightest noise, level exceeds the specified threshold, the system automatically displays an error message (2) in «**QT**» window (see. Fig. 2.5).

Despite the fact that the television camera may transmit to 30 f/s with the set resolution, it does not guarantee that the computer receives and processes the incoming video data in real time. Any deviation from the information processing in real time resulting in a loss of information and hence reduce the reliability of the test. By reducing the actual input frames frequencies and processing frequencies below the set limit, the system automatically displays a warning error (3).

Window «**Quality Test**» (**QT**) indicates the time in %, for which the image quality of 100 %. When the quality test indicates 43 % means that only 43 % of the testing time have no errors, and the 57 % of test time the image quality contained 1, 2 or 3 errors.

**Note**, before the start of the test should ensure that the program processed the image of a human without errors.



### 3 VibraMed. User's manual

After start of VibraMed in the main window, there is an image from connected video device.

#### 3.1 Main window

In heading of the basic window, the following information is indicated (see fig. 3.1):

- type of video source: Video camera or AVI file;
- model of video source: Video camera model or AVI file name;
- name of running VibraMed module;
- name of the current database record to which there is an operation.

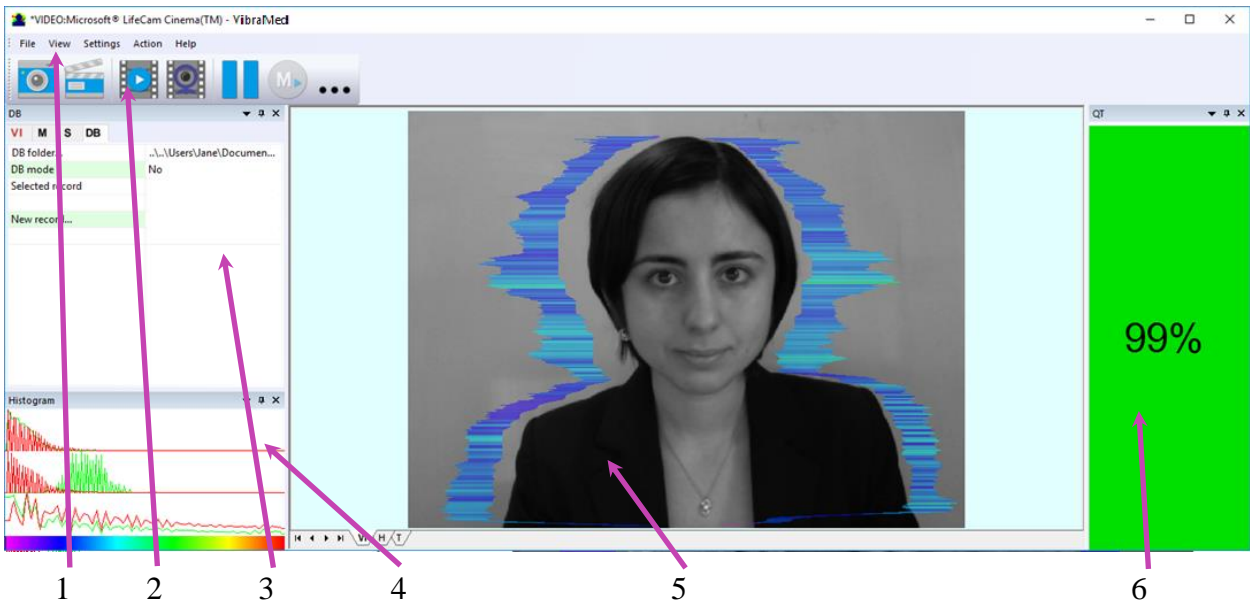


Fig. 3.1. Main window VibraMed

The program for the user's convenience have the ability to change the style of the main elements of the working window. To change the style, use the submenu «View» - «Application Look» (fig. 3.2.).

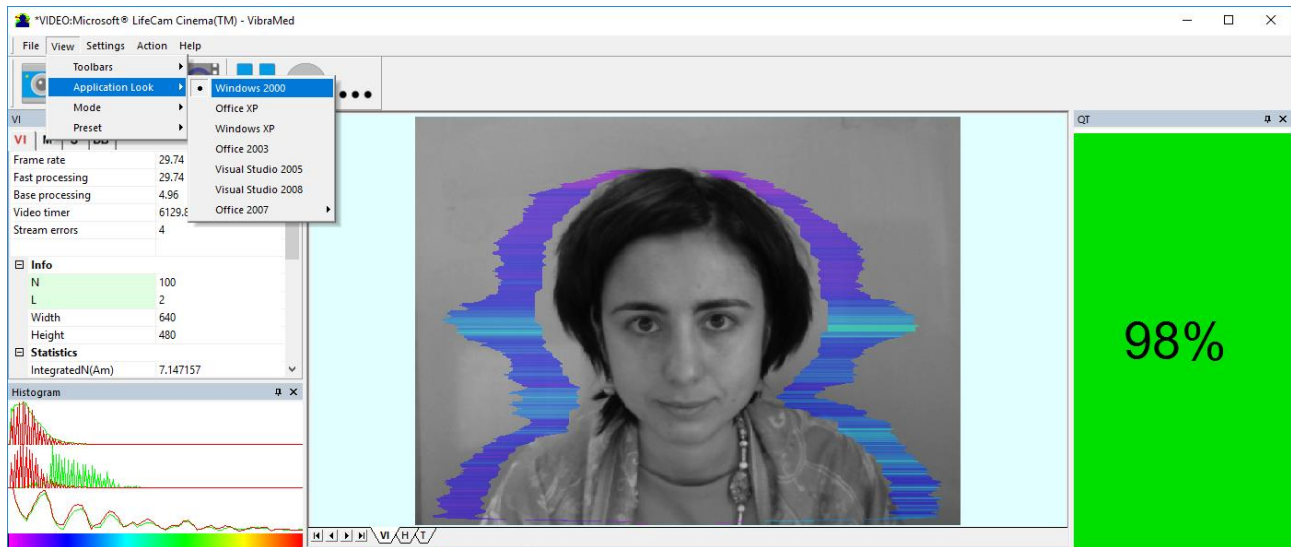


Fig. 3.2. Style «Windows 2000»

### 3.1.1 Basic window design

In total in the main window of the program in addition to the video area, you can see an additional 6 windows that display information about the parameters of mental and emotional state of a person, and program settings (on fig 3.1 the windows labeled corresponding numbers):

1. File, View, Settings, Action, Help – main menu;
2. Toolbar – main toolbar;
3. VI, M, S, DB – information panel windows;
4. Histogram – window for vibraimage parameters histogram in real time mode;
5. Images window for displaying vibraimage (VI), result's histograms (H), information-energy graph (T);
6. QT – image quality window.

User can add or delete windows by submenu «**View**» - «**Toolbar**» (fig. 3.3).

**Note**, double click by the left button of a mouse in the image field of makes **RESET** of all saved up information and statistics about frames and start new cycle collection of information.

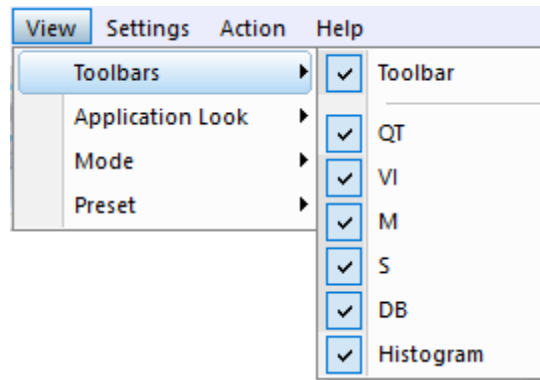


Fig. 3.3. Submenu «Toolbars»

### 3.1.2 Windows position control

The user can control the placement of additional windows on the screen and the size using the controls elements on the left side of each window title. For each window it is available control menu (fig. 3.4). This menu also appears when you click the left mouse button in finding the mouse pointer in the desired window. In «Docking» mode, window position and size are fixed, and when opening/closing the window will open in a given position. The mode «Floating» window position and size can be changed by the user.

If the window is in a random location on the screen, then double-click the left mouse button on the window, the window will move on the screen in the «default» position.

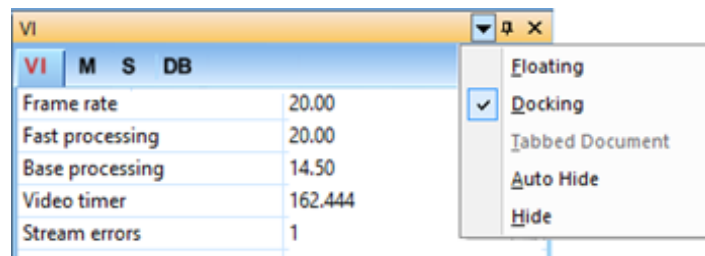


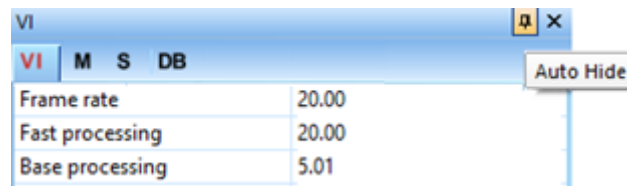
Fig. 3.4. Window control element

Each window can be closed, or by using the window menu or by using a separate control element (fig. 3.5).

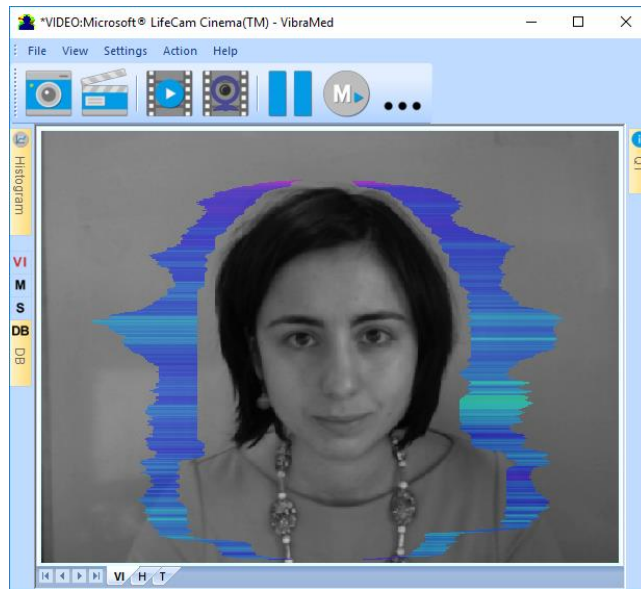


Fig. 3.5. Control element «close window»

Each window can be temporarily minimized and moved to the border of the main program window (fig. 3.6). Figure 3.11 additional windows hided and moved to the border of the main window and they icons are highlighted in orange color.



*Fig. 3.6. Control element «hide window»*



*Fig. 3.7. All additional windows are hide.*

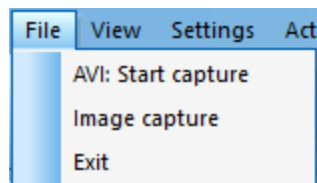
## 3.2 Main menu

The main menu contains the following items:

- «File»
- «View»
- «Settings»
- «Action»
- «Help»

### 3.2.1 Menu «File»

Menu «File» (fig. 3.8) contains following items:



*Fig. 3.8. Menu «File»*

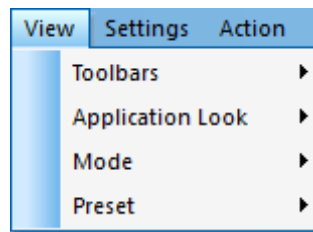
Item **«AVI: Start Capture»** - start record AVI-file. If the database folder is not specified, record of AVI files is blocked.

Item **«Image capture...»** - saving the current frame of a window in the database folder.

Item **«Exit»** - exit from program.

### 3.2.2 Menu «View»

Menu **«View»** (fig. 3.9) defines visible in the basic window information and contains the following items:



*Fig. 3.9. Menu «View»*

Item **«Toolbars»** - switch on/off the toolbar (fig 3.3).

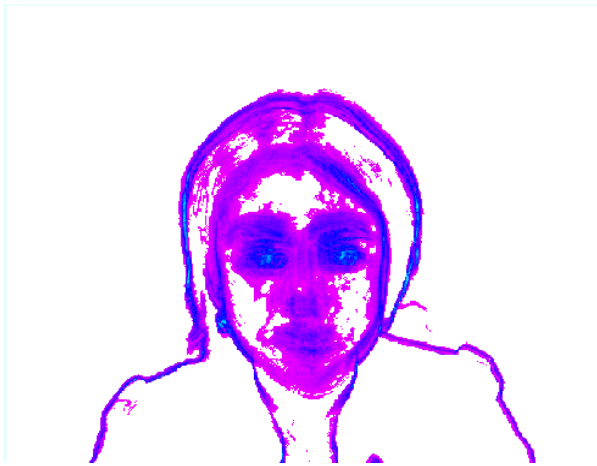
Item **«Application Look»** - choose style of program (fig 3.2).

Submenu **«Mode»** defines additional configuration and number of windows with an image displayed in the image area.

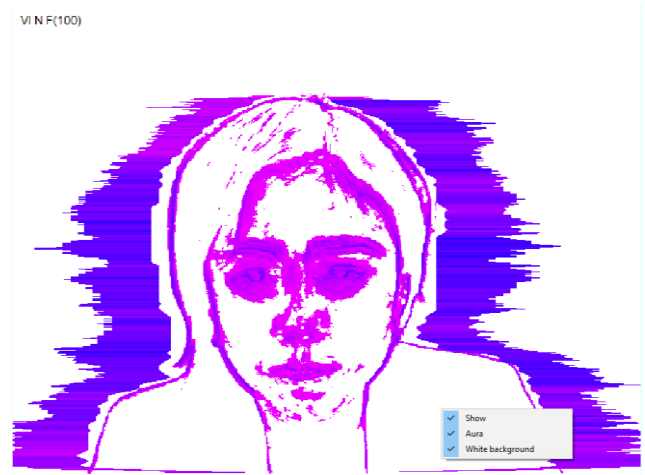
Submenu **«Preset»** defines the type of the display image:

Item **«Presets»** menu **«View»** (Fig. 3.10) intended to choice one basic mode in image area.

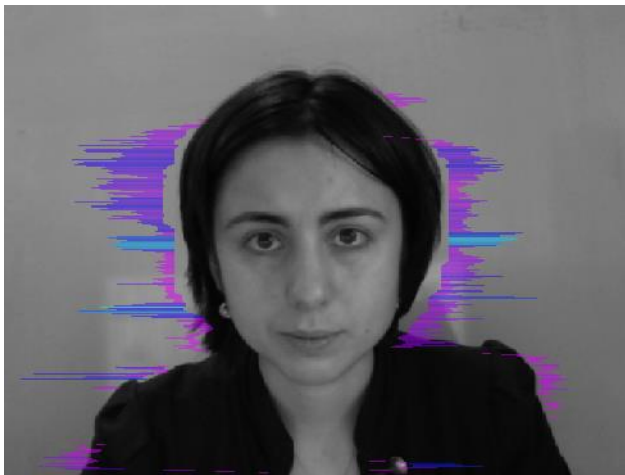
- In **«VI»** mode [«VibraImage mode»] displays vibraimage of person. Color for every image pixel depends on its amplitude or frequency of vibrations (fig. 3.10a).
- In **«AV»** mode [«Aura - Vibraimage mode»] the contour of the object allocated around the vibraimage. Vibra-aura line size depends on medium line vibration amplitude. Vibra-aura line color depends on maximum line vibration frequency inside vibraimage contour (fig. 3.10b).
- In **«AR»** mode [«Aura on the Real image»] the vibra-aura of the person is shown around his real image (fig. 3.10c).
- In **«LD»** mode [«Lie Detector mode»] image area shows real object image(fig. 3.10d).



*3.10a Режим VI*



*3.10b Режим AV*



*3.10c Режим AR*



*3.10d Режим LD*

*3.10 Image area in different modes*

### **3.2.2.1 Submenu «Mode»**

Item «**Mode**» (fig. 3.11) selects additional settings of information in image area.

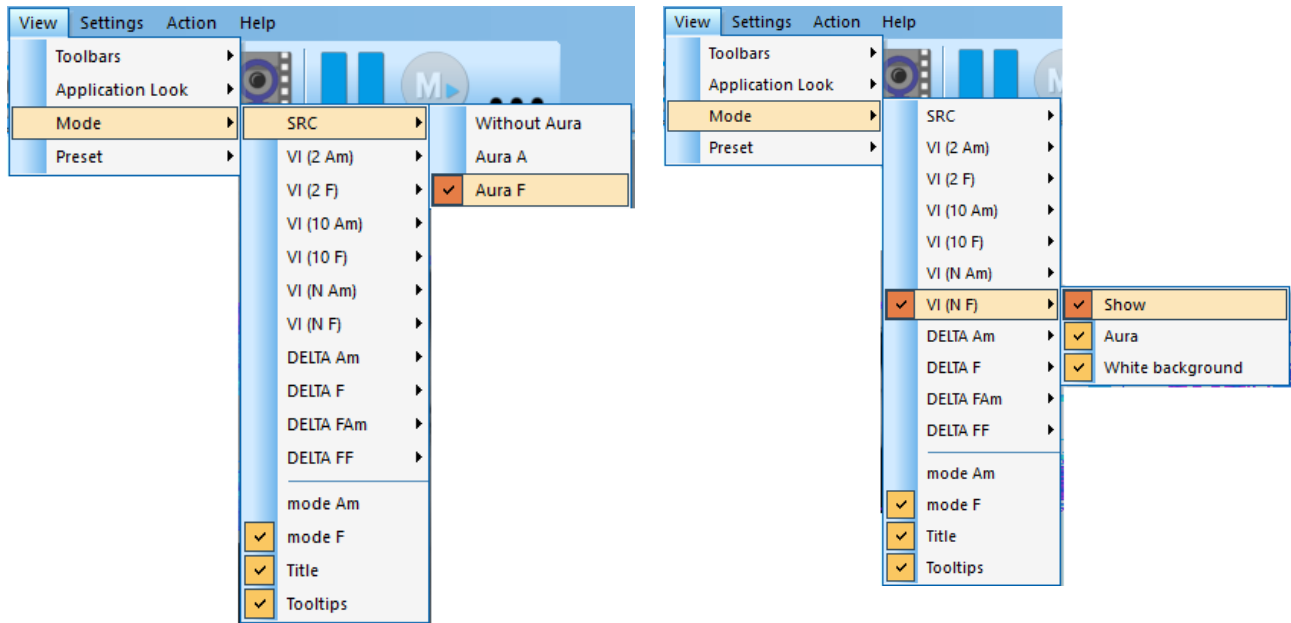


Fig. 3.11. Submenu «Mode»

**Note**, in different modes VI and AV you have the additional possibility to change color of a background image and to add aura to vibraimage. The same result is possible to receive if to bring the mouse pointer to a window of the chosen image and to press the right button of a mouse (fig. 3.10b).

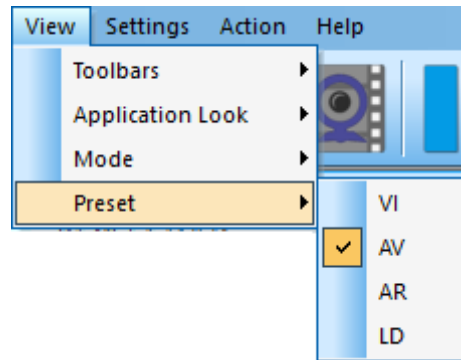
- In «SRC» mode shows source video from camera without processing (fig. 3.11). It is additional possibility to display the aura on the real image of person constructed on the analysis of pixels vibration amplitude or frequency or pixels vibration frequencies. The length of the beam vibra-aura in this case will be determined by the average value of the points parameter in a row, and the color of the beam vibra-aura – by the maximum value.
- In «VI (2 Am)» and «VI (2 F)» modes display vibraimage, processed during 2 frames and constructed on the basis of amplitude **Am** and frequency **F** analysis of vibration. It is additional possibility to change color of background image and to add vibra-aura to vibraimage.
- In «VI (10 Am)» and «VI (10 F)» modes display vibraimage, processed during 10 frames and constructed on the basis of amplitude **Am** and frequency **F** vibration analysis.
- In «VI (N Am)» and «VI (N F)» modes display vibraimage, processed during N frames and constructed on the basis of amplitude **Am** and frequency **F** vibration analysis. The number of frames, corresponding to parameter N, is set in «VI» information panel. It is additional possibility to change color of background image and to add aura to vibraimage.
- In «Delta Am» and «Delta F» display frame difference on the basis of amplitude **Am** and frequency **F** vibration analysis in base processing mode without filter preprocessing. It is additional possibility to change color of background image.

**Note.** In this mode the vibra-aura will be based on the vibraimage which has been accumulated for N frames!

- In «View mode Delta FA» and «View mode Delta FA» modes display frame difference on the basis of amplitude **Am** and frequency **F** vibration analysis in fast

processing mode without filter preprocessing. It is additional possibility to change color of background image.

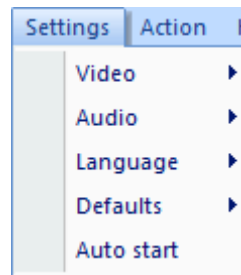
- In «**mode Am**» visualization and calculation of object parameters processed by pixel vibration amplitude.
- In «**mode F**» visualization and calculation of object parameters processed by pixel vibration frequency.
- Item «**Title**» [Title] switch on displaying a name of mode or AVI file in the upper left corner of each image window.
- Item «**Tooltips**» – enable/disable output tips.



*Fig. 3.12. Submenu «Preset»*

### 3.2.3 Menu «Settings»

Menu «**Settings**» (fig. 3.13) allows choosing video or audio source, language, settings by default and auto start program:



*Fig. 3.13. Menu «Settings»*

**VibraMed** allows to process «live» video signal coming from a video camera and video data recorded before and saved as AVI-file. The system works with a signal from a video camera by default.

Item «**Auto start**» enable to start measurement if video quality will normal during 20 sec minimum.

Submenu «**Language**» allows to select interface language (See par. 2.3).

Submenu «**Defaults**» => «**Micro**» allows set parameters to default value. Files of default settings are stored in the catalogue \VibraMed10\defaults\.



### 3.2.3.1 Submenu «Video»

Submenu «**Video**» contains settings of video modes. It can differ depend on connected devices. For example, this menu contains the following items (fig. 3.14). You can choose as video source one from many installing in PC video-devices or load external video file.

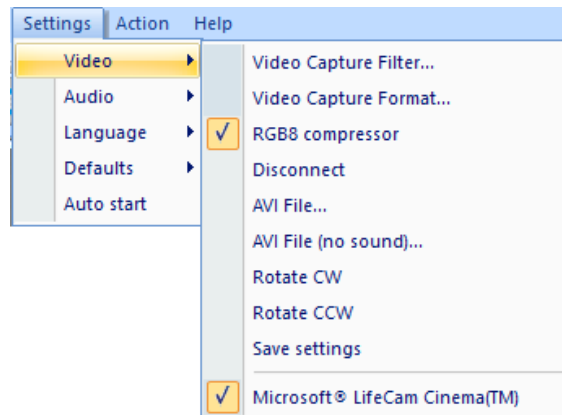


Fig. 3.14. Submenu «Video»

Subitem «**Video Capture Filter...**» - by pressing the window of video device setting (contrast, exposition, brightness) opens. Each device has the especial window of settings.

Subitem «**Video Capture Format...**» - change video capture format.

Subitem «**RGB8 compressor**» are intended for management of a videofile record format. If this item is chosen, that, for economy of a space on a hard disk, the videofile saved in a black-and-white format.

Subitem «**Disconnect**» allows to disconnect all videocamera or videofile

Subitems «**AVI File...**» and «**AVI File (no sound)...**» [AVI File (no sound)...] are intended for selecting for the analysis of an external video file

Subitems «**Rotate CW**» and «**Rotate CCW**» allow allow to make turn of an input video image on 90 and 270 degrees before its processing in the VibraMed.

Subitem «**Save settings**» allows to save current camera settings in the Windows registry in order to load them at next startup programs with this camera

The bottom menu allows you to choose a used device video capture from multiple installed on this computer.

### 3.2.3.2 Submenu «Audio»

Submenu «**Audio**» contains settings of audio modes. It can differ depend on connected devices. For example, this menu contains the following items (fig. 3.15). You can choose as video source one from many installing in PC video-devices or load external video file.

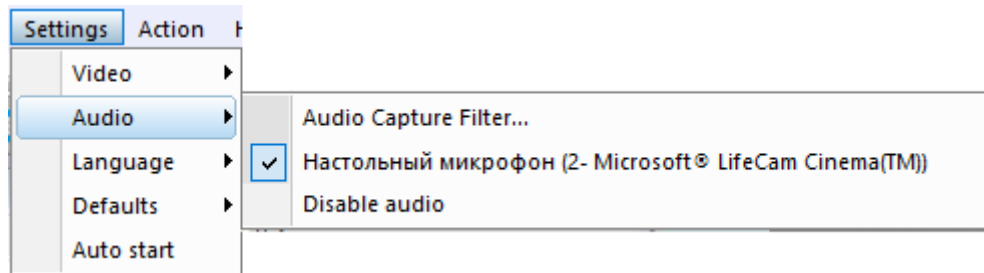


Fig. 3.15. Submenu «Audio»

Subitem «**Audio Capture Filter...**» - the window of audio device setting. This subitem exist only when you choose videosource. Each device has the especial window of settings.

Subitem «**Disable audio**» allows disconnecting all audiosource.

Menu between these subitems allows choosing used audio device capture from multiple installed on this computer.

### 3.2.4 Menu «Action»

Menu «**Action**» (fig. 3.16) contains the following items:

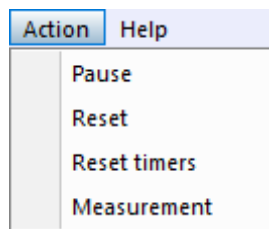


Fig. 3.16. Menu «Action»

Item «**Pause**» - stop last accepted frame of data in image area of windows.

Item «**Reset**» - reset all saved up information and statistics about frames and start new cycle collection of information.

Item «**Reset timers**» - reset to «0» all timers: video file timer, graph timer. The conclusion video and construction of graph begins all over again.

At a choice of item «**Measurement**» the system makes accumulation, averaging and a display of parameters for the specified time period. The results display is made in the information panel in a mode «M». In the same place in seconds value of the averaging period «**Duration**» is set.

### 3.3 Toolbar

**VibraMed** toolbar (fig. 3.17) contains following buttons:



*Fig. 3.17. VibraMed toolbar.*

All toolbar buttons (fig. 3.17) duplicated the corresponding items in the menu system. When the tool tip determines the assignment of toolbar buttons. Note, the selected toolbar button is highlighted in color or volume, depending on the main window style.



–AVI files download for PDD analysis;



–AVI files download for PDD analysis;



–AVI files download for PDD analysis;



– live video camera connection;



– choice of internal vibraimage mode (VI);



– choice of external vibraimage (vibra-aura) around internal video image mode (AV);



– choice of external vibraimage (vibra-aura) around real video image mode (AR);



– choice real video image mode (LD);



– pause on image and program operations;



– start of measurement;



– open the folder where you saved the images and measurement's data.

### 3.4 Information column

Indication of information column (fig. 3.18) depends on using mode:

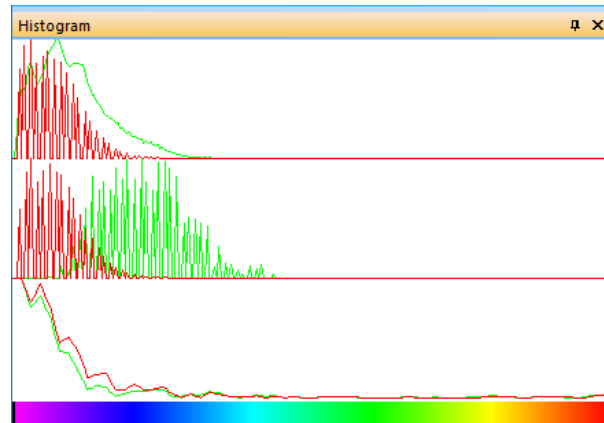


*Fig. 3.18. Modes of the information column*

- In the mode «VI» information about adjustments of system and results of data vibraimage processing is displayed;
- In the mode «M» the average values of vibraimage parameters which have been calculated and are average for the certain period are displayed;
- In the mode «S» settings of basic parameters for vibraimage processing are configured;
- In the mode «DB» input and selection of the demographic information and a folder for archive storage is configured.

**Note**, values of parameters in fields which are allocated by a green font, can be changed by the user (fig. 3.20, parameters N, L - it is possible to change in Information table). For this purpose it is necessary to bring the mouse pointer to the chosen field and twice to click the left button of a mouse.

In the down part of information panel displays three windows with results of the frequency analysis (fig. 3.19). In the first window the frequency analysis vibraimage on the whole frame (by red color - amplitude, green color - frequency of vibration pixels) is displayed. In the second window the frequency and amplitude histograms for external vibraimage (aura), and in the third - spectrums of the frequency analysis with application of FFT of two parameters (A1X and F1X) are displayed.



*Fig. 3.19. Histograms windows*

### 3.4.1 Information column. VI mode

In the mode «**VI**» information panel (fig. 3.20) displays following information:

VI	
Frame rate	29.96
Fast processing	29.96
Base processing	4.97
Video timer	3732.65
Stream errors	113
Info	
N	100
L	2
Width	640
Height	480
Statistics	
IntegratedN(Am)	6.385629
IntegratedN(F)	6.439371
Critical level %	60.0 %
Suspect	17.9
Aggression	22.1
Stress	23.0
Tension	9.1
Audio	
Level	0.0

Fig. 3.20. Information column in the VI mode

#### Frame rate:

- «**In**» – Number of the frames per second, received from the video source;
- «**Fast processing**» – Maximum number of the processed frames per second used for calculation. Selected by user;
- «**Base processing**» – Number of the processed frames per second used in base algorithm. Selected by user;
- «**Video Timer**» – For camera mode-displays time of supervision. For recorded video - time of current video-file record. For viewing a video-file - time from the file beginning);
- «**Stream errors**» – The counter of mistakes that increases if time between the next accepted frame unstably. This mistake can arise, if productivity of a computer suffices or poor-quality video is loaded;

#### Info:

- **N** – Number of the frames for accumulation. Selected by user;
- **L** – Palette Threshold. Defines a threshold in the displayed image, value of brightness less threshold is considered «black». Selected by user;

**Width and Height** – Displays the current video camera or avi file resolution;

**Statistics:**

- **IntegratedN(Am)** – Average frame amplitude vibraimage intensity processed for the N frames;
- **IntegratedN(F)** – Average frame frequency vibraimage intensity processed for the N frames;
- **«Critical level %»** – Threshold of a psychoemotional status of the person exposed in % in case of which exceeding on the remote terminal the warning message will be issued;
- **«Suspect»** – Calculated level of suspect for object in frame;
- **«Aggression»** – Calculated level of anger for object in frame;
- **«Stress»** – Calculated level of stress for object in frame;
- **«Tension»** – Calculated level of tension for object in frame;

**Audio:**


- **«Level»** – current level of audio signal.

### **3.4.2. Information column. M mode**

In a mode «**M**» an information column (fig. 3.21) allows to control average for the period parameters value of psycho-emotional person conditions and their deviation from the established norm. The basic applicability of the given mode is use of vibraimage system for medical diagnostics and psychological researches.

M		
Config		
Progress	0%	
Duration (s)	60	
T10		
Aggression (P7)	25.0	0.0
V	25.0	
S	0.0	
Vi	0.0	
N Min	20.0	
cMin	0.0	
N Max	50.0	
cMax	0.0	
Stress (P6)	17.3	0.0
Tension/Anxiety (F...	13.9	0.0
Suspect (P19)	19.0	0.0
Balance (P16)	70.4	0.0
Charm (P17)	85.3	0.0
Energy (P8)	19.6	0.0
Self regulation (P1...	77.9	0.0
Inhibition (F6)	23.5	0.0
Neuroticism (F9)	13.2	0.0
P		
P1	45.750839	
P3	16.436762	
P4	1.366881	
Health (P21)	0.000000	
Health' (P22)	0.000000	
ΣVi (P23)	0.000000	
Extraversion (P26)	0.000000	
Stability (P27)	0.000000	
A		
F		
S		

Fig. 3.21. Information column in the M mode

Value of the averaging period is set in seconds in a field «**Duration**». Start of the beginning of information accumulation is made by a choice of item [«Measurement»] the menu [«Action»] or pressing of the toolbar button . After start of an accumulation and averaging mode in the top of an information column there is a running line [«Progress»], displaying a course of data accumulation process. Also you can see «Progress» in percent in the window QT (fig. 3.22).

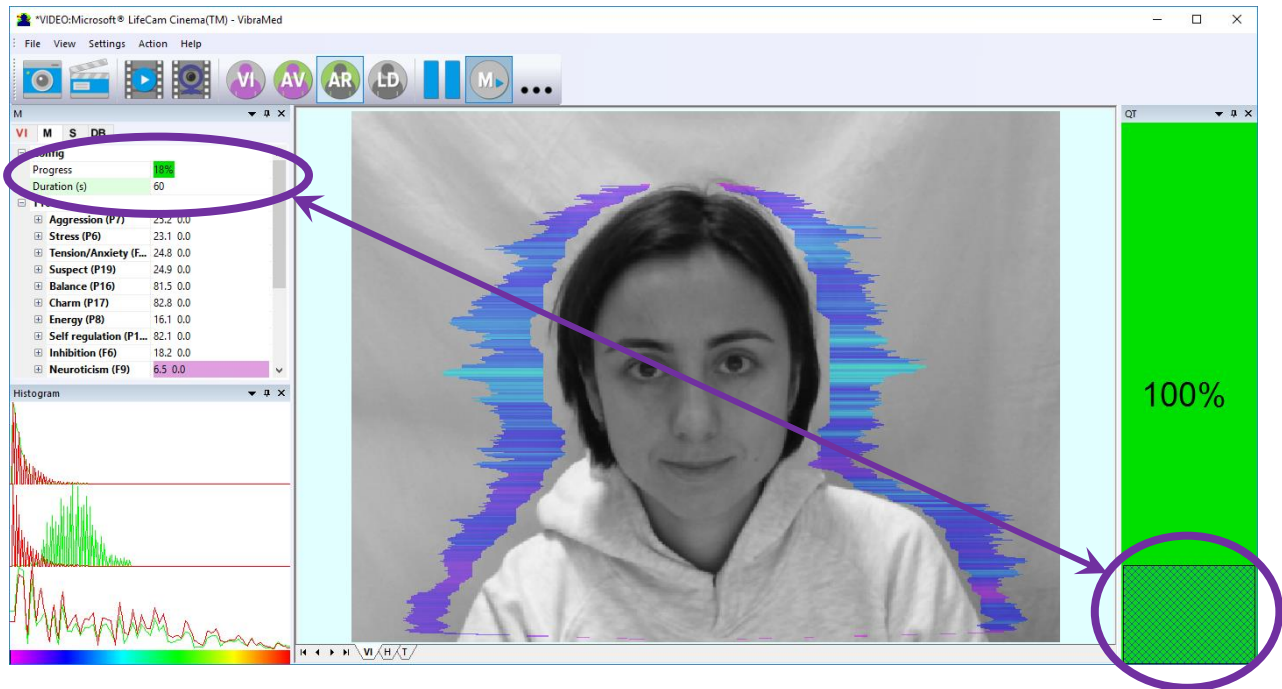


Fig. 3.22. Progress of the measurement.

Information column in the «M» mode shown following information:

- Configuration of measurement:  
Line «Progress», displaying a course of data accumulation process and «Duration» – testing period in seconds.
- Basic parameters describing psycho-emotional condition of the person T10: Aggression (P7), Stress (P6), Tension/Anxiety (F5fast), Suspect (P19), Balance (P16), Charm (P17), Energy (P8), Self-regulation (P18), Inhibition (F6), Neuroticism (F9). See more information in p. 4.1.



The following numerical values are displayed for each parameter:

M –	the value of the parameter average for the set period
S –	root-mean-square deviation of parameter
Vi –	variability S/M
cMin –	the minimal value of parameter for the period
cMax –	the maximal value of parameter for the period
NMin –	the minimal value of parameter for a normal condition of the person
NMax –	the maximal value of parameter for a normal condition of the person

**Note,** values of cMin, cMax parameters are displayed only when measurement mode «M» has been began and the information for the specified period is saved up.



**Note**, after ending of the information accumulation some lines of an information column can be allocated by color:

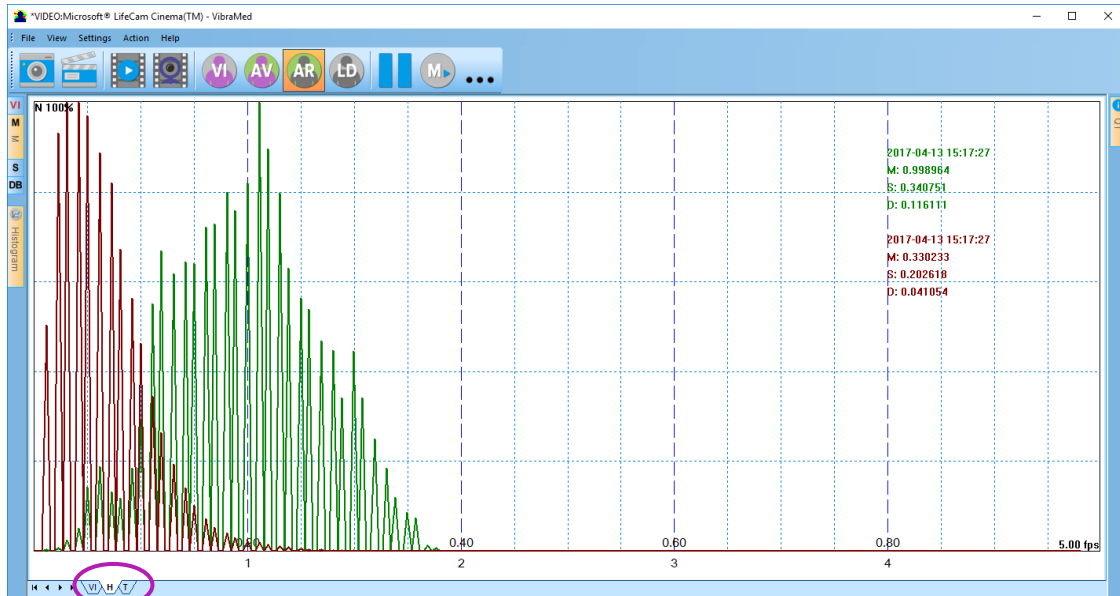
-  - parameters, which values less than the set limits are allocated.
-  - parameters, which values more than the set limits are allocated.

**Note**, for correct diagnostics psycho-emotion conditions of the person speed of data input from the camera should be within the limits of 25-30 frame/second.

- The group of parameters **P** registers features of mathematical Processing of vibrations:
  - P1 – Dispersion of vibration density for frequency distribution at 10 processing frames
  - P3 – Center density distribution displacement of frequency at 10 processing frames
  - P4 – Center density distribution displacement of frequency at N processing frames
  - P21 – Parameter «**Health**» (Health level for general oncology);
  - P22 – Parameter «**Health'**» (Health level for prostate oncology);
  - P23 –  $\sum V_i$  – the average of the «**Health**» (Mean value of health level);
  - P26 – Extraversion level
  - P27 – Stability level
- The group of parameters **A1-A4** registers amplitude of vibrations:
  - A1 – Frame difference between two consecutive frames
  - A2 – Frame difference accumulated in 10 consecutive frames
  - A3 – Frame difference accumulated in N consecutive frames
  - A4 – Value of parameter A1 filtered on 10 frames
- The group of parameters **F1-F9** registers frequency of vibrations (amount of changing points):
  - F1 – Calculated value of changed signal pixels amount in 2 consecutive frames
  - F1 (fast) – Calculated value of changed signal pixels amount in frames difference in fast processing mode
  - dF1 (fast) – The average value of changes in the quantity of elements (the increment) for F1 (fast) parameter
  - F2 – Averaged value of changed signal pixels amount in 10 consecutive frames
  - F3 – Average value of elements quantity which have changed for the period of N frames
  - F4 – Changed pixels maximum frequency during N processed frames

- F5 – Current **tension level** (%). Ratio of «high» frequency density to «low» frequency for parameter F1. Its speed of element changing in frames difference.
- F5 (fast) – The average value of the rate of elements change in the fast processing mode calculation
- F6 – **Inhibition parameter.** Average value of the F1 parameter period (in seconds), determined during period F6N. Value of parameter F6N is set in section [Filters] an “S” information panel and defines quantity of the frame processed in Fast Processing mode
- F7 – Root-mean-square deviation for F6 parameter
- F8 – Not average (current) value of F6 parameter (in seconds), showing the current time period of F1 parameter changing
- F9 – **Neuroticism parameter**
- The group of parameters **S1-S7** registers symmetry of vibrations between left and right parts of person body:
    - S1 – Ratio (symmetry) of amplitude left to the right changed pixels inside the object in 2 consecutive frames
    - S2 – Difference between the left and right average amplitude of object vibration in 10 frames
    - S3 – Difference between the left and right average amplitude of object vibration in N frames
    - S4 – Ratio of the changed pixels quantity in the left part of object to the changed pixels in the right part in 2 consecutive frames
    - S5 – Ratio of the changed pixels quantity in the left object part to the changed pixels quantity in the right object part calculated in 10 frames
    - S6 – Ratio of the changed pixels quantity in the left object part to the changed pixels quantity in the right object part calculated in N frames
    - S7 – Difference between the maximal frequency of vibrations of the left and right object parts in N frames

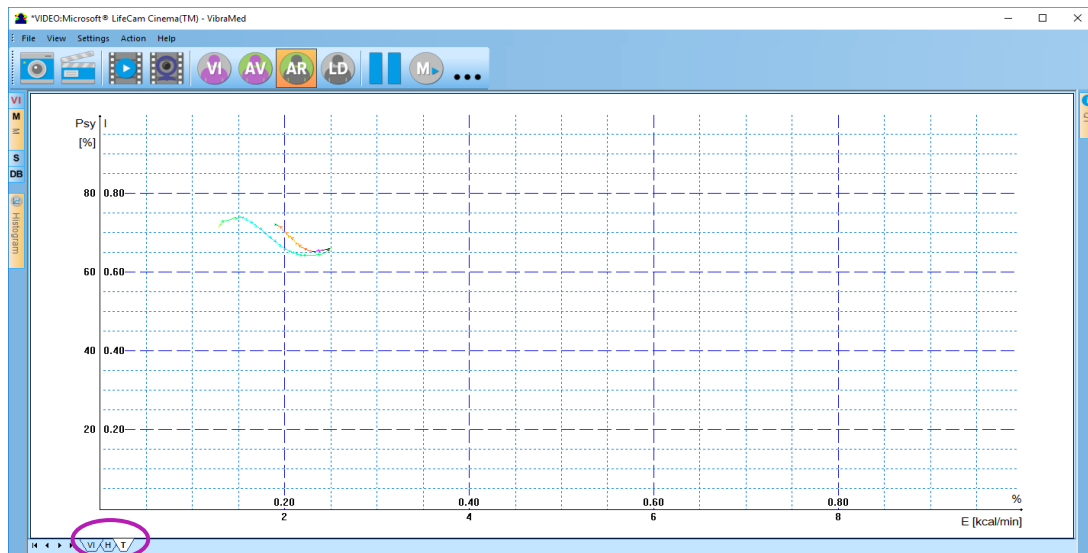
After the end of the information gathering, the results of the "frequency analysis" and the results of the analysis of the change in the person's psychophysiological state will be available. To do this, open the corresponding tab in the main image window (see fig. 3.23, 3.24).



*Fig. 3.23. Results of frequency analysis*

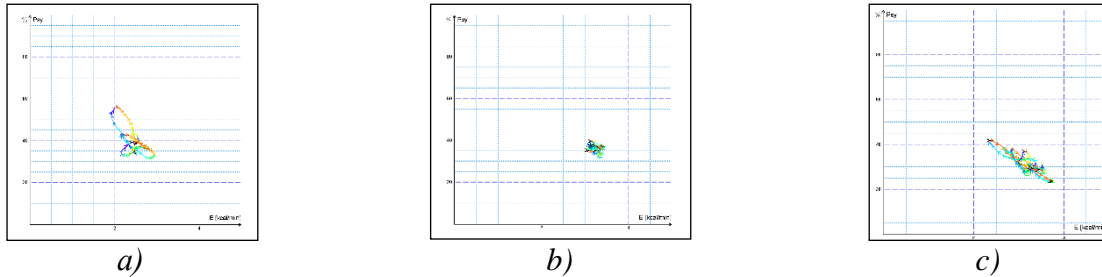
Each histogram characterizes by the following parameters:

- M – the center of weights of frequency distribution (average value of microvibrations frequency);
- S – root-mean-square deviation of frequency distribution;
- D – a dispersion of frequency distribution.



*Fig. 3.24. Information-energy graph*

The graphs are saved to an external file (you choose it in information column in mode DB) automatically after the measurement is completed.



*Fig. 3.25 (a, b, c). Change person psycho-energy conditions for the chosen period. a) change around the average value, b) stable condition, indicating a high degree of self-control person, c) periodic change psycho-energetic state along a certain trajectory, usually characteristic for an interview, type a question-answer*

Change of psycho-energy state of the person during a controlled time frame is visually reflected in a graphics (fig. 3.25). Only the person who is in weakened, or on the contrary in a status of high concentration (fig. 3.25-b), can be in the fixed psycho-energy state during such insignificant time, as 1 minute. The majority of people is made by noticeable oscillations of psycho-energy state, even for short periods, depending on the thoughts (fig. 3.25-a) and under the influence of an environmental situation (fig. 3.25-c). More information in p. 4.2.

### 3.4.3 Information column. S mode

Information table (fig. 3.26) allows adjusting vibraimage parameters and displays the following information:

<b>Frame rate</b>	
Fast processing	0.0
Base processing	5.0
FPS proc. period	2.00
Downrate	0
<b>Main</b>	
N(2)	2
N(10)	10
N	100
L	2.00
Apply global filter	No
<b>Filters</b>	
Single points	Yes
Extended	8
Extended (fast)	8
Stretch	No
Max speed contour	No
Am scale	16
Space	4
color image	No
<b>Crop</b>	
crop X	0
crop Y	0
crop X pos	0
crop Y pos	0
<b>F6</b>	
F6 HF	0
F6 LF	10
F6 N	100
FPS filter	No
E-Monster	No
Auto downrate	No
Fixed contour	No
Stab. X	No
Stab. Y	No
<b>State levels</b>	
Ag	80
St	80
Tn	80
<b>disable *</b>	
disable Am	No
disable F	No
disable 2x(fast)	No
disable VI(10)	No
disable VI(2)	No
disable FFT	No
disable Entropy	No
disable Audio	Yes
<b>Motion detector</b>	
Motion detector	No
level	0.1
auto reset	No
skip frames	20
<b>LD's global</b>	
Enable	No
Stat period (s)	10
Base period (s)	3
Lie threshold	25
Audio sens. (s)	5
Audio level	30
Opposite mode	No
LD mode	Audio
Compare	Off
Text	No
<b>AVG filter</b>	
Aggression	10
Stress	10
Tension	10
Suspicious	0
<b>Quality test</b>	
Enable	Yes
light level	5
FPS max	100
FPS min	24
face delay	2
<b>Fn</b>	
X1	
X2	
X3	
X4	
X5	

Fig. 3.26. Information table

### Frame Rate Settings

Fast processing	Frequency (fps) for processing «fast» parameters of vibraimage, noted by a word «fast»
Base processing	Frequency (fps) for processing «base» parameters of vibraimage, noted by a word «base»
FPS proc. period	Frequency of the frames (fps) during calculation period
Downrate	Reduce input frame rate. At value 3, will be processed every third frame.

### Main settings

N(2)	Minimum number of accumulated frames. By default, 2
N(10)	Average number of accumulated frames. By default, 10
N	Maximum number of accumulated frames. By default, 100
L	Threshold of a palette. Defines a threshold of displayed image, value of less brightness considers as «black»
Apply global filter	If this parameter is included, all the remaining calculated parameters change on processed by filters.

### Filters

Single points	Removes single points, surrounded by black
Extended	It is intended for reduction of noise of a video camera. Delete video noise in bit. By default, 8. This filter is important, when the object is motionless, and values changed because of camera noise.
Extended (fast)	Delete video noise for fast processing.
Stretch	Scale normalization filter to a range 0-255 after its «trimming» by filter Extended
Max speed contour	At the included mode, calculation fast parameters are made only inside of aura contour, at switched off - on the whole frame.
Am scale	Multiplication factor used for vibraimage visualization in a «amplitude» mode
Space	Reduce vibraimage on borders of motionless contrast objects.
Color image	No – Black and white real image in image area. Yes – color image in image area.

Crop X, Crop Y	If real image size more than 640x480 pixels, than will be use only 640x480 pixels from center part of image.
Crop X pos, Crop Y pos	When cropping images define the coordinates (position of the upper-left corner) of the clipping region
F6 HF	Sets in % frequency of a cut for the filter of high frequencies at processing F1_fast parameter.
F6 LF	Sets in % frequency of a cut for the filter of low frequencies at processing F1_fast parameter.
F6 N	Number of averaging frame at calculation of F6 parameter
FPS filter	It is used for exact synchronization with a binding to the concrete frame at work with AVI files. Frequency of the input frame from the camera divided on set Base processing frequency and for processing will undertake each N frame.
E-Monster	Switch to the E-monster mode. The program opens the person face deformed by latent emotions though externally he can constrain these emotions. If the emotional condition of the person is like to normal, then the the program image is like to real video. Accordingly, than more emotions overflows the person and then more especially deformed his image in Monsters Detector mode (E-Monster).
Auto downrate	Automatic calculation of <b>Downrate</b> parameter is made in view of frequency of the input frames, Base processing frequency and computing capacity of a computer.
Fixed contour	In this mode vibra-aura around the human contour will be built around a fixed path, and not to repeat the contours of the body.
Stab. X	Image stabilization in the X coordinate entered when significant vibrations image on the X-axis.
Stab. Y	Image stabilization in the Y coordinate entered when significant vibrations image on the Y-axis.
State levels Ag, St, Tn	Suspicious level in the Aggression parameters (Ag), «Stress» (St), «Tension» (Tn) is set. When exceeding level of danger the system gives out a sound signal and fixes a frame.
<b>Disable</b>	<b>Note:</b> Canceling of parameter calculation is use for increase calculation speed of other parameters.
Disable Am	Canceling of vibration amplitude calculation.
Disable F	Canceling of vibration frequency calculation.

Disable 2x(fast)	Canceling of 2 frames parameters fast calculation.
Disable VI(10)	Canceling of 10 frames parameters calculation.
Disable VI(2)	Canceling of 2 frames parameters calculation.
Disable FFT	Canceling of Fast Fourier Transformation frequency processing.
Disable Entropy	Canceling of Entropy processing.
Disable Audio	Canceling audio analysis.
<b>Motion detector</b>	
Motion detector	Delete emotion calculation for object with motion amount less than threshold.
Level	Threshold level of Integrated10 for emotion calculation.
Auto reset	Reset emotion calculation for macro movement.
Skip frames	Skip frames with the frame difference more than threshold.
<b>Lie detection</b>	
Enable	Enable LD mode.
Stat periods	Before you begin the process of «lie detection» system during the « <b>Base period</b> » (in seconds) collects information to determine the maximum and minimum current values of human parameters that then at «lie detection» time during the « <b>Stat period</b> » define «abnormal» change individual values parameters.
Base periods	
Lie threshold	Threshold (in %) for the detection of lie level in view of every calculated parameters and their «weights».
Audio sens. (s)	After the ending of answer, the system continues to expect «lie» calculation during the specified time interval.
Audio level	The sound level used to start / stop lies detection process in the «Audio» mode.
Opposite mode	Alternative method of lie level calculation.
LD mode:	Selection of mode for lie detection.
Audio	Calculation of lie level starts when the level of entrance audio signal exceeds the established threshold. LD calculation stops, when the level of audio signal becomes less than the established threshold



Manual	Accumulation of the information is made in time «Base periods». Calculation of lie level is made only after pressing button «Start LD», the end of processing - after repeated pressing this button.
Auto	Calculation of a lie level works constantly, current values of parameters (Stat period) are compared to values processed for previous Base period.
Compare	<p><b>Off</b> - at the analysis of lie, as test, the interval «Base periods» directly till the moment of started lie detection is used.</p> <p><b>On</b> - at the analysis of lie, as test, the interval «Base periods» which has been marked by the user beforehand is used. When the user includes accumulation the preliminary information, in this field value «<b>Capture</b>».</p>
Text	Switch on/off display «text questions» in «LD Question» window.
<b>AVG filter</b>	
Aggression	Number of frames for aggression level averaging
Stress	Number of frames for stress level averaging
Tension	Number of frames for tension level averaging
Suspicious	Number of frames for suspect level averaging
<b>Face detection</b>	
Face detection	Yes – face detection mode is used. No – without face detection
Detection quality	Quality of face capture. 1 – capture one large person face in the frame (loading of the processor is minimal), 4 – search of all (even small) persons face in the frame (loading of the processor is maximal).
Min size, Max size	Sets in pixels the size of rectangle for search of persons
Config	In VibraMed software for person search use basic algorithm ocv_face.xml only.
Draw	No – not draw rectangle around face, Yes – draw rectangle around more danger single person, All – draw rectangle for all person in frame. For non-danger person rectangle draw green color, but if person suspect level more than «Critical level», than rectangle draw red color.
<b>Quality test</b>	
Enable	Switch on mode of automatical check of image quality (see p. 2.4.5)

Light level	Parameter use for define image noise level when illumination is low.
FPS max, FPS min	Maximum and Minimum allowable input frame rate.
Face delay	This parameter determines how long (in seconds) the program can not recognize a human face in the frame before you will get an error message.

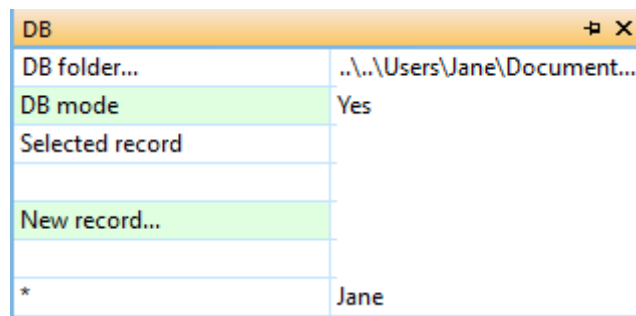
### **Fn**

X1-X5

In **VibraImage** program user can form itself formulas for calculation of new parameters of vibraimage, using any vibraimage parameters.

## **3.4.4 Information column. DB (data base) mode**

In the «**DB**» mode information column (fig. 3.27) adjusts parameters of recorded video information and shows the following information:



*Fig. 3.27. Information column in the DB mode*

- «**DB folder**» – way to the database folder for written video files and files of statistics;
- «**DB mode**» – switch on/off DB mode;
- «**Selected record**» – data on current object of research;
- «**New record**» – information about object of research. To delete new record it is necessary to delete the data folder on a disk and having selected the «**DB folder**» item again to select the folder for saving.

## 4 **VibraMed**. Emotion Recognition and Behavior Detection System

In medical imaging and biometrics, **VibraImage** is psychologically-based, emotional-recognition visual imaging technology that measures pixels microvibrations in terms of digital frequency and amplitude parameters. The visualization of a 3-dimensional object fluctuation, based on vibration parameters, can thus be correlated to various mental states, such as anger, tension, aggression, etc., as well as mood, normal states, and subconscious reflections. Vibraimage characterizes as one of primary images as visible spectrum, such as infrared, x-ray, MRI or ultrasound imaging. Vibraimage technology is operating in areas such as terrorist recognition, emotional recognition, interpersonal video-dating interactions, as well as for personal use. Visualization of every pixels vibration became possible only in 21<sup>st</sup> century with the development of digital cameras and high power computers. Long ago, past scientists, such as Aristotle, had realized that biological object movement parameters characterize emotions; thus vibraimage technology is a potential realization of this goal. **VibraMed** system realizes remote and auto monitoring of emotions levels, such as stress, aggression and tension, and detects lie in a real time mode. **VibraMed** also allows to register and analyze human activity characteristics from recorded video files (AVI format) and to analyze medical, psychological and emotional human state for different applications.

### **VibraMed** goals

- Cognitive control of emotions;
- Psychological and medical monitoring;
- Psychophysiological detection;
- Training and relax control for fitness and sport applications;
- Meditation and aura control;
- Live and recorded video processing.

The direct link between reflex movement and brain activity was discovered in 1863 by the famous Russian physiologist Ivan Sechenov in his publication «Reflexes of Brain». Charles Darwin in his book «The expression of the emotions in man and animals», 1872, also declared that reflex movements associated with emotions. Nobel laureate and the famous researcher of aggression Konrad Lorenz claims, that amplitude and intensity of reflex movements characterized the aggression. (On Aggression, 1966). According to the action of vestibular system functions and mechanical movement, person stands with the head in a balanced vertical position, continuously and reflexively performing three-dimension micromovements or vibrations. The dependence between head vibration parameters and emotional state characterized by the vestibular-emotional reflex (VER) or vestibular-energy reflex.

**Vibraimage** technology is the realization of medicine, psychology, modern computers and television sciences for human emotion recognition. **Vibraimage** plans to do human emotion control so precise, like physics measurements!

## 4.1 M mode. T1-T12 parameters

The average values of personal psychophysiological parameters, their deviation and variability are measuring in the «**M**» mode. The main goals of this mode are application of vibraimage system for accuracy security checking, medical diagnostics and psychological testing and researches. M mode based on measurement and calculation of psychophysiological parameters T1–T10 and checking its math variability during testing period. For vibraimage visual control in this chapter are given the pictures characterizing changes of said psychophysiological parameters T1–T10.

The mathematical expectation  $M$ , standard deviation (SD)  $S$  and variability  $V$  ( $S$  are calculating for the following human psychophysiological parameters:

### **T1 – Aggression (P7)**

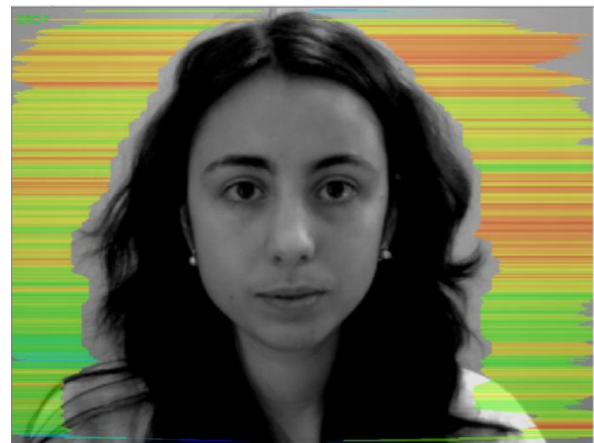
The parameter determines by the frequency histogram and represents the maximum allocation of the frequency and SD vibration frequency of the human face. The higher value of the maximum distribution and higher SD value gives the greater value of the parameter T1.

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.



a)



b)

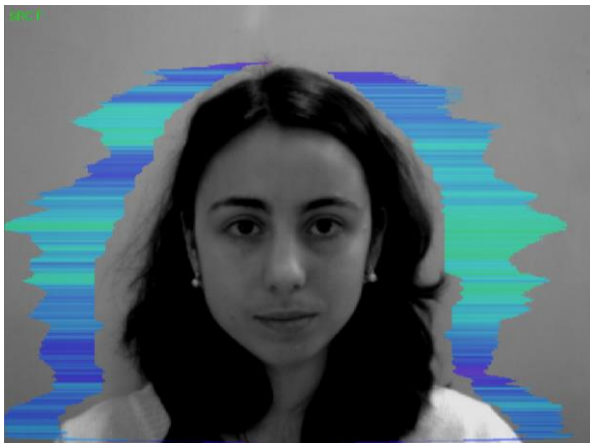
*Fig. 4.1 Aggression a) T1 = 18 %, b) T1 = 60 %*

### **T2 – Stress (P6)**

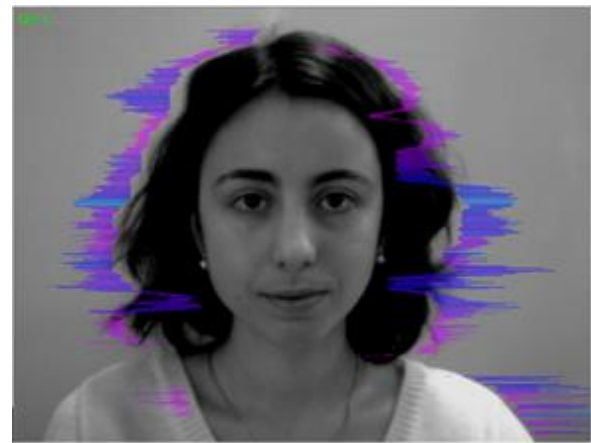
Parameter determines by degree of the external vibraimage (vibra-aura) asymmetry, means asymmetry of micromovements from the left and right parts of the persons head. The great difference in amplitude and frequency movements for the left and right parts of the face (head) characterizes the increased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



a)

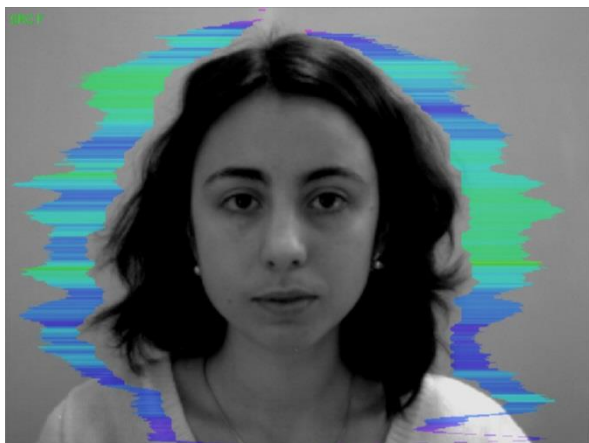


b)

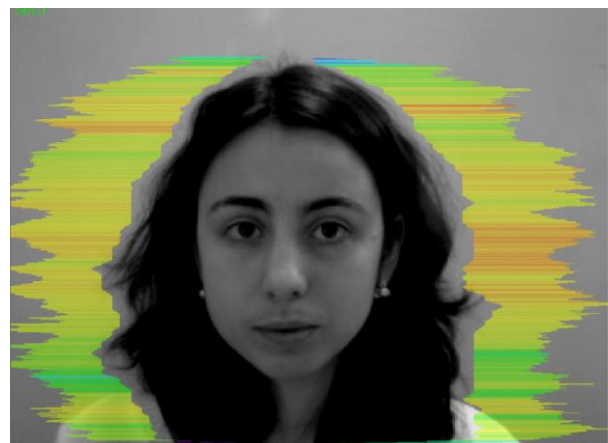
*Fig. 4.2 Stress a)  $T2 = 17\%$ , b)  $T2 = 45\%$*

### **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.



a)

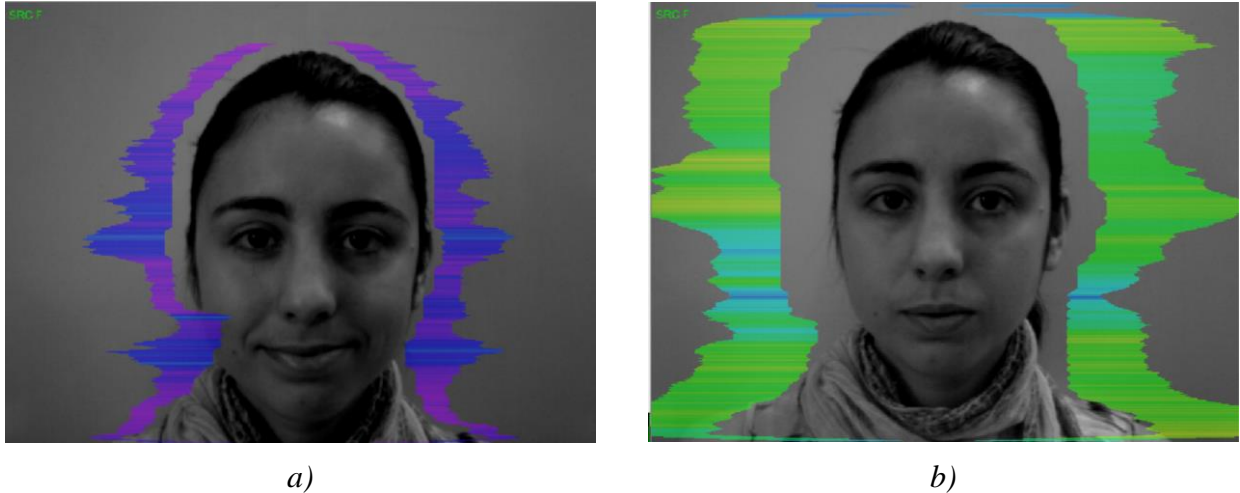


b)

*Fig. 4.3 Tension a)  $T3 = 28\%$ , b)  $T3 = 48\%$*

#### T4 – Suspect (P19)

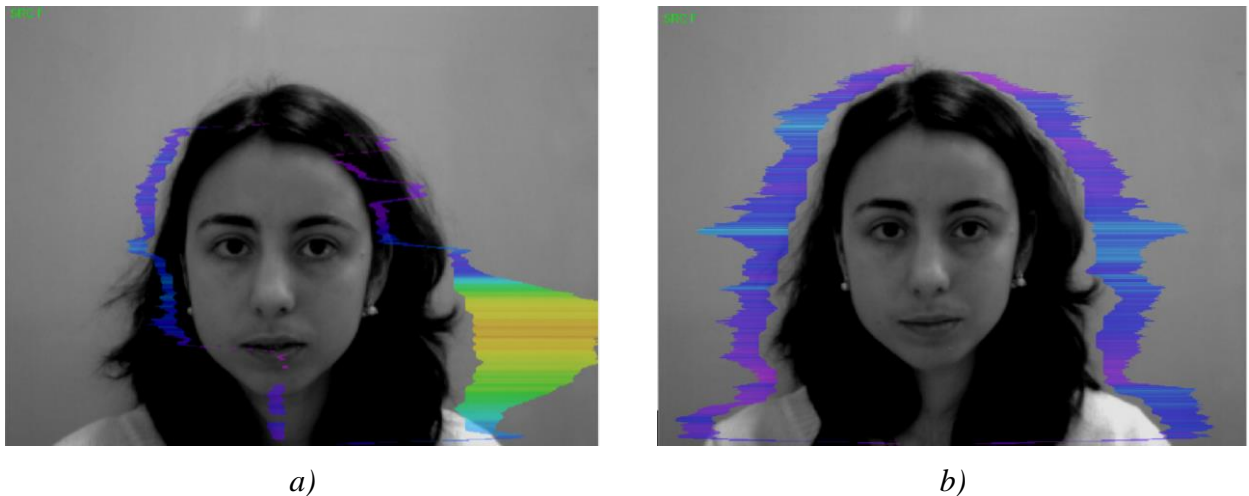
The parameter is determined as the sum average of the first three conditionally negative emotions (T1, T2, T3) and characterizes the general level of conditionally negative emotions in a person status.



*Fig. 4.4 Suspect a) T4 = 20 %, b) T4 = 65 %*

#### 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.



*Fig. 4.5 Balance a) T5 = 10 %, b) T5 = 80 %*



### 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.

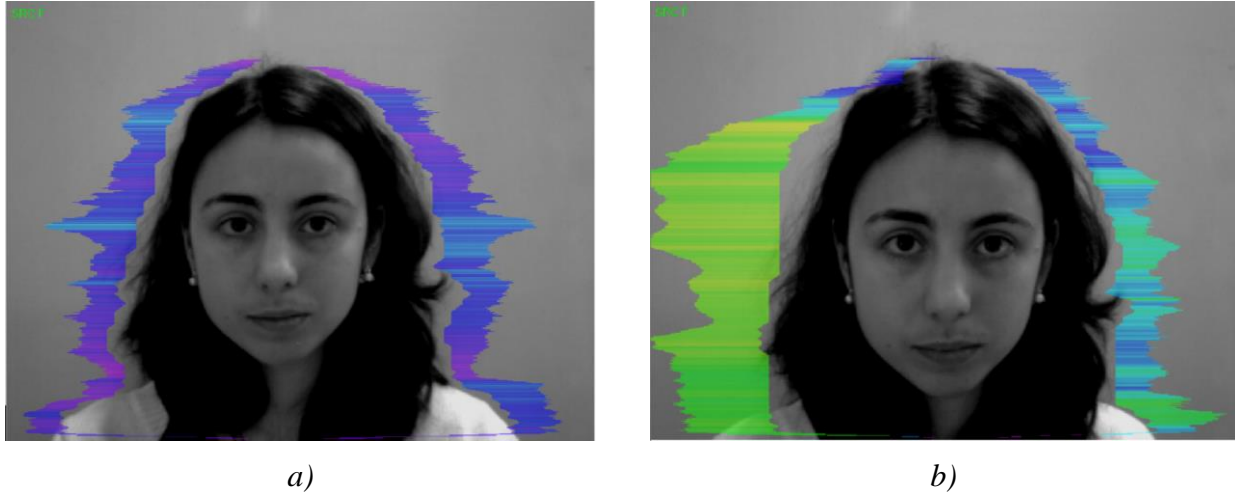


Fig. 4.6 Charm a) T6 = 85 %, b) T6 = 40 %

### 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.

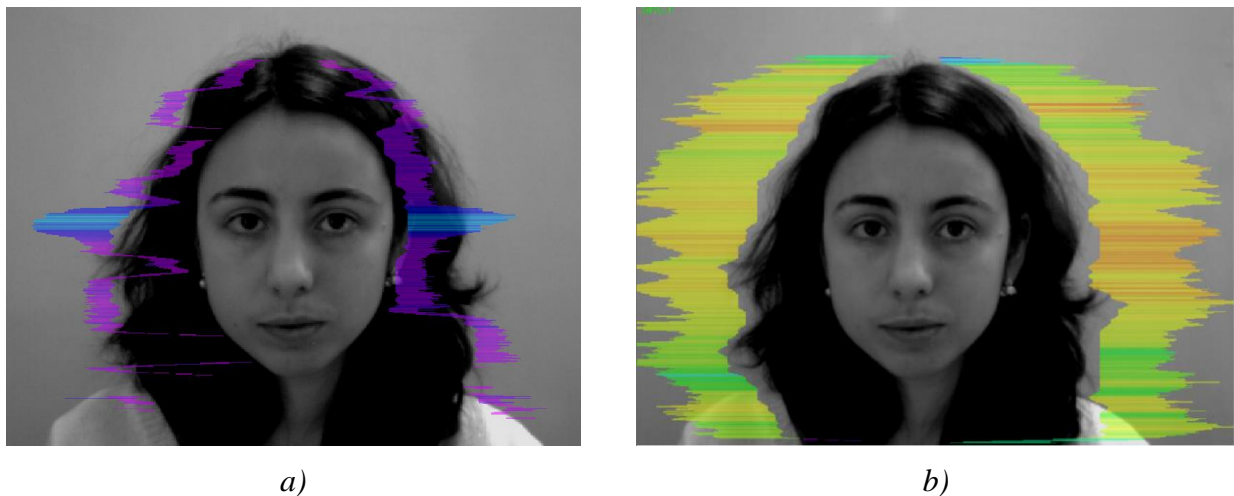
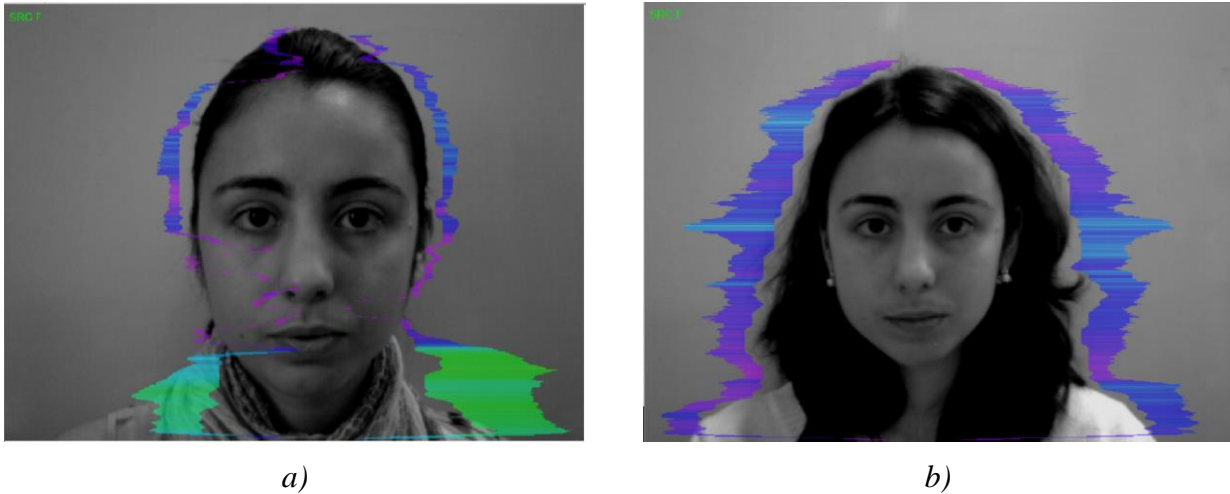


Fig. 4.7 Energy a) T7 = 3 %, b) T7 = 70 %

### T8 – Selfregulation (P18)

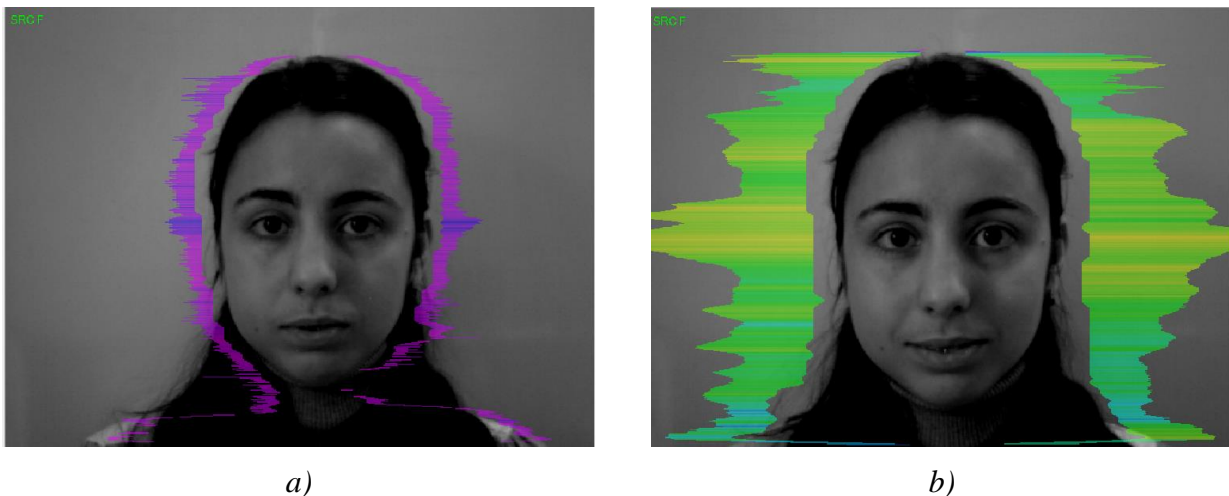
The parameter is determined as the sum average for conditionally positive emotions (T5, T6) and characterizes the general level of conditionally positive person emotions at the measurement time.



*Fig. 4.8 Selfregulation a)  $T8 = 30\%$ , b)  $T8 = 80\%$*

### **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.

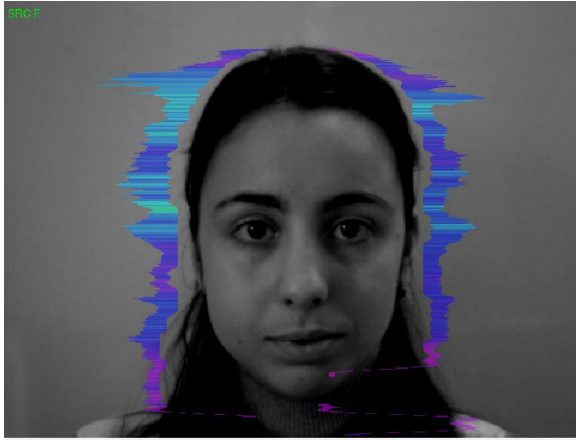


*Fig. 4.9 Inhibition a)  $T9 = 12\%$ , b)  $T9 = 25\%$*

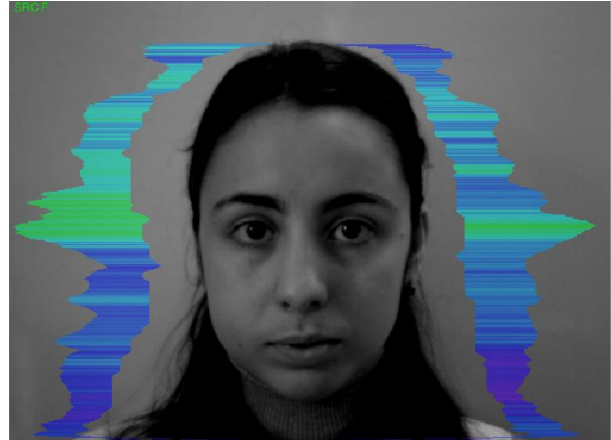
### **T10 – Neuroticism (F9)**

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.





a)

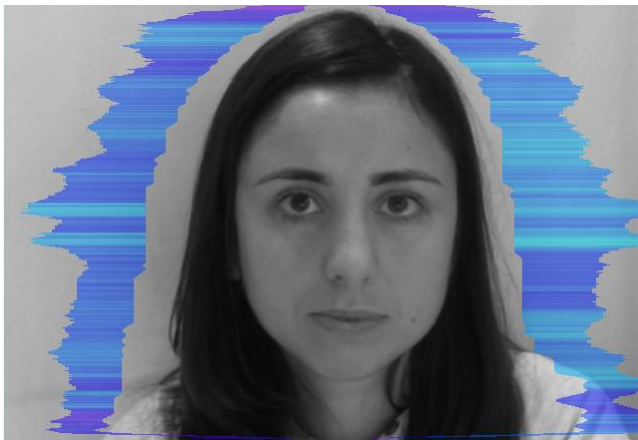


b)

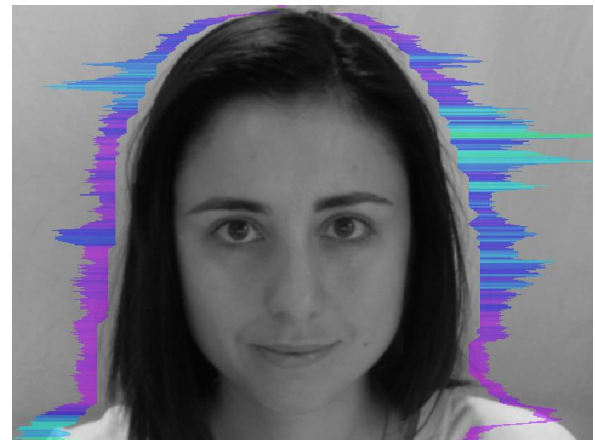
Fig. 4.10 Neuroticism a)  $T10 = 10 \%$ , b)  $T10 = 35 \%$

### **T11 – Depression (P29);**

The parameter is determined by the frequency histogram. It characterizes the SD of histogram and how much energy testee spend for the state. The high level of SD with big meaning energy of M is characterized by a high level of depression. Depression will be minimally if vibro-aura has 1 colour.



a)

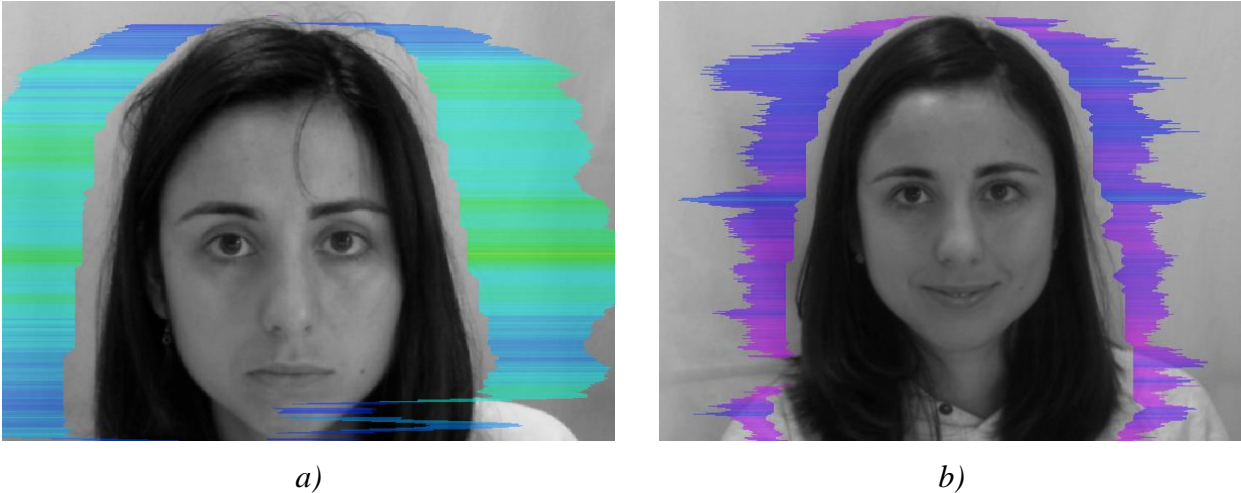


b)

Fig. 4.11 Depression: a)  $T11 = 16 \%$ , b)  $T11 = 40,2 \%$

### **T12 – Happiness (P30).**

The parameter displays position of test result on I-E diagram. Low level of energy consumption and high level of the information content of the exchange mean high level of T12. If energy consumption increases and PPS (mood) decreases than T12 becomes smaller.



*Fig. 4.12 Happiness: a)  $T12 = 43,3 \%$ , b)  $T12 = 90,9 \%$*

**Note:**

The set of parameters T1 – T12 is selected for capturing of the maximum information content for human head micromotion. At the same time the name of each Ti parameter can characterize different physiological characteristics, depending on the application of the vibraimage system. The primary characteristic for each parameter is not his name, the name can be considered secondary, but only math formula (equation) for psychophysiological parameter calculation is primary. Mathematical formulas, on which a calculation of parameters T1 – T12 are shown in the description of the program of statistical processing of the measurement results ([VibraStat](#)).

**Note:**

1. Every from T1-T12 psychophysiological parameters measured by vibraimage system are specified to range 0 – 1 (0 – 100) % using fixed coefficients experimentally selected.
2. Mathematical formula by which measured psychophysiological parameter is determined is primary, and a code name (for example, Aggression) is secondary. Psychophysiological meaning of each parameter T1 – T12 may be varied depending on the experimental conditions.
3. The set of measured parameters T1 – T12 determines the total psychophysiological (psychosomatic, functional) status of a person based on the integral coefficient K.

**Note:**

This description is valid for the parameters to the default settings of the system and perform basic rules for getting vibraimage:

- uniformity and stability of the lighting;
- use of low-noise television cameras;
- frontal location of the object in front of the camera;
- maximum "inscribing" the subject's face in the monitor;
- mechanical stability of video camera.

## 4.2 Psychophysiological (unconscious) response

The unconscious response measures by analyzing the information state and energy state (IE) as general features of psychophysiological state by vibraimage technology. This technology is similar to psychophysiological detection of deception and confirms or rejects conscious response based on positive or negative reaction of the examined person on the indicated stimulus.

As an example, we consider the change of a psychophysiological status (PPS) of the person given in a scale information - energy in fig. 4.11 Actual PPS displayed in the form of a point and change of person's PPS in time is displayed in the form of a straight line or a curve between two points. The example of PPS change from a state 0 in various states 1, 2, 3, 4, 5 is given in figure 4.11.

As shown in fig. 4.11 on the information-energy diagram changing from initial PPS (point 0) to other states characterized by one change of consumed energy and different states of psychological comfort.

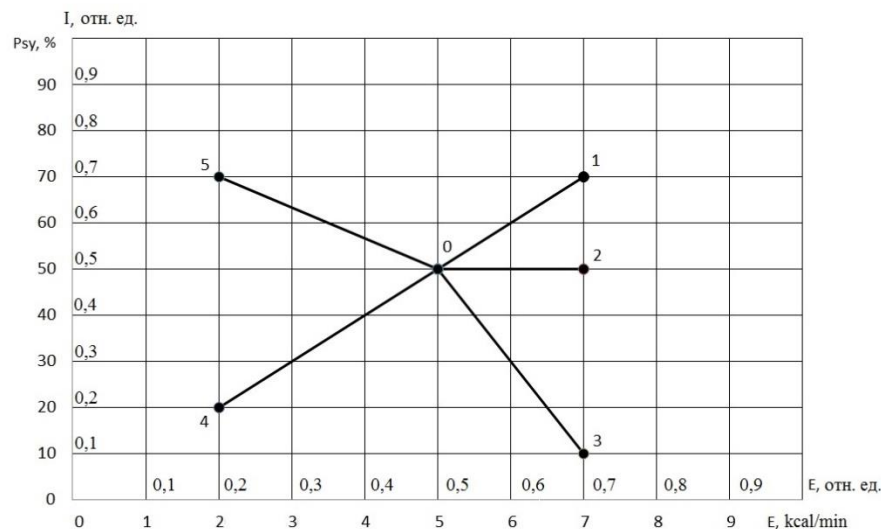


Fig. 4.11. Information-energy diagram of the PPS.

Transition 0-1 characterized by an increase in energy consumption and improvement of psychological state. The reason of this PPS change can be a good or pleasant news (the stimulus), it leads to a more intensive exchange processes (increase in energy consumption), and the psychological condition and mood notably improved (entropy of metabolic processes decreased, and the information content of the exchange increased).

Transition 0-2 characterized by an increase in energy consumption and an even level of psychological state. The reason can be, for example, an increase in mental and physical activity, which lead to more intensive exchange processes (increase in energy consumption), at the same time, the psychological state and mood are unchanged, as conducted by the impact did not cause emotional changes.

Transition 0-3 characterized by an increase in energy consumption and impairment of psychological state. The reason can be unpleasant information that leads to a more intensive exchange

processes (increase in energy consumption), and the psychological condition and mood became notably worse (entropy of metabolic processes became worse, and the information content of the exchange decreased).

Transition 0-4 characterized by a decrease in energy consumption and impairment of psychological state. The reason can be unpleasant information that leads to a slowing of metabolic processes (reducing energy consumption), and the psychological condition and mood became notably worse (entropy of metabolic processes became worse, and the information content of the exchange decreased).

Transition 0-5 characterized by a decrease in energy consumption and improvement of psychological state. The reason can be pleasant news, which soothes and slows down the metabolic processes (reducing energy consumption), and the psychological condition and mood are notably improved (entropy of metabolic processes decreased, and the information content of the exchange increased).

### 4.3 Definition of emotions

Head movements in space classically associated with vestibular system are studied and discussed in relation to the status of vestibular reflexes (i.e., the vestibulo-ocular, vestibulo-collic, and cervico-ocular reflexes). But it is possible to look on head movements according to the vibraimage system and technology. We supposed that head balance for person without consciously movements could be considered as isolated thermodynamic system and any emission of internal energy would change the balance of this isolated system and realized by movements or vibrations.

Every emotional state characterized by specific energy conversation and work done by the system transfers to micro vibrations, if the person forced to stand or set still. The head vibration parameters (frequency in range 0.1-10 Hz and amplitude) are stable in time for stable emotional state of person. Parameters of vibrations changed only after emotional state alteration. **VibraImage** technics allows to contactless register of person vibration parameters and calculates emotions according to accumulated statistics of comparative testing with EEG, skin galvanic reaction and psychological testing. **VibraImage** technics, parameters and research results are below.

#### 4.3.1 VibraImage parameters

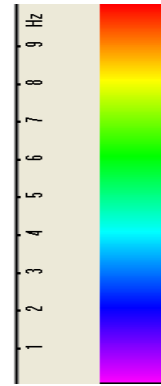
Values of amplitude and frequency of vibrations of a person head differ in each point of space and displays as pseudo color image. Integrated processing of parameters values of vibration in each point can give the general information on parameters of the person movement. Vibraimage the person heads displaying amplitude (fig. 4.12) and frequency (fig. 4.13) the distributions of vibrations modulated by a color scale (fig. 4.14), showed below:



*Fig. 4.12. Amplitude vibraimage*



*Fig. 4.13. Frequency vibraimage*



*Fig. 4.14. Pseudo color scale of frequency distributions*

Each point (pixel) amplitude vibraimage (fig. 4.12) reflects the relative moving of an element of the image saved up for determined time as it is known, that at insignificant moving the frames difference is proportional to the movement of object. For transformation of this relative moving in absolute, it is necessary to have the exact information on distance up to object and a working corner of an objective of the chamber, and then a color scale (fig. 4.14) can be scaled in millimeters or microns. However, at about the same location of faces on the screen, automatically the condition the single relative amplitude vibraimage scale satisfies. This allows to compare the obtained information about moving images to different people.

As against amplitude analyses, each point frequency vibraimage has physical dimension frequencies (Hz) as really displays frequency of signal change in each element of the image. Therefore, the resulted color scale (fig. 4.14) scaling in Hz, i.e. violet color frequency vibraimage displays a range of vibrations (0-1) Hz, dark blue displays a range of vibrations (1-4) Hz, green the range of vibrations displays (4-8) Hz, red displays a range of vibrations (8-10) Hz.

Based on the given two primary images the technique assumes definition more than 40 integrated vibraimage parameters, reflecting various types of movement and vibration, and the parameters divided into 4 basic groups:

- A – amplitude parameters;
- F – frequency parameters;
- S – symmetry parameters;
- P – spatial and timing parameters of mathematic calculation.

### **4.3.2 Aura-Vibraimage**

External (around of a head) interline display of the maximal frequency and average amplitude vibraimage looks as aura and more informatively displays a condition of the person, than internal vibraimage. Color of vibra-aura codes by the same color scale, as vibraimage (fig. 4.15), and displays the maximal frequency in each line. The size of aura defines by average amplitude for the given line. Any non-uniformity in color and the size of aura characterizes movements of object and its emotion condition. The normal condition of the person is characterized more uniform external vibraimage (vibra-aura), and for an intense condition of the person are characteristic the big space and color non-uniformity of vibra-aura.



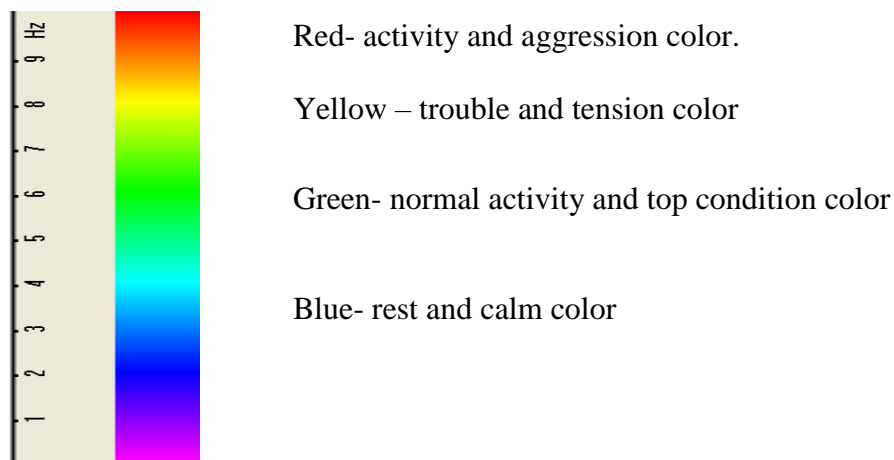


*Fig. 4.15. External vibraimage (vibra-aura) of person in normal condition*



*Fig. 4.16. External vibraimage (vibra-aura) of person in tension condition*

Obvious distinctions between images on fig. 4.15 and fig. 4.16 illustrate advantages of the visual analysis of the person condition on external aura in comparison with the visual analysis initial vibraimage. The vibraimage method gives significant freedom of a choice of registration of a condition, and visual supervision of aura allows estimating quickly and evidently practically all emotion parameters of the person. Brief interpretation of the form and color of aura is resulted on the fig 4.17. This brief information does not limit, and sets to the user of system the basic directions of the analysis of person condition. Getting experience and taking into account the specificity of application, each user of system can diversify and deepen essentially results of the analysis of vibra-aura, open secret secrets of soul and a body of the person.



*Fig. 4.17. Brief vibra-aura color interpretation*

### **Brief aura form analysis**

1. Any aura asymmetry (form, color) characterized deviation from mental or physiological norms.
2. Color irregularity of vibra-aura characterizes psycho-physiological imbalance of a person status.
3. Any breaks in aura uniformity characterized deviation from mental or physiological norms.

4. Ideal aura has mono color, symmetrical and uniform. Any real aura differs from ideal and the question of interpretation is to characterized real aura deviations.

**Note!**

This brief aura interpretation correspond default vibraimage system settings and based on main rules for right vibraimage scanning:

- uniform and stable object illumination;
- high quality and low noise camera application;
- frontal plane object before camera;
- maximum facial image size on monitor;
- mechanical stabilization of camera.

### 4.3.3 Vibraimage emotion samples

#### Normal and top emotional state

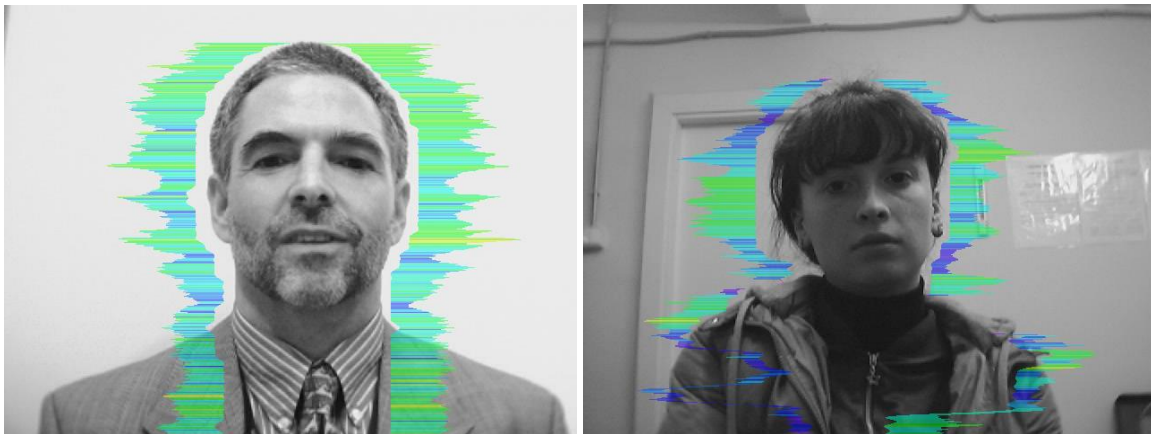
Normal condition characterized by aura color and form uniformity around the head, relevant monochrome color in the middle of suggested color scale (fig. 4.18). Activity level is about 0.3– 0.6. Stress level is about 0.2– 0.5.

Tension level is not more than 0.4.

Every emotion level measured in the range from 0 till 1,0 and minimal value coordinates with minimal emotion intensity.

Frequency distribution histogram is near normal (Gauss) distribution and spectrum of high speed vibraimage signals is near exponential distribution.

Vibra-aura photos samples for normal condition of person are on fig. 4.18 below:



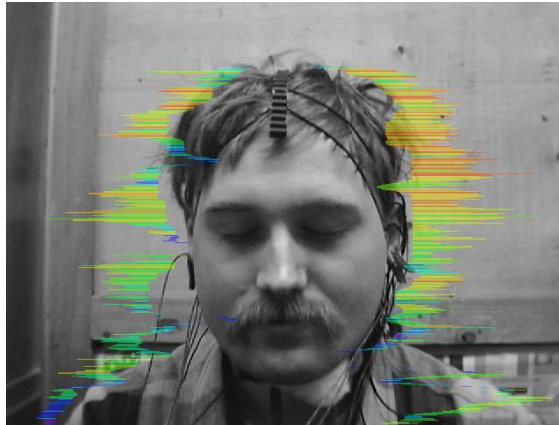
*Fig. 4.18 Vibra-aura photos samples for normal condition of persons*

### Stress state

Stress state characterized by amount gaps in aura form and greatly aura colors non uniformity. Vibra-aura includes every scale colors and sharp color transfer, like red color could transfer to blue (fig. 4.19). 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.



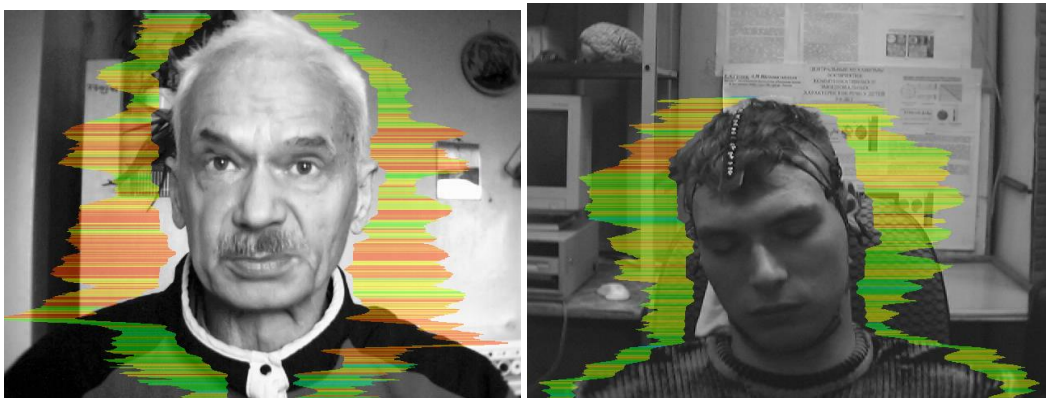
*Fig. 4.19. Vibra-aura photos samples for stress condition of person*

### Aggressive and/or tension state

Aggressive state is not every time coordinates with tension, and tension state is not always coordinates with aggression. But often these two emotions accompany each other. Aggressive state obligatory characterized by high frequency vibrations and red colors in vibra-aura (fig. 4.20). Vibra-aura size is more than normal and gaps could absent, but color and form non uniformity must present. Stress level could be low, less than 0.3.

Anger level is more than 0.7 and tension level is 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.

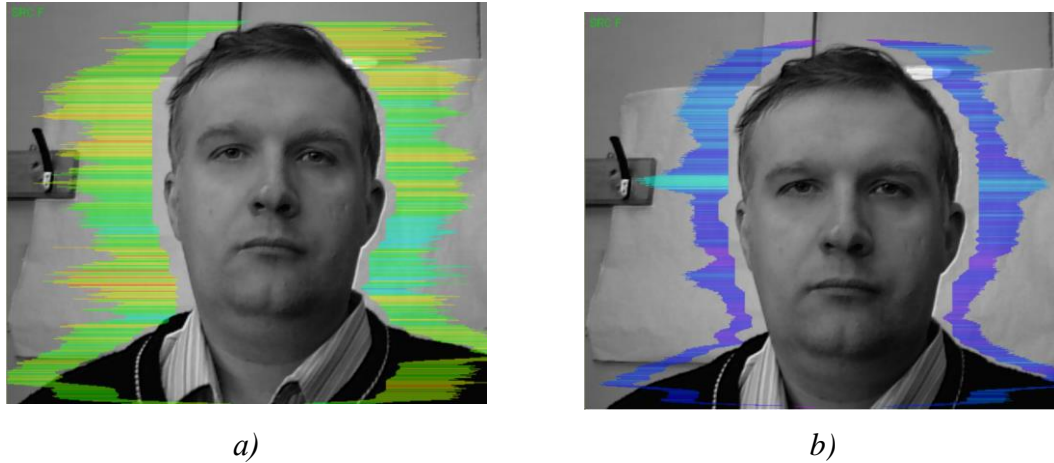


*Fig. 4.20. Vibra-aura photos samples for aggression condition of persons.*



## Meditation

**VibraMed** system application allows to register distinction not only between the aggressive (abnormally excited) and normal condition of the client, but also and to register a degree of condition change of the person when the person calms down (fig. 4.21).



*Fig. 4.21. Samples of self-correction person emotional states: a - 10 seconds after the beginning of supervision, b - 100 seconds after (the person have asked to calm down and count up to 100).*

## 5 Psychophysiological state analysis results

After the end of information processing in a mode «**M**» user (operator or examiner) can view all testing results and save it by standard Windows functions: PrintScreen result in system and download image from the screen to any standard program such as Paint to view graphics.

After end of the test program **VibraMed** automatically also creates files with the test results in the directory «C:\Users\user\Documents\Med Result».

Statistical processing of parameters measured in a mode «**M**» is carried out by the program VibrastatAdvanced.

The result of testing recorded in the form of files of the following types:

<b>YYYY-MM-DD hh_mm_ss_M.xlsx</b>	<b>BASE RESULT</b> for Mental-Functional state. Excel format (fig. 5.1)
<b>YYYY-MM-DD hh_mm_ss_histH.png</b>	graphic file with the histogram of frequency distribution (fig. 3.22)
<b>YYYY-MM-DD hh_mm_ss_histH.xml</b>	data file with the histogram of frequency distribution. XML format
<b>YYYY-MM-DD hh_mm_ss_histT.png</b>	graphic file with graphs of I-E state of a person changes over the period (fig. 3.23, 3.24)
<b>YYYY-MM-DD hh_mm_ss_M.xml</b>	testing result for Mental-Functional state. XML format

In all files in names **YYYY-MM-DD** and **hh\_mm\_ss** date and time of measurement.

**Base results** of psychophysiological research are in Exel file list Measurement (fig. 5.1). Data in a main table (Testing result for mental-functional state) in the Exel file based on data from a Reference table with yellow row and column headers (fig. 5.2) for 60 s duration (whole measurement).

In the reference table there are parameters M, S, Vi, bmin, cmin, bmax, cmax (see p. 3.4.2) according to each parameter T1 – T10. Parameter M is the same as parameter Avg in the main table. Parameters bmin and bmax are the same as parameters Nmin and Nmax from p. 3.4.2.

Conditionally **positive** emotions are Balance, Charm, Energy, Self-regulation (T5 – T8). Conditionally **negative** emotions are Aggression, Stress, Tension, Suspect (T1 – T4). Conditionally **physiological** emotions are Inhibition and Neuroticism (T9, T10). In a row “Positive” (fig. 5.1) there are average value for parameters M and Vi for T1 – T4. By analogy, values in rows “Negative” and “Physiological” are calculating.

«Sat» is a satisfaction level. It shows change of the state of a person from the first part of the measurement to the second. It's calculated as  $P=(I2-I1) +(E1-E2)$  where average values mean:

I1 and E1 for the first time period (30 s in default mode, half of the measurement); I2 and E2 for the second time period. On fig. 5.3

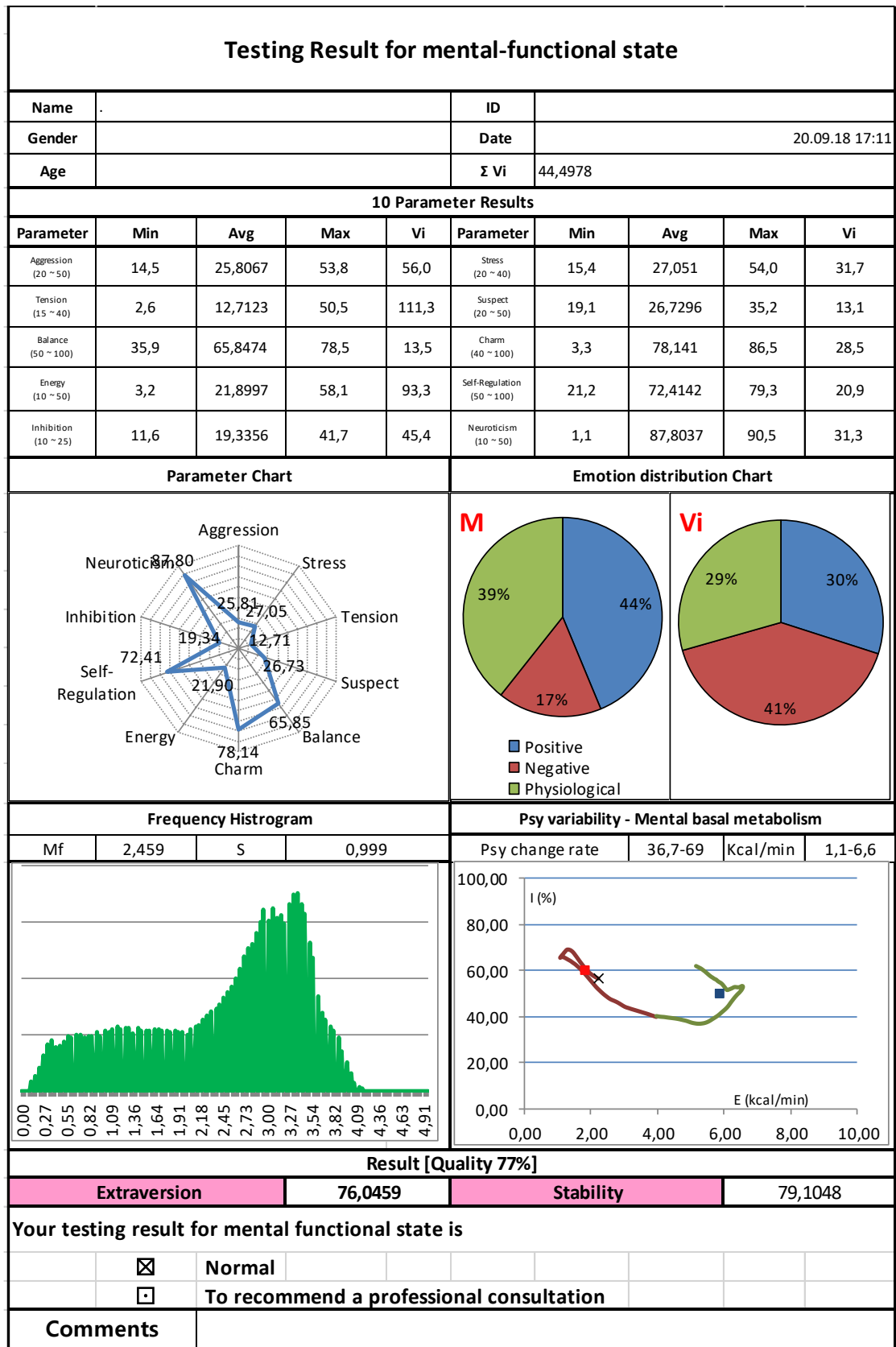


Fig. 5.2. Psycho-emotional state of the person

1st Test							
	M	S	Vi (S/M)	bMin	cMin	bMax	cMax
Aggression	25,81	14,45	55,98	20,00	14,52	50,00	53,83
Stress	27,05	8,56	31,66	20,00	15,45	40,00	53,99
Tension	12,71	14,14	111,26	15,00	2,56	40,00	50,48
Suspect	26,73	3,51	13,13	20,00	19,09	50,00	35,21
Balance	65,85	8,87	13,48	50,00	35,93	100,00	78,51
Charm	78,14	22,30	28,54	40,00	3,27	100,00	86,50
Energy	21,90	20,43	93,30	10,00	3,24	50,00	58,13
Self-Regulation	72,41	15,16	20,93	50,00	21,22	100,00	79,32
Inhibition	19,34	8,78	45,41	10,00	11,62	25,00	41,71
Neuroticism	87,80	27,47	31,29	10,00	1,13	50,00	90,54
Positive	59,58	43,7%	39,06	30,0%			
Negative	23,0749	16,9%	53,0072	40,6%			
Physiological	53,56965	39,3%	38,3482	29,4%			
Sat	-50,13%						

Fig 5.2 Reference table in the result Exel file (list Measurement)

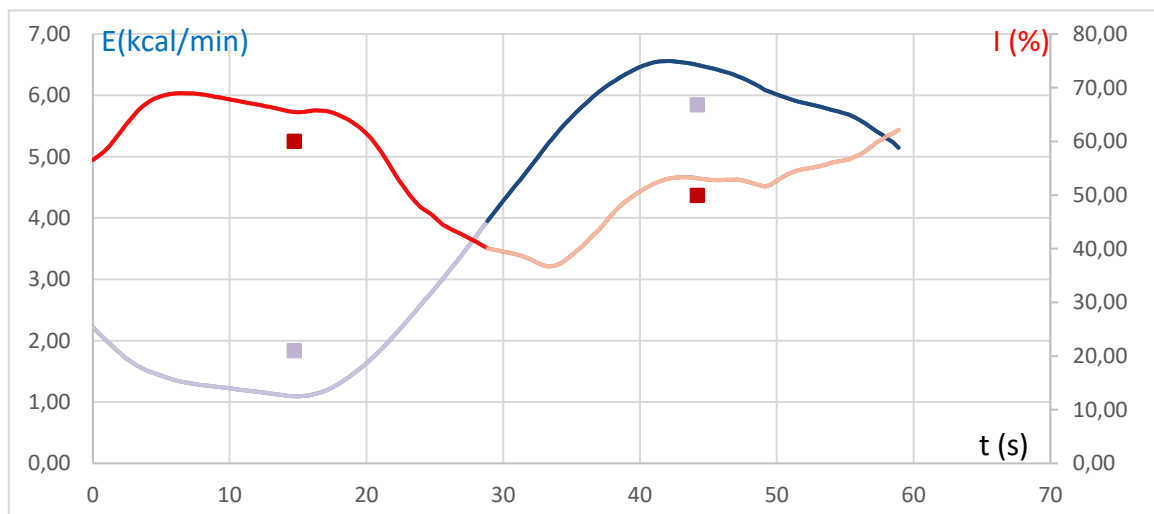


Fig 5.3 Time dependences of Information exchange  $I(t)$  and consumed energy  $E(t)$  graphs,  $t$  – time.

At the beginning of the main table, there are data about testing person (name, gender, age, ID), date and time of measurement and  $\sum Vi$  – the average of the «Health» (mean value of health level).

Further there are values of parameters T1-T10 during the test minimum (Min), maximum (Max), average (Avg) and variability (Vi). For example on fig. 5.1 for parameter T1 Aggression with normal value between bmin 20 and bmax 50: Min – 18,9; Max – 43,7; Avg – 26,6 and Vi – 25,3.

**Parameter Chart** is round diagram with average values of parameters T1-T10 during the test (fig. 5.4).

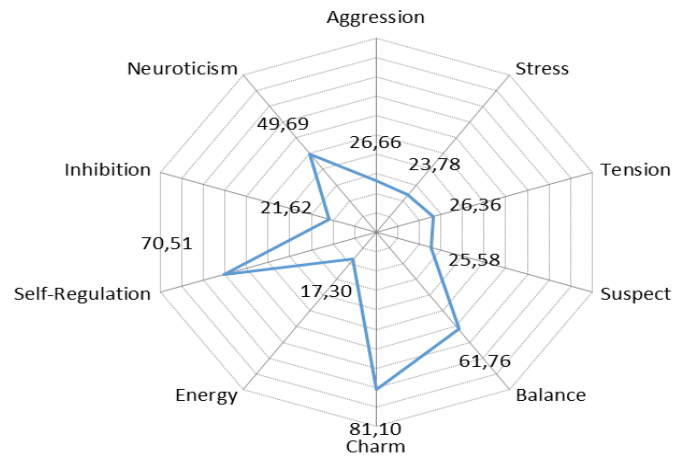


Fig. 5.4. Parameter Chart

**Emotion distribution charts** (fig. 5.4) display part of positive, negative or physiological parameters indicating by corresponding color.

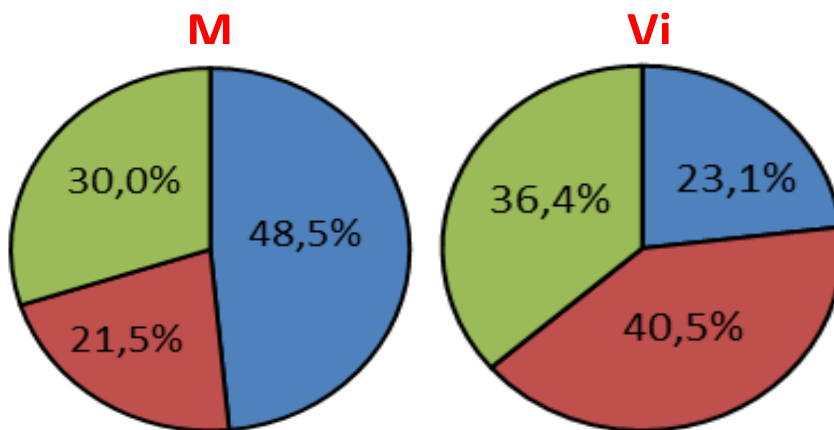


Fig. 5.5 Emotion distribution charts

Frequency Histogram and Psy variability - Mental basal metabolism (I-E graphs) described in p. 3.4.2, 4.2. Symbol “×” on this diagram is start of measurement. Change color from red to green shows first and second parts of the measurement. Dots on the charts I (E), I(t), E(t) show average state of the person by periods of time.

Information about changes of the person psychophysiological state on the first half and the second half of total measurement time is given in the list dMeasurement (fig.5.6) period.

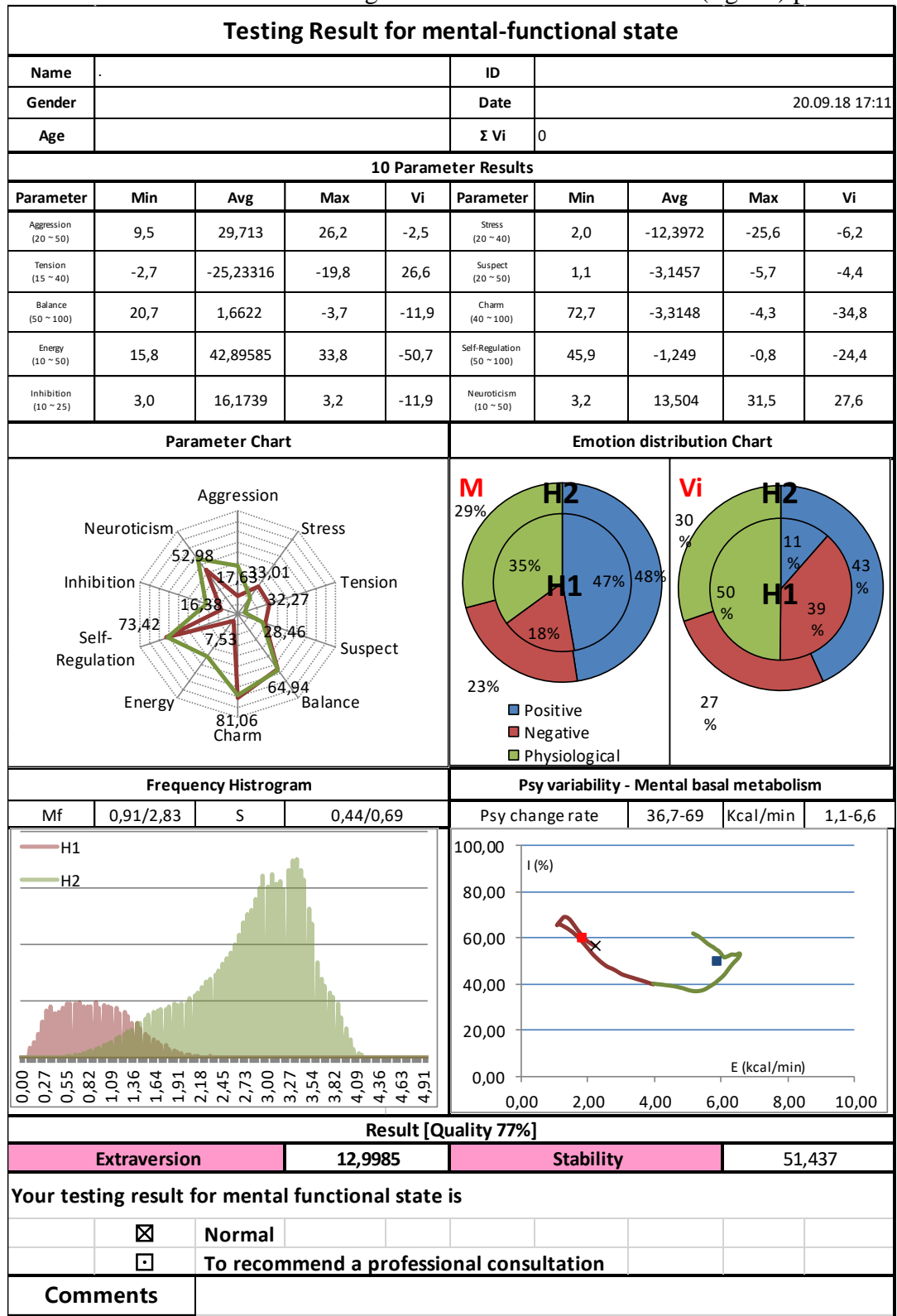


Fig. 5.6 Testing Result for psychophysiological state corresponding to first (half) and final (half) time period.

On the fig. 5.6 **red** graphs are results of 1 period of time, **green** – second period.

Table Dtest is the same as table on fig. 5.2 but based on difference between results of 2<sup>nd</sup> Test and 1<sup>st</sup> Test.

dMeasurement page gives information about differential changes for all calculated vibraimage parameters for the both time periods. This page shows dynamics in psychophysiological changes instead of Measurement page showing average meaning for all vibraimage parameters during measurement. So for measurement of dynamics changes in psychophysiological state is better to use dMeasurement page, but for measure of static psychophysiological state is preferable to use Measurement page data.

## 6 Warranty

Maintenance service and service regulations of **VibraMed** system is carried out according to this Manual and instructions of used hardware maintenance (a computer, the camera, etc.).

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Updates and questions on [www.psymaker.com](http://www.psymaker.com)

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